



OREF NORTHEAST REGION  
VIRTUAL RESIDENT RESEARCH SYMPOSIUM  
Thursday, October 14, 2021

Hosted by:  
**David Jevsevar, MD**  
Chair, Department of Orthopaedic Surgery  
Regional Vice President of Orthopaedics  
Dartmouth-Hitchcock Medical Center  
The Geisel School of Medicine at Dartmouth

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### 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 more than \$147 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](http://www.oref.org). Follow OREF on its Facebook page (OREFtoday) and on Twitter (@OREFtoday).

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**OREF NORTHEAST REGION  
RESIDENT RESEARCH SYMPOSIUM  
SUMMARY AGENDA**  
Thursday, October 14, 2021

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- 8:00 a.m. – 8:05 a.m.      **Welcome and Introductions**  
David S. Jevsevar, MD  
Chair  
Department of Orthopaedic Surgery  
Regional Vice President of Orthopaedics  
Dartmouth-Hitchcock Medical Center  
The Geisel School of Medicine at Dartmouth
- 8:05 a.m. – 8:08 a.m.      **OREF Welcome**  
Lee Grossman  
Chief Executive Officer  
Orthopaedic Research and Education Foundation
- 8:08 a.m. – 8:38 a.m.      **Session I – Resident Research Presentations and Discussion**
- 8:38 a.m. – 9:08 a.m.      **Session II – Resident Research Presentations and Discussion**
- Break*
- 9:18 a.m. – 9:52 a.m.      **Session III – Resident Research Presentations and Discussion**
- 9:52 a.m. – 10:22 a.m.      **Session IV – Resident Research Presentations and Discussion**
- Break*
- 10:32 a.m. – 11:02 a.m.      **Session V – Resident Research Presentations and Discussion**
- 11:02 a.m. – 11:57 a.m.      **Keynote Address**  
*“QVARA: A Guide to Fulfillment as a Clinician-Educator-Investigator”*  
Vincent D. Pellegrini, Jr., MD  
Professor and Vice Chair for Education Research Affairs  
Department of Orthopaedics  
Chair, Faculty Council  
Dartmouth-Hitchcock Medical Center and  
The Geisel School of Medicine at Dartmouth
- 11:57 a.m. – 12:12 p.m.      **Awards Presentation and Closing Remarks**

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## KEYNOTE SPEAKER

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**Vincent D. Pellegrini, Jr., MD**

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Professor and Vice Chair for Education Research Affairs  
Department of Orthopaedics  
Chair, Faculty Council  
Dartmouth-Hitchcock Medical Center and  
The Geisel School of Medicine at Dartmouth

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**Vincent Pellegrini Jr., MD**, hails from Cranston, Rhode Island and graduated from Dartmouth College summa cum laude with a double major in Biology and Economics. He was on the men's swimming and golf teams and an active member of Beta Theta Pi fraternity. He received the Dean's Valedictory Medal and served on the admissions committee while earning his medical degree from Dartmouth Medical School. He completed an orthopaedic residency and fellowship in surgery of the hand at the University of Rochester Strong Memorial Hospital. He is a diplomate of the American Board of Orthopaedic Surgery and holds a Certificate of Added Qualifications in Surgery of the Hand. Clinical interests focus on care of arthritis and his expertise includes adult reconstructive and total joint replacement surgery of the hip and knee, as well as hand/upper extremity surgery. He is a passionate educator and mentor. Active research interests include venous thromboembolic disease, heterotopic ossification, mechanisms of fracture repair, and osteoarthritis at the base of the thumb. His research is funded by the Department of Defense and the Patient-Centered Outcomes Research Institute (PCORI) and has resulted in over 150 original peer-reviewed articles.

For 27 years he served as chair of Departments of Orthopaedics at three academic health centers; the Pennsylvania State University College of Medicine, the University of Maryland School of Medicine, and the Medical University of South Carolina. He has served as President of the American Orthopaedic Association, The Hip Society, the Maryland Orthopaedic Association, and the Medical Staff of the University of Maryland Medical Center. He was Chair of the Council of Faculty and Academic Societies of the AAMC and member of the AAMC Board of Directors, a Deputy Editor of *The Journal of Bone and Joint Surgery*, and a member of the ACGME Residency Review Committee in Orthopaedic Surgery. Currently, he is an examiner for the American Board of Orthopaedic Surgery, Chair of the Faculty Council at Geisel School of Medicine and serves as Vice Chair for Education and Research Affairs in the Department of Orthopaedics at Dartmouth-Hitchcock Medical Center and Professor of Orthopaedics at the Geisel School of Medicine at Dartmouth.

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## Judges

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Ida Lea Gitajn, MD  
Dartmouth-Hitchcock Medical Center

Michael Kain, MD  
Boston University

Scott Mallozzi, MD  
University of Connecticut

Hardeep Singh, MD  
University of Connecticut

David P. Trofa, MD  
Columbia University

**OREF Northeast Region Resident Research Symposium  
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8:00 a.m. – 8:05 a.m.

**Welcome and Introductions**

David S. Jevsevar, MD  
Chair  
Department of Orthopaedic Surgery  
Regional Vice President of Orthopaedics  
Dartmouth-Hitchcock Medical Center  
The Geisel School of Medicine at Dartmouth

8:05 a.m.-8:08 a.m.

**OREF Welcome**

Lee Grossman  
Chief Executive Officer  
Orthopaedic Research and Education Foundation

**Session I – Resident Research Presentations & Discussion**

8:08 a.m. – 8:12 a.m.

*International Validation of Natural Language Processing Algorithms for Automated Detection of Incidental Durotomy*  
Aditya V. Karhade, MD, Harvard University Medical Center

8:12 a.m. – 8:16 a.m.

*Tensile Strength of Superficial Suture Patterns with and without a Self-Adhesive Mesh Augmentation on Cadaveric Human Skin*  
Francisco Rodriguez Fontan, MD, University of Colorado

8:16 a.m. – 8:20 a.m.

*Supination Adduction Vertical Medial Malleolar Fracture Fixation with Buttress Plating versus Screw-Only Fixation with Internal Buttressing: A Cadaveric Biomechanical Study*  
Edward J. Testa, MD, Brown University

8: 20 a.m. – 8:24 a.m.

*Mortality Benefit from Low Molecular Weight Heparin for Patients Undergoing Operative Treatment of Closed Femoral Shaft Fractures*  
Nicholas C. Danford, MD, Columbia University

8:24 a.m. – 8:28 a.m.

*Long-Term Outcomes of Multi-Ligament Knee Injuries*  
Tina Zhang, MD, University of Maryland

8:28 a.m. - 8:38 a.m.

**Question and Answer**

**Session II – Resident Research Presentations & Discussion**

8:38 a.m. – 8:42 a.m.

*Applying to Fellowship During a Pandemic: Lessons Learned from the 2020-2021 Orthopaedic Spine Fellowship Application Cycle*  
Bo Zhang, MD, Johns Hopkins Hospital

8:42 a.m. - 8:46 a.m.

*Collegiate Athletes' Preferences for Their Team Physicians*  
Gabrielle Ray, MD, Dartmouth Hitchcock Medical Center

8:46 a.m. - 8:50 a.m.

*Gluteal Compartment Syndrome: Presentation, Etiology, Diagnosis, and Treatment*  
Davis Rogers, MD, Johns Hopkins Hospital

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- 8:50 a.m. – 8:54 a.m.      *Representation of Women in Academic Orthopaedic Leadership: Where Are We Now?*  
Andrew S. Bi, MD, NYU Langone Health
- 8:54 a.m. – 8:58 a.m.      *A Virtual Curriculum to Prepare Medical Students to Achieve Accreditation Council for Graduate Medical Education Level-1 Milestones in Orthopaedic Surgery*  
Meghan Morley, MD, Cooper University Hospital
- 8:58 a.m. – 9:08 a.m.      **Question and Answer**
- 9:08 a.m. – 9:18 a.m.      **Break**
- Session III – Resident Research Presentations & Discussion**
- 9:18 a.m. – 9:22 a.m.      *Incidence and Risk Factors for Heterotopic Ossification After Pediatric Hip Arthroscopy*  
Stephen Maier, MD, Harvard University Medical Center
- 9:22 a.m. – 9:26 a.m.      *Age is Associated with Hypercoagulability in Musculoskeletal Oncology Patients: Analysis of Thromboelastography-Derived Coagulation Profiles*  
Samir Sabharwal, MD, Johns Hopkins Hospital
- 9:26 a.m. – 9:30 a.m.      *Improved Functional Outcome Scores Associated with Greater Reduction in Cam Height Using the Femoroacetabular Impingement Resection Arc During Hip Arthroscopy*  
Daniel J. Kaplan, MD, NYU Langone Health
- 9:30 a.m. – 9:34 a.m.      *Gender Differences in the Management of Carpal Tunnel Syndrome*  
Brian W. Yang, MD, Hospital for Special Surgery
- 9:34 a.m. – 9:38 a.m.      *Genetic Risk Factors of Adhesive Capsulitis are Comparable to Traditional Risk Factors*  
Mark T. Langhans, MD, Hospital for Special Surgery
- 9:38 a.m. – 9:42 a.m.      *Scapholunate Interosseous Ligament Complex (SLIL) Complete Tear Is Associated with Injury of the Long Radiolunate (LRL), Dorsal Intercarpal (DIC) and Dorsal Radiocarpal (DRC) Ligaments*  
Emil Stefan Vutescu, MD, Brown University
- 9:42 a.m. – 9:52 a.m.      **Question and Answer**

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**Session IV – Resident Research Presentations & Discussion**

- 9:52 p.m. – 9:56 a.m. *Surgical Invasiveness Index: A Novel Approach to Risk-Adjustment in Total Hip Arthroplasty*  
James Jackson Gregory, MD, Dartmouth-Hitchcock Medical Center
- 9:56 a.m. – 10:00 a.m. *Perioperative and Patient Risk Factors for Postoperative Hyponatremia in Total Hip and Knee Arthroplasty Patients*  
Michael S. Roberts, MD, University of Vermont
- 10:00 a.m. – 10:04 a.m. *Onodera’s Prognostic Nutritional Index a Valuable Measure in Predicting Complications After TKA*  
Alisina Shahi, MD, Cooper University Hospital
- 10:04 a.m. – 10:08 a.m. *Head-to-Head Comparison of Kinematic Alignment vs. Mechanical Alignment for Total Knee Arthroplasty*  
Ameer Elbuluk, MD, Hospital for Special Surgery
- 10:08 a.m. – 10:12 a.m. *Alignment Accuracy for Total Knee Arthroplasty Performed Using Accelerometer-Based Handheld Navigation Versus Computed Tomography-Based Surgical Robot*  
Tony S. Shen, MD, Hospital for Special Surgery
- 10:12 a.m. – 10:22 a.m. **Question and Answer**
- 10:22 a.m. – 10:32 a.m. **Break**

**Session V – Resident Research Presentations and Discussion**

- 10:32 a.m. – 10:36 a.m. *Prior Non-Shoulder Periprosthetic Joint Infection Increases Risk of Surgical Site Infection, Sepsis, and All-Cause Revision Following Primary TSA*  
Jacob Mikula, MD, Johns Hopkins Hospital
- 10:36 a.m. – 10:40 a.m. *Assessment of Staphylococcal Clinical Isolates from Periprosthetic Joint Infection for Potential Bacteriophage Therapy*  
Brian De Palma, MD, University of Maryland
- 10:40 a.m. – 10:44 a.m. *Does Time to Reimplantation After Explant for Prosthetic Joint Infection Influence Likelihood of Successful Outcome at 2 Years?*  
Tracy Borsinger, MD, Dartmouth-Hitchcock Medical Center
- 10:44 a.m. – 10:48 a.m. *Comparing Articulating Spacers for Periprosthetic Joint Infection After Primary THA: All-Cement vs. Real Component Articulating Spacers*  
David Kugelman, MD, NYU Langone Health
- 10:48 a.m. – 10:52 a.m. *Leptin Receptor Expressing Skeletal Stem Cells Accumulate and Divert to a Fibrogenic Phenotype in Peri-implant Membrane of Patients with Aseptic Loosening*  
Vincentius Jeremy Suhardi, MD, PhD, Hospital for Special Surgery
- 10:52 a.m. – 11:02 a.m. **Question and Answer**

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11:02 a.m. – 11:57 a.m.     **Keynote Address**  
***“QVARA: A Guide to Fulfillment as a Clinician-Educator-Investigator”***  
Vincent D. Pellegrini Jr., MD  
Professor and Vice Chair for Education Research Affairs  
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11:57 a.m. – 12:12 p.m.     **Awards Presentation and Closing Remarks**

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## International Validation of Natural Language Processing Algorithms for Automated Detection of Incidental Durotomy

Aditya V. Karhade, MD

Harvard University Medical Center

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**Purpose:** The purpose of this study was to validate NLP algorithms for automated detection of incidental durotomy in patients from Massachusetts, Maryland, and Australia.

**Background:** Natural language processing algorithms (NLP) is an emerging methodology for automated surveillance of adverse events in orthopaedic surgery.

**Methodology:** Patients 18 years or older undergoing lumbar spine surgery in Massachusetts, Maryland, and Australia. The primary outcome was defined as intra-operative durotomy. Performance of the NLP algorithms was assessed by discrimination via area under receiver-operating curves [AUC].

**Results:** Overall, 1000 patients from Massachusetts, 1279 patients from Maryland, and 944 patients from Australia were included in the study. NLP algorithms developed on the Massachusetts cohort had excellent performance on the Maryland cohort (AUC = 0.97) but worse performance on the Australian cohort (AUC = 0.77). A hybrid NLP algorithm combining data from Australia and Massachusetts achieved excellent performance on independent testing data from Australia (AUC = 0.97) and Maryland (AUC = 0.95).

**Conclusion:** Hybrid NLP algorithms retain excellent performance in individual countries relative to algorithms developed in the same country alone. Further multi-institutional, international collaborations can facilitate the creation of universal NLP algorithms that improve the quality and safety of orthopaedic surgery.

## Tensile Strength of Superficial Suture Patterns with and without a Self-Adhesive Mesh Augmentation on Cadaveric Human Skin

Francisco Rodriguez Fontan, MD  
University of Colorado

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**Purpose:** The Lindeque locking stitch applied through a self-adhesive mesh will provide the strongest tension for wound closure.

**Significance:** Surgical wounds need to withstand tension. The material and technique utilized for wound closure contribute to wound healing. No prior studies have assessed the tensile strength through a self-adhesive mesh.

**Methods:** A 6cm incision was made on cadaveric skin flaps. Three skin closure patterns using Ethilon 3-0 nylon with/without a self-adhesive mesh 2-octyl cyanoacrylate (Prineo) ( $\pm P$ ) were compared: simple (S), horizontal-mattress (HM), and Lindeque locking (L), totaling 6 groups. A tensioning device applied 1 N of force/second to samples. Outcome measures: wound dehiscence, force required to separate the wound edges by 3mm; and ultimate load to failure.[1] Statistics included one-way ANOVA with post-hoc Tukey tests.

**Results:** The L had the greatest tensile strength for 3mm failure (221,9 N). Among all patterns, the HM had the least force for 3mm failure (93.9 N) and for ultimate load to failure (110.1 N). There was no intragroup significant difference  $\pm P$ .

**Conclusion:** We proposed a unique suture pattern designated as the L locking stitch. The  $\pm P$  didn't significantly change the strength. The L stitch may have fewer wound complications related to tensile forces.[2]

## Supination Adduction Vertical Medial Malleolar Fracture Fixation with Buttress Plating versus Screw-Only Fixation with Internal Buttressing: A Cadaveric Biomechanical Study

Edward J. Testa, MD  
Brown University

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**Purpose:** The purpose was to compare plate to screw-only fixation for the treatment of vertical medial malleolus fractures. We hypothesized that these constructs would be comparable when simulating early weightbearing.

**Significance:** Screw-only fixation for vertical medial malleolar fractures may be preferable to plating in certain clinical scenarios as it is less invasive and avoids plate prominence.

**Methods:** Six cadaver pairs underwent vertical medial malleolar osteotomies. One specimen from each pair was randomized to a 1/3<sup>rd</sup> tubular buttress plate construct, and the other to the screw-only fixation group. Specimens were axially and cyclically loaded for 100,000 cycles to simulate weightbearing in a boot, and subsequently loaded to failure in supination. Stiffness, displacement, and load to failure were recorded.

**Results:** There were no significant differences in displacement during cyclic loading after 100,000 cycles (Plate,  $0.74 \pm 0.09$  mm; Screws,  $0.79 \pm 0.18$  mm;  $p=0.225$ ). In load to failure testing, the plate group failed at a mean of  $716 \pm 240$  N, while the screw group failed at a mean of  $567 \pm 237$  N ( $p=0.015$ ).

**Conclusions:** For vertical medial malleolar fractures, the screw-only construct is non-inferior to buttress plating for cyclical axial loading, simulating early weightbearing in a boot. However, buttress plating is overall stronger in preventing catastrophic failure in supination.

## Mortality Benefit from Low Molecular Weight Heparin for Patients Undergoing Operative Treatment of Closed Femoral Shaft Fractures

Nicholas C. Danford, MD  
Columbia University

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**Purpose:** Our hypothesis was that for patients who had operative treatment of closed femoral shaft fractures, low molecular weight heparin (LMWH) would have a mortality benefit compared to patients who did not receive chemical venous thromboembolism (VTE) prophylaxis.

**Significance:** Though chemical prophylaxis has been shown to reduce VTE rate, it has not demonstrated a mortality benefit in orthopaedic trauma patients.

**Methods:** We queried the National Trauma Data Bank for patients aged 18 years or greater who underwent operative treatment of closed femoral shaft fractures. Patients were divided into a control group of no chemical VTE prophylaxis and treatment groups of prophylaxis with either LMWH, factor Xa inhibitor, coumadin, heparin, or other. Multivariate analyses were conducted with primary outcome of in-hospital mortality.

**Results:** 2,664 patients were included. Patients who had prophylaxis with LMWH had lower odds of in-hospital mortality compared to no VTE prophylaxis ( $p < 0.0001$ ).

**Conclusions:** Patients receiving VTE prophylaxis with LMWH had decreased odds of inpatient mortality compared to patients who did not receive chemical VTE prophylaxis. To our knowledge, this is the first study to report such an association for a cohort of orthopaedic trauma patients.

## Long-Term Outcomes of Multi-Ligament Knee Injuries

**Tina Zhang, MD**  
University of Maryland

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Multi-ligament knee injuries (MLKIs) are rare, but severe injuries that may result in lifelong functional impairment. The purpose of our study is to characterize MLKI outcomes at a minimum ten-year follow-up. This was a retrospective clinical follow-up study of a previously published study of 106 MLKIs treated at a Level 1 trauma center between 2000 and 2008. Six patients died, 4 had amputations, and 1 had a total knee replacement. Of the remaining eligible patients, 20 knees were evaluated at a mean follow-up of 13.1 years. The primary outcome was the International Knee Documentation Committee Subjective Knee Form (IKDC). Sixteen knees had physical examinations and bilateral knee radiographs assessed with the Kellgren-Lawrence (KL) score. Data was analyzed with Wilcoxon signed-rank test. The mean IKDC score was 56, lower than the age-matched normative value of 77. Osteoarthritis was present in all MLKIs, and KL scores were worse in injured knees. Comparing operative and non-operative management, the former demonstrated better SF-36 Social Functioning and Tegner scores. This study is one of few to report long-term outcomes of MLKIs, demonstrating that outcomes are generally poor even with modern treatment techniques. Clinicians should be aware of these results when counseling patients.

## Applying to Fellowship During a Pandemic: Lessons Learned from the 2020-2021 Orthopaedic Spine Fellowship Application Cycle

Bo Zhang, MD  
Johns Hopkins Hospital

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**Purpose:** How did COVID-19 impact the spine fellowship application process.

**Significance:** COVID-19 mandated a virtual fellowship application process. Previous studies have discussed the successful implementation of virtual interviews, but there has been no data on how the application process has changed for fellowship programs during the pandemic.

**Methods:** We surveyed the program directors of all 75 U.S. spine fellowship programs. Questions focused on the changes in the application process from the prior to current cycle. Univariate analyses were used to compare data. Alpha = 0.05.

**Results:** 25 program directors responded. Virtual open houses increased from 20% to 52% the prior year ( $p=0.018$ ). Number of interviews offered increased by 50% (32.7 vs. 21.9,  $p=0.024$ ). There was no significant difference in the total number of applications received ( $p>0.05$ ). The in-person interview was the most important factor the prior year, whereas this year the virtual interview, recommendation letters, and research were equally ranked. Half of programs would “likely” consider virtual interviews as an option in the future, but most answered “unlikely” that virtual interviews would continue entirely.

**Conclusion:** In the virtual format, spine fellowships adopted changes to recruiting, interviewing, and selection criteria. This data may help guide future application cycles post pandemic.

## Collegiate Athletes' Preferences for Their Team Physicians

Gabrielle Ray, MD

Dartmouth Hitchcock Medical Center

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**Purpose:** To investigate whether collegiate varsity athletes have any preference for the gender of their team physician and to identify which attributes athletes consider to be the most important.

**Significance:** This should inform hiring committees in selecting the best candidates as gender and race prove meaningless characteristics for the student-athlete.

**Methods:** All varsity athletes from a Division I University were recruited to participate in a web-based anonymous survey. Participants were asked to select their ideal team physician from two candidates with identical qualifications except their gender, then they ranked the 10 most important factors in the selection of a team physician.

**Results:** 213 student-athletes (20%) participated in the survey. The majority of respondents identified as female (70%). 70% of males and 59% of females indicated no preference between either candidate for team physician ( $p = 0.14$ ).

The top three qualities deemed most important by both men and women in the hiring of a team physician were understanding of the sport, trust, and years of experience. Gender and race were ranked the two least important qualities.

**Conclusion:** The majority of student-athletes have no preference for the gender of their team physician. Collegiate athletes deem trust and understanding of their sport as most important attributes.

## Gluteal Compartment Syndrome: Presentation, Etiology, Diagnosis, and Treatment

Davis Rogers, MD  
Johns Hopkins Hospital

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**Purpose:** To describe the presentation, etiology, diagnosis, and treatment of gluteal compartment syndrome (GCS).

**Significance:** GCS is a rare but devastating condition with a paucity of literature guiding diagnosis and management.

**Methods:** Retrospective case series of patients undergoing fasciotomy for GCS at a Level I trauma center from 2016-2020. Patient demographics, presenting symptoms, operative findings, and postoperative outcomes were analyzed. Continuous variables reported as mean and standard deviation, categorical variables as percentage and number.

**Results:** Of 9 cases identified: 8 (88.9%) were male, with mean age 45.2+/-15.4 years and mean BMI 25.6+/-4 kg/m<sup>2</sup>. Mechanisms included ballistic (1), "found-down" (5), and iatrogenic (3). Five reported drug use (>2 substances in 44.4%). Comorbidities included hypertension (22.2%). INR (1.1+/-0.2) and platelets (223+/-33x10<sup>9</sup>/L) were normal; hemoglobin (Hgb) (11.8+/-4.3 g/dL) was low. Creatine kinase (CK) (57,000+/-65,000 units/L) was consistently elevated, as was lactate (2.7+/-1.5 mmol/L) in 8. Five demonstrated sciatic nerve palsy. All received fasciotomy. Intra-operatively, mean blood loss (1025+/-2250 mL) was considerable, and 8 had non-viable muscle requiring debridement. Postoperatively, mean ICU length of stay was 15+/- 27 days. All patients required discharge to rehabilitation facilities.

**Conclusion:** GCS is devastating and leads to complex clinical courses. Multiple risk factors were identified, and further investigation may improve management.

## Representation of Women in Academic Orthopaedic Leadership: Where Are We Now?

Andrew S. Bi, MD  
NYU Langone Health

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**Purpose:** To determine the proportion of women in leadership roles in academic orthopaedic surgery departments (specifically, Chairs, Vice Chairs (VC), Program Directors (PDs), Assistant Program Directors (APDs), and subspecialty Division Chiefs (DCs)) and their characteristics.

**Significance:** Women remain significantly underrepresented within orthopedic surgery, particularly in leadership roles.

**Methods:** 161 academic orthopaedic programs were analyzed from the ACGME. Data was collected about leaders in July 2020 to control for changes in leadership. P values < 0.05 were considered significant.

**Results:** Women made up 3% of Chairs, 8% VCs, 11% PDs, 27% APDs, and 9% DCs. Women Chairs had fewer years in their position than men ( $2\pm 1$  versus  $9\pm 7$ ;  $p < 0.001$ ). Women VCs and PDs were more commonly Hand or Tumor specialized compared to men. Women APDs had fewer years in practice ( $9\pm 4$  versus  $14\pm 11$ ;  $p = 0.045$ ) and publications ( $11\pm 7$  versus  $30\pm 48$ ;  $p = 0.01$ ) than men. Women DCs had fewer years in practice and publications than men and were most prevalent in Tumor and Pediatrics. Women PDs were more likely than men to stay at the institution they trained at for residency (61% versus 42%;  $p = 0.01$ ).

**Conclusion:** There is a promising trend of increasing women in junior leadership positions in orthopedic surgery.

## A Virtual Curriculum to Prepare Medical Students to Achieve Accreditation Council for Graduate Medical Education Level-1 Milestones in Orthopaedic Surgery

Meghan Morley, MD  
Cooper University Hospital

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**Purpose:** The purpose of this study was to evaluate the efficacy of a virtual curriculum in moving 4<sup>th</sup> year medical students towards ACGME Level-1 Milestones.

**Significance:** There is a paucity of formal orthopaedic curriculum available to most medical students prior to their “audition” rotations as a 4<sup>th</sup> year subintern. The small number of students from each school applying into the field makes it difficult for any one institution to create a formal learning opportunity for students. The lack of standardized educational opportunities may put women, minority students, and other students who may decide to pursue orthopaedics later in school at a significant disadvantage.

**Methodology:** A 5-week virtual curriculum focused on ACGME Level 1 Milestone skills was created consisting of weekly didactic lectures followed by virtual small group sessions of 5 students with an attending faculty proctor. Fifty students from 10 different institutions participated for the 5-week course.

**Results:** All students found the experience to be highly effective, rating the overall educational value as 4.98/5. All students indicated that they’d highly recommend the course to future medical students.

**Conclusion:** A centralized, virtual course for students from multiple schools can effectively and equitably prepare students for their sub-intern rotations.

## Incidence and Risk Factors for Heterotopic Ossification After Pediatric Hip Arthroscopy

Stephen Maier, MD  
Harvard University Medical Center

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**Purpose:** To determine incidence/risk factors for heterotopic ossification (HO) in pediatric patients following hip arthroscopy.

**Significance:** HO—a known complication after hip arthroscopy in adults—is associated with male sex/older age/larger CAM resection/obesity; however, incidence after hip arthroscopy in the pediatric population is not well-documented.

**Methodology:** Single-center, retrospective, case-control study of patients <21yr who underwent hip arthroscopy. HO cases were matched on age and sex. Univariate logistic regression (demographics/perioperative factors vs. HO risk) and multivariate logistic regression (prophylactic indomethacin—75mgx3wk vs. HO risk) controlling for change in alpha angle were conducted.

**Results:** 3.9%(27/693) developed HO within 2yr of surgery. Indomethacin prophylaxis did not significantly decrease HO formation( $p=0.06$ ), including when controlling for alpha angle change( $p=0.12$ ). For each degree increase in alpha angle change, the odds of HO formation increased 8%(OR=1.08;95%CI=1.02-1.15; $p=0.01$ ). After controlling for preoperative alpha angle and prophylactic indomethacin, the odds of developing HO increased 19% for every degree increase in alpha angle change(OR=1.19;95%CI=1.08-1.31; $p<0.001$ ). For each degree increase in preoperative alpha angle, the odds of developing HO increased by 11%(OR=1.11;95%CI=1.03-1.20; $p=0.006$ ).

**Conclusion:** Protective role of indomethacin prophylaxis in HO formation may not apply to the pediatric hip arthroscopy population. Resection of larger CAM lesions is a risk factor for development of HO.

## Age is Associated with Hypercoagulability in Musculoskeletal Oncology Patients: Analysis of Thromboelastography-Derived Coagulation Profiles

Samir Sabharwal, MD  
Johns Hopkins Hospital

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**Purpose / Significance:** We sought to collect and analyze preoperative TEG data in order to establish a coagulation profile of musculoskeletal oncology patients, and determine factors associated with hypercoagulability.

**Methods:** We prospectively collected preoperative TEG assays on patients with either primary bone or soft-tissue sarcoma or metastatic disease to bone. We analyzed factors for association with hypercoagulability, defined as a TEG result indicative of supranormal clot formation (i.e., reduced R-Time, reduced K-value, or increased MA). Categorical variables were analyzed via Pearson's chi-squared test. Continuous variables were analyzed via Student's t-test.

**Results:** 25/42 patients (60%) demonstrated TEG markers of hypercoagulability. On univariate analysis, there was no association between hypercoagulability and sex, tumor location, bony versus soft-tissue disease, or metastatic stage. Age was significantly associated with hypercoagulability, with a mean age of 42.7 years (SD, 22.6) in patients with normal TEG results versus a mean age of 58.4 years (SD, 17.7) in patients with TEG-defined hypercoagulability ( $p=0.016$ ).

**Conclusion:** Age was significantly associated with hypercoagulability among our population of musculoskeletal oncology patients. As a whole, patients with primary bone or soft-tissue sarcoma and metastatic disease to bone represent a hypercoagulable population.

## Improved Functional Outcome Scores Associated with Greater Reduction in Cam Height Using the Femoroacetabular Impingement Resection Arc During Hip Arthroscopy

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**Purpose/hypothesis:** Patients with lower “femoroacetabular impingement resection”(FAIR) arcs would have improved outcome scores.

**Significance:** Under resection for cam impingement is a common cause of failure. This new intraoperative tool may help guide resection.

**Methods:** A retrospective review of hip arthroscopy patients for FAI with  $\geq 2$ -year follow-up were included. Cam FAIR arc measurements were made pre and postoperatively on a 45° Dunn x-ray. The clinical effect of postoperative cam maximal radial distance(MRD) was assessed using the modified Harris Hip Score(mHHS) and Non-Arthritic Hip Score(NAHS). Patients were divided into subgroups based on relationship to the mean and standard deviations for cam MRD. One half standard deviation above the mean was found to be 3.15mm.

**Results:** Sixty-one hips (59 patients) (age 38.1+/-13.1; BMI:25.5+/-4.3; 36 females) were included. Mean pre-and postoperative cam maximal radial distances (MRD) were 4.5±1.7mm and 2.3±1.7mm ( $p < 0.001$ ), respectively.

Patients in the cam MRD < 3.15 mm group had significantly higher mHHS (89.7 vs 70.0  $p < 0.001$ ) and NAHS scores (90.5 vs 72.9,  $p < 0.001$ ) than those in the > 3.15 mm group. Additionally, more patients in the < 3.15 mm group reached the minimal clinically important difference (MCID) (95.2% vs 78.9%,  $p = 0.048$ ) and were above patient acceptable symptomatic state (PASS) (95.2% vs 52.6%,  $p < 0.001$ ) compared to the > 3.15 mm group.

**Conclusion:** Patients with a lower postoperative cam MRD relative to the FAIR arc demonstrated significantly improved outcomes compared to those with higher postoperative MRD.

## Gender Differences in the Management of Carpal Tunnel Syndrome

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**Purpose/Significance:** While the effects of gender on patient care have been assessed in multiple orthopedic subspecialties, these impacts have been less elucidated in hand surgery. We performed a retrospective cohort analysis assessing the differences in carpal tunnel syndrome (CTS) treatment based on gender. We hypothesized that male patients would be offered surgery more frequently than females.

**Methodology:** Patients with EMG-confirmed CTS at our institution from 2016-2020 were identified. Demographic and electrodiagnostic variables were obtained. Outcome measures included treatment recommendation, treatment completion, and time to surgery. Differences in outcomes were analyzed using Pearson's chi-squared test and two-sample t-test.

**Results:** A total of 949 patients (375 male, 574 female) met our inclusion criteria with a mean age of 54 years (range 18-80). A significantly greater proportion of males presented with moderate-to-severe CTS (45.3%) when compared to females (34.8%,  $p < 0.002$ ) and were offered surgical intervention more frequently than females (50.9% vs 44.1%, respectively,  $p < 0.05$ ). However, when stratified by electrodiagnostic severity, there was no difference between genders in treatment recommendation, rate of surgical intervention, or time to surgery.

**Conclusion:** CTS is a common condition. It is important for providers to recognize potential gender-based differences in treatment in order to provide highest quality care.

## Genetic Risk Factors of Adhesive Capsulitis are Comparable to Traditional Risk Factors

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**Purpose:** To quantify and identify major variants that comprise genetic risk for the development of adhesive capsulitis.

**Significance:** Identification of elements of genetic risk for adhesive capsulitis with population-based techniques provides the basis for guiding treatment using genetics and identification of pathomechanism for development of new treatments.

**Methods:** A genome wide association study (GWAS) was conducted using the UK Biobank, a collection of over 500,000 patients with genetic data and associated ICD10 codes, comparing patients with/without the ICD10 code for adhesive capsulitis (M750). Separate GWAS were conducted controlling for known risk factors of adhesive capsulitis—hypothyroidism and diabetes. Logistic regression analysis was conducted controlling for gender, thyroid dysfunction, diabetes, dislocation, smoking, and genetics.

**Results:** Three loci of significance were identified: rs334315830 (WNT7B) OR 1.28 (95% CI 1.22-1.39), rs2965196 (POU1F1) OR 0.60 (95% CI 0.50-0.72), and rs1912256 (MAU2) OR 0.82 (95% CI 0.77-0.87). These loci retained significance when controlling for thyroid dysfunction and diabetes. OR for total genetic risk was 1.60 (95% CI 1.22-2.10) versus hypothyroid 1.79 (95% CI 1.28-2.44).

**Conclusion:** Total genetic risk for adhesive capsulitis is significant and similar to hypothyroidism. Identification of WNT7B, POU1F1, and MAU2 implicate Wnt pathway and cell proliferation response in the pathomechanism of adhesive capsulitis.

## Scapholunate Interosseous Ligament Complex (SLIL) Complete Tear Is Associated with Injury of the Long Radiolunate (LRL), Dorsal Intercarpal (DIC) and Dorsal Radiocarpal (DRC) Ligaments

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**Purpose** To evaluate the presence and severity of secondary stabilizing ligaments on MRI in patients with complete scapholunate interosseous ligament complex (SLIL) tears. We hypothesized that complete SLIL tears are significantly associated with lesions to long radiolunate ligament (LRL), dorsal intercarpal ligament (DIC) and dorsal radiocarpal ligament (DRC).

**Background:** Current biomechanical data suggests that SLIL dissociation occurs in the setting of incompetence or injury to volar and dorsal secondary stabilizing ligaments of the wrist.

**Methods:** Ligament injury was evaluated on MRI and described as complete, partial, edema, or intact by one musculoskeletal radiologist. The following ligaments were evaluated: LRL, short radiolunate (SRL), radioscapohcapitate (RSC), DRC and DIC. Categorical data was analyzed using Pearson-Chi square test.

**Results:** Twenty-five patients with complete SLIL tear were evaluated. Compared with controls, patients with complete SLIL tears had a severe injury (described as partial or full tear) of the LRL ( $p<0.005$ ), DIC ( $p<0.005$ ) and DRC ( $p<0.05$ ). No differences in severity of tears of the SRL ( $p=1.00$ ) and RSC ( $p=3.6$ ) were noted.

**Discussion and Conclusion:** Our results suggest that SLIL injury should be evaluated in the context of additional pathology to volar and dorsal secondary stabilizing ligaments of the wrist. MRI evaluation of these secondary ligaments may assist in the clinical management of patients with SLIL tears.

## Surgical Invasiveness Index: A Novel Approach to Risk-Adjustment in Total Hip Arthroplasty

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**Purpose/Significance:** Total hip arthroplasty (THA) risk-adjustment commonly assesses medical comorbidities and perhaps socioeconomic factors, but Individual patient surgical complexity risk-adjustment is currently unavailable. By developing the Surgical Invasiveness Index (SII), we sought to create a surgical risk-adjustment approach quantifying operative difficulty experienced during primary THA.

**Methods:** Primary THA implants used between 01/01/2017–05/01/2019 were referenced for scoring criteria creation with the following values: Acetabular-fixation-screw=0.5; Femoral-cable/plate, cement=1; Protrusio-acetabulum, acetabular-bulk-graft, femoral-bone-graft, Wagner-stem, dual-mobility constructs=2; revision-implant, acetabular-augment/jumbo-cup (women  $\geq 62$ mm, men  $\geq 66$ mm)=3; acetabular-cage=4.  $SII = \text{SUM}(\text{implanted.component.Values})$ . Validity was assessed by SII association with 90-day readmissions and 90-day complications in 1,069 primary THA surgeries, adjusting for age, gender, BMI, Charlson Comorbidity Index (CCI), and operative duration.

**Results:** Multiple regression identified significant risk-factors for 90-day complications: age (Odds-Ratio:1.02,95%CI:1.00–1.04,p=0.028), operative time (mins)(Odds-Ratio:1.01,95%CI:1.01–1.02,p<.001), male gender (Odds-Ratio:0.56,95%CI:0.36–0.84,p=.006), and SII (Odds-Ratio:1.28,95%CI:1.04–1.57,p=.017). Significant predictors for 90-day readmission were age (Odds-Ratio:0.97,95%CI:0.95–1.00,p=.021), and CCI (Odds-Ratio:1.39,95%CI:1.24–1.58,p<.001).

**Conclusions:** More invasive primary-THA, as measured by SII, had greater 90-day complication risk. SII was a significant risk-factor for 90-day complications after adjusting for age, gender, BMI, CCI, and operative duration. This quantitative description of primary THA surgical risk-adjustment may prove beneficial for assessing variations in THA outcomes not currently captured with conventional risk-factors.

## Perioperative and Patient Risk Factors for Postoperative Hyponatremia in Total Hip and Knee Arthroplasty Patients

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**Purpose:** To determine the prevalence and severity of postoperative hyponatremia in the TJA population, evaluate patient and perioperative risk factors and the effect of this electrolyte imbalance on outcomes.

**Significance:** Hyponatremia is common following orthopaedic surgery and associated with adverse outcomes and increased costs, which may be attenuated with prevention, prompt diagnosis and correction.

**Methods:** A retrospective cohort study was performed evaluating 3,063 consecutive patients who underwent THA or TKA procedures. Prevalence of hyponatremia was determined and stratified based on severity. Potential risk factors and associations between patient characteristics, hyponatremia and outcomes were assessed by univariate and multivariate logistic regression models.

**Results:** Of the 3,063 patients, 493 (13.9%) were hyponatremic on postoperative day one. Postoperative hyponatremia was associated with increased length of stay. Female sex, lower BMI, older age, THA compared to TKA, and perioperative use of proton pump inhibitors were risk factors for postoperative hyponatremia. Intraoperative use of tranexamic acid and higher postoperative hematocrit were associated with a decreased risk of postoperative hyponatremia.

**Conclusion:** Postoperative hyponatremia is common following THA and TKA operations and is associated with prolonged hospital stays and increased costs. Intraoperative use of tranexamic acid and higher postoperative hematocrit were associated with a decreased risk of this complication.

## Onodera's Prognostic Nutritional Index a Valuable Measure in Predicting Complications After TKA

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**Purpose:** The purpose of this study was to investigate the utility of Onodera's prognostic nutritional index (OPNI) in predicting early complications following TKA, and to determine the threshold above which the risk of complications increase significantly.

**Significance:** The best marker for assessing nutritional status prior to total knee arthroplasty (TKA) remains unknown.

**Methods:** This prospective multi-center study evaluated primary TKAs. The OPNI was measured within 14 days of surgery. Complications were assessed for 12 weeks from surgery and included prosthetic joint infection (PJI), wound complications, re-admission, and re-operation. The Youden's index was used to determine the cut-off for OPNI and albumin. Multiple regression model was performed using the Charlson comorbidity index.

**Results:** 1325 patients (562 males, 763 females) were included in the study. OPNI cutoff score of 45.1 was determined as the optimal threshold associated with complications. Patients with lower OPNI (<45.1) were 9.8 times more likely to develop PJI compared to patients with higher OPNI ( $p=0.001$ ). Re-admission and re-operation rates were 4.6 and 4.2 times higher in patients with OPNI below the threshold ( $p = 0.017$  and  $p = 0.005$ , respectively). Unlike OPNI, albumin failed to show a significant association with complications (cutoff: 38.2 g/L).

**Conclusion:** OPNI is a valid and an excellent predictor of complications following TKA. Based on these findings, we recommend screening of all patients undergoing TKA using OPNI and for those who have a score lower than 45.1 the risk of surgery should be carefully weighed against its benefit and consider nutritional optimization.

## Head-to-Head Comparison of Kinematic Alignment vs. Mechanical Alignment for Total Knee Arthroplasty

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**Purpose:** To compare functional outcomes in patients undergoing TKA with a mechanical alignment (MA) target versus a kinematic alignment (KA) target.

**Significance:** It is imperative to determine differences between TKA alignment strategies in order to optimize patient outcomes.

**Methods:** 100 consecutive patients who underwent TKA using MA technique were 1:1 matched to 100 patients who underwent TKA using a KA technique, using the same implant and robotic technology. Patient reported outcomes were measured postoperatively at 1- and 2-years. Power analysis revealed 94 patients to detect a significant difference.

**Results:** Mean VAS scores were higher in the MA group during the first 6 weeks ( $p=0.04$ ), but statistically similar at 1-year. Six-week VR-12 mental and physical components were statistically similar ( $p=0.1$ ). Patients did not differ in 6-week or 1-year knee range of motion ( $p>0.43$ ). KOOS-JR was significantly better in the KA group at 6-weeks, 1- and 2-years ( $p=0.09$ ). Forgotten Joint Score at 1- and 2-years postoperatively were significantly higher in the KA group ( $p<0.001$ ).

**Conclusion:** Patients undergoing TKA with kinematic alignment experienced less pain in 6-weeks after surgery, and higher Forgotten Joint Scores at 1- and 2-years postoperatively. Alternative TKA alignment and balancing strategies should be considered to increase patient satisfaction.

## Alignment Accuracy for Total Knee Arthroplasty Performed Using Accelerometer-Based Handheld Navigation Versus Computed Tomography-Based Surgical Robot

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**Purpose:** We compared the precision of different computer-assisted technologies in performing bony resections for TKA and hypothesized that an accelerometer-based system will have similar accuracy as a computed-tomography based system.

**Significance:** Studies directly comparing the precision of bony resections performed using different computer-assisted technologies are few and limited. Evaluation of these new technologies may be needed to guide surgeons considering these options.

**Methods:** Patients who underwent primary TKA using an imageless accelerometer-based handheld navigation system (KneeAlign2®) or computer tomography-based large-console surgical robot (Mako®) from 2017-2020 were retrospectively reviewed. Preoperative alignment targets were recorded. Varus/valgus alignment and tibial slope were measured on postoperative hip-to-ankle radiographs. The sample size needed to detect a 10% difference in the rate of accuracy within 3° of the alignment targets was calculated to be 120 (80% power,  $\alpha=0.05$ ).

**Results:** 120 were included in the two cohorts for a total of 240 patients. There were no differences in the rate of overall accuracy between either cohort. A small but statistically significant difference in accuracy was observed for the distal femoral resection between two cohorts (1.48° vs. 1.14° difference between the templated and measured alignments,  $p=0.024$ ). There were no differences in the accuracy of the tibial resection (coronal plane 0.90° vs. 0.97°,  $p=0.46$ ; sagittal plane 1.17° vs. 1.10°,  $p=0.64$ ).

**Conclusions:** A high degree of component alignment accuracy was observed in the imageless handheld navigation and CT-based robotic cohorts.

## **Prior Non-Shoulder Periprosthetic Joint Infection Increases Risk of Surgical Site Infection, Sepsis, and All-Cause Revision Following Primary TSA**

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**Purpose:** To determine whether prior non-shoulder PJI contributes to increased risk of infectious complications, greater healthcare utilization, and increased revision surgery following primary total shoulder arthroplasty (TSA).

**Significance:** Periprosthetic joint infection (PJI) following total joint arthroplasty is a known risk factor for infection in subsequent joint replacement.

**Methodology:** Patients who underwent primary TSA for osteoarthritis (OA) with prior non-shoulder PJI were identified in a national database. These patients were propensity-matched based on age, sex, Charlson Comorbidity Index, smoking status, and obesity to a control cohort of patients who underwent primary TSA for OA without any prior PJI. Primary outcomes included revision rates. Bivariate analysis was conducted using Chi-square tests to compare outcomes and complications between both cohorts.

**Results:** Patients with prior PJI had significantly higher risk of 2-year revision surgery compared to patients without prior PJI (3.36% vs. 1.57%). Patients with prior PJI also had significantly higher risk of 90-day SSI (7.61% vs. 0.56%), sepsis (1.79% vs. 0.56%) and 90-day readmission (3.36% vs. 1.23%) following TSA.

**Conclusion:** Prior non-shoulder PJI of any joint increases rates of 90-day SSI, sepsis, hospital readmission, and 2-year all-cause revision following TSA. These results are important for risk-stratifying patients undergoing TSA with prior history of PJI.

## Assessment of Staphylococcal Clinical Isolates from Periprosthetic Joint Infection for Potential Bacteriophage Therapy

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**Purpose:** Assess bacteriophage therapy feasibility in periprosthetic joint infection (PJI) by (1) categorizing the causative pathogens in hip and knee PJI, and (2) evaluating in vitro activity of a bacteriophage population against PJI isolates.

**Significance:** Bacteriophage therapy offers a potential adjunctive treatment for PJI given biofilm degradation, bacterial lysis and self-replication capabilities. Narrow spectrums of activity and regulatory hurdles limit this therapeutic presently.

**Methodology:** Clinical intra-operative tissue culture data from the first stages of two-stage revision protocols for 129 chronic hip or knee PJI cases were reviewed retrospectively. 29 preserved clinical *S. aureus* isolates were tested for in vitro growth inhibitory activity by 14 Staphylococcal bacteriophages.

**Results:** 26% of the PJIs were caused by *S. aureus* and 14% by coagulase negative Staphylococcus. 97% of the predominant *S. aureus* colonies tested were adequately inhibited via phage activity; 24% exhibited secondary colonies all resistant to growth inhibition by these phages.

**Conclusion:** Staphylococcal species were the most common pathogens in chronic hip and knee PJI. Predominant *S. aureus* isolates were successfully matched to and inhibited by bacteriophage agents. Lack of phage activity to presumed small colony variants supports in vitro testing of phages against all in vivo bacterial morphologies when considering phage therapy.

## Does Time to Reimplantation After Explant for Prosthetic Joint Infection Influence Likelihood of Successful Outcome at 2 Years?

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**Purpose:** Determine whether time to reimplantation influences two-year successful infection eradication after two-stage resection arthroplasty.

**Significance:** Two-stage resection arthroplasty remains gold-standard for chronic PJI, however no definitive recommendations exist regarding timing for reimplantation.

**Methodology:** Retrospective review of 101 resection arthroplasties with antibiotic spacer placement for PJI. Time from resection arthroplasty with spacer placement and reimplantation was categorized: <12 weeks, 12-18 weeks, and >18 weeks, with comparison of baseline patient and treatment characteristics. Logistic regression modeling evaluated prior revision surgery, ASA, and time to replant as predictors of failure (MSIS Outcome Reporting Tool).

**Results:** Time to replant >18 weeks demonstrated statistically significant increased odds of failure (OR 5.82, CI 1.80-20.71,  $p = 0.004$ ). Requiring second spacer or girdlestone prior to replant also associated with significantly increased odds of failure (OR 14.0, CI 3.53-94.66,  $p = 0.001$ ). No significant differences demonstrated among the groups with respect to age, BMI, type of spacer, cement antibiotics, or prior revision surgery. There were more unplanned readmissions ( $n=11$ ) between spacer and replant for the >18 weeks group ( $p<0.002$ ).

**Conclusion:** Time from spacer placement to replant beyond 18 weeks, as well as interim spacer exchange or girdlestone prior to replant, may be associated with worse overall outcomes.

## Comparing Articulating Spacers for Periprosthetic Joint Infection After Primary THA: All-Cement vs. Real Component Articulating Spacers

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**Introduction:** Periprosthetic joint infection (PJI) is a devastating and costly complication following total hip arthroplasty (THA). There are a variety of methods available to treat PJI, including two-stage revision with the use of an antibiotic spacer. This study compares the outcomes of real-component (RC) and all-cement (AC) articulating spacers for THA PJI treatment.

**Methods:** This multicenter retrospective study assessed all articulating spacers placed for primary THA PJI between April 2011 and August 2020. Patients were dichotomized based on spacer type (RC vs. AC). RC spacers were defined as those involving an articulation between a metal or ceramic head and a polyethylene liner. AC spacers were defined as pre-molded or surgeon-molded implants involving an articulation between a cement head and native or cement-exposed acetabulum. Data on demographics, surgical information, and outcomes were collected.

**Results:** One-hundred and four patients received articulating spacer constructs (RC group = 70, AC group = 34). Leg length discrepancy was significantly greater in the AC group after the second-stage (3.15mm vs 11.55mm,  $p=0.02$ ). There were no significant differences in reoperation rates following first-stage spacer placement (RC group = 14.3%, AC group = 17.6%,  $p=0.773$ ), re-implantation rates (RC group = 78.6%, AC group = 94.1%,  $p=0.051$ ), and time to re-implantation (RC group = 170 days, AC group = 208 days,  $p=0.283$ ) between the groups. There were no significant differences in re-infection rates (RC group = 10.9%, AC group = 6.3%,  $p=0.705$ ) and reoperation rates following second stage revision THA (RC group = 12.7%, AC group = 9.4%,  $p=0.739$ ). Hospital length of stay (LOS, in days) was shorter following the first (6.74 vs 12.55,  $p=0.046$ ) and second stage (3.62 vs 5.28,  $p=0.048$ ) for patients in the RC group. Patients in the RC group were more likely to be discharged home following the first ( $p=0.003$ ) and second ( $p=0.002$ ) stages.

**Conclusion:** Patients who received RC articulating spacers had significantly shorter LOS and were more likely to be discharged home compared to AC spacers. Given that there were no differences in re-infection and re-operation rates between the two spacer constructs, RC articulating spacers may provide a significant benefit for patient comfort during two-stage exchange treatment of PJI while adding no increase in risk profile.

# Leptin Receptor Expressing Skeletal Stem Cells Accumulate and Divert to a Fibrogenic Phenotype in Peri-implant Membrane of Patients with Aseptic Loosening

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**Purpose:** The purpose of this study is to find the cells responsible for formation of the fibrous tissue in patients suffering from aseptic loosening.

**Significance:** One of the leading causes of the failure of TJR is formation of fibrous tissue between host and implant interface, often termed aseptic loosening. The cellular origin and mechanism of this fibrous tissue is poorly understood, hence pharmaceutical targeting of this pathologic fibrous tissue has been elusive.

**Methods:** Samples of peri-implant tissue was collected from patients during revision surgery for symptomatic hip or knee aseptic loosening. Flow cytometry and RNA sequencing was used to determine the cellular constituents and gene expressions of the peri-implant tissue respectively.

**Results:** Higher percentage of LepR<sup>+</sup> stem cells were found in the human peri-implant fibrotic tissue as compared to cancellous bone. Increased expressions of pro-fibrotic were found in human LepR<sup>+</sup> cells from peri-implant fibrotic tissue.

**Conclusion:** LepR expressing human skeletal stem cells accumulate in peri-implant fibrotic tissue and could be responsible for the formation of fibrotic tissue in patients suffering from aseptic loosening. Further studies seeking the molecular and cellular triggers of this diversion will identify diagnostic marker and targets for the prevention or treatment of aseptic loosening.

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