

 **Washington University in St. Louis**  
SCHOOL OF MEDICINE

**Orthopaedic Surgery**

**OREF MIDWEST REGION  
RESIDENT RESEARCH SYMPOSIUM**  
Monday, October 10, 2022

**Washington University in St. Louis**  
Eric P. Newman Center (EPNEC)  
320 S. Euclid Avenue  
St. Louis, MO 63110

Hosted by:

**Regis J. O’Keefe, MD, PhD**  
Chair  
Department of Orthopaedic Surgery  
Washington University in St. Louis



## Table of Contents

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Resident Research Symposium Summary Agenda .....	5 – 6
Keynote Speakers .....	7 – 9
Judges.....	11
Detailed Agenda.....	13
Abstracts .....	17
Corporate Recognition.....	47

### 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 well over \$100 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 MIDWEST REGION RESIDENT RESEARCH SYMPOSIUM**  
**SUMMARY AGENDA**  
Monday, October 10, 2022

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- 7:00 a.m. – 7:45 a.m.      **Registration and Breakfast**  
Washington University in St. Louis  
Eric P. Newman Center (EPNEC)  
320 S. Euclid Avenue  
St. Louis, MO 63110
- 7:45 a.m. – 7:50 a.m.      **Welcome and Introductions**  
Regis J. O’Keefe, MD, PhD  
Chair, Department of Orthopaedic Surgery  
Washington University in St. Louis
- 7:50 a.m. – 7:55 a.m.      **OREF Welcome**  
Lee Grossman  
Chief Executive Officer  
Orthopaedic Research and Education Foundation
- 7:55 a.m. – 8:15 a.m.      **Keynote Speaker**  
**Christopher Dy, MD, MPH, FACS**  
Associate Professor of Orthopaedic Surgery  
Washington University School of Medicine  
Director of the Hand and Microsurgery Fellowship  
Washington University Orthopedics
- 8:15 a.m. – 8:45 a.m.      **Session I – Resident Research Presentations & Discussion**  
**Moderators:** Faculty: Alexander Aleem, MD  
Residents: Andrea Tian, MD and Justin Hicks, MD
- 8:45 a.m. – 9:15 a.m.      **Session II – Resident Research Presentations & Discussion**  
**Moderators:** Faculty: Alexander Aleem, MD  
Residents: Andrea Tian, MD and Justin Hicks, MD
- 9:15 a.m. – 9:25 a.m.      *Break – please submit your scores from the first 2 sessions to OREF Staff*
- 9:25 a.m. – 9:55 a.m.      **Session III – Resident Research Presentations & Discussion**  
**Moderators:** Faculty: Martin Boyer, MD  
Residents: Kate Buesser, MD and Quante Singleton, MD
- 9:55 a.m. – 10:21 a.m.      **Session IV – Resident Research Presentations and Discussion**  
**Moderators:** Faculty: Martin Boyer, MD  
Residents: Kate Buesser, MD and Quante Singleton MD
- 10:21 a.m. – 10:31 a.m.      *Break – please submit your scores from Sessions 3 and 4 to OREF staff*
- 10:31 a.m. – 11:05 a.m.      **Session V – Resident Research Presentations and Discussion**  
**Moderators:** Faculty: Simon Tang, PhD  
Residents: David Clever, MD, PhD and Sarah Ballatori, MD
- 11:05 a.m. – 11:31 a.m.      **Session VI – Resident Research Presentations & Discussion**  
**Moderators:** Faculty: Simon Tang, PhD  
Residents: David Clever MD, PhD and Sarah Ballatori, MD
- 11:31 a.m. – 11:35 a.m.      *Break – please submit your scores from sessions 5 & 6 to OREF staff*

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**OREF MIDWEST REGION RESIDENT RESEARCH SYMPOSIUM**  
**SUMMARY AGENDA (continued)**  
Monday, October 10, 2022

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- 11:35 a.m. – 11:55 a.m.     **Keynote Speaker**  
**Cecilia Pascual-Garrido, MD, PhD**  
**Associate Professor**  
**Department of Orthopaedic Surgery**  
**Washington University School of Medicine**
- 11:55 a.m. – 12:00 p.m.     **Announcement of top 6 as determined by Judges scores**  
*Thank you to sponsors*  
*Closing of program to OREF TV audience*
- 12:00 p.m. – 12:15 p.m.     **Box Lunch**
- 12:15 p.m. – 12:50 p.m.     **Panel Discussion**  
*How To Set Up a Research Infrastructure*
- 12:50 p.m. – 1:00 p.m.     **Presenters' Choice Award Announcement**  
**Photos of ALL Award winners**  
**Closing Remarks**

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## KEYNOTE SPEAKER

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**Christopher Dy, MD, MPH, FACS**

**Associate Professor of Orthopaedic Surgery  
Washington University School of Medicine  
Director of the Hand and Microsurgery Fellowship  
Washington University Orthopedics**

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**Christopher J. Dy, MD MPH FACS** - Dr. Dy (**dee**) is a board-certified orthopedic hand surgeon with subspecialty expertise in brachial plexus and peripheral nerve injury. He graduated from the combined BS/MD program at the University of Miami, where he also obtained an MPH degree. Dr. Dy completed his orthopedic surgery residency and postdoctoral research fellowship at Hospital for Special Surgery in New York City and a fellowship in hand surgery at Washington University Orthopedics. He has received additional training in brachial plexus and peripheral nerve surgeries at leading centers in India, China, Taiwan, Thailand, and Sweden.

Dr. Dy is currently a tenured Associate Professor of Orthopedic Surgery at Washington University School of Medicine with a secondary appointment in the Division of Public Health Sciences. He is also director of the Hand and Microsurgery Fellowship at Washington University Orthopedics.

Dr. Dy's research program has two main areas of focus: (1) improving delivery of care for patients with brachial plexus injuries and (2) addressing disparities in access to orthopedic care. He has received research funding from the National Institutes of Health (active R01 and R03 grants; former K23 Career Development Award), Orthopedic Research and Education Foundation (Young Investigator Award, Mentored Clinician Scientist Award, and Orthopaedic Health Disparities Award), American Foundation for Surgery of the Hand, and other sources. Dr. Dy was the 2019 ASSH Richard H. Gelberman Scholar, was the 2018 recipient of the ASSH J. Leonard Goldner Pioneer Award and was named "Clinical Teacher of the Year" by Washington University School of Medicine's Class of 2021. He has published over 115 peer-reviewed articles and co-edited the textbook "ASSH Surgical Anatomy: Nerve Reconstruction". Dr. Dy co-hosts "The Upper Hand: Chuck and Chris Talk Hand Surgery" podcast, which receives over 2000 downloads each week, and is co-moderator for FIRSTHAND, the ASSH online master class in hand surgery. Dr. Dy is a Fellow of the American College of Surgeons, American Orthopaedic Association, and American Academy of Orthopaedic Surgeons



## KEYNOTE SPEAKER

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**Cecilia Pascual-Garrido, MD, PhD**

**Associate Professor  
Department of Orthopaedic Surgery  
Washington University School of Medicine**

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Dr. Pascual-Garrido earned her PhD at Universidad Catolica and her MD at René Favaloro Medical University, both in Buenos Aires. She completed residency training in orthopaedic surgery at Hospital Italiano de Buenos Aires. Following her residency, she pursued a postdoctoral research fellowship in the Biochemistry department and a research fellowship in the Cartilage Restoration Center, both at Rush University Medical Center in Chicago. She then completed fellowship Sports Medicine and Shoulder Surgery at the Hospital for Special Surgery in New York and Adult Reconstruction and Hip Preservation at the University of Colorado Hospital in Boulder.

Dr. Pascual-Garrido is currently an Associate Professor at Washington University School of Medicine in the Department of Orthopaedic Surgery. She treats young and adult patients with hip pain. She performs adult hip reconstruction and hip preservation procedures, including open and arthroscopic complex hip procedures.

Dr. Pascual-Garrido leads a basic science lab with a specific focus on mechanism of disease in the pre-arthritis hip, specifically epigenetic changes that occur in the pre-arthritis hip. She has also developed a small animal model of FAI that she will be using as a platform to study progression of hip OA. She has secured extramural funding from the NIH, as well as several OREF and AOSSM grants. Dr. Pascual-Garrido is a nationally recognized leader in the field of Hip Preservation and has been awarded by the AAOS for Award of Excellence, the Lee T. Ford Academic Award, the William Harris Career Development Award in Hip Preservation from the ANCHOR Group and the AOSSM Cabaud Memorial Award. She was also selected as the recipient of the Hip Society's Otto Aufranc Award.



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## Judges

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Alexander W. Aleem, MD, MSc  
Washington University Orthopedics

Martin I. Boyer, MD, FRCS(C)  
Washington University in St. Louis

David Brogan, MD, MSc  
Washington University in St. Louis

Simon Tang, PhD  
Washington University in St. Louis



**OREF Midwest Region Resident Research Symposium**  
**DETAILED AGENDA**  
Monday, October 10, 2022

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- 7:00 a.m. – 7:45 a.m.      **Registration/Breakfast**  
Washington University in St. Louis  
Eric P. Newman Center (EPNEC)  
320 S. Euclid Avenue  
St. Louis, MO 63110
- 7:45 a.m. – 7:50 a.m.      **Welcome**  
**Regis J. O’Keefe, MD, PhD**  
Chair  
Department of orthopaedic Surgery  
Washington University in St. Louis
- 7:50 a.m. – 7:55 a.m.      **OREF Welcome**  
Lee Grossman  
Chief Executive Officer  
Orthopaedic Research and Education Foundation
- 7:55 a.m. – 8:15 a.m.      **Keynote Speaker**  
**Christopher Dy, MD, MPH, FACS**  
Associate Professor of Orthopaedic Surgery  
Washington University School of Medicine  
Director of the Hand and Microsurgery Fellowship  
Washington University Orthopedics
- Session I – Resident Research Presentations and Discussion**  
**Moderators: Faculty: Alexander W. Aleem, MD, MSc**  
**Residents: Andrea Tian, MD and Justin Hicks, MD**
- 8:15 a.m. – 8:19 a.m.      *The Influence of Dorr Type and Femoral Fixation on Outcomes Following Total Hip Arthroplasty for Acute Femoral Neck Fractures: A Multicenter Study*  
Julian Emerson Dilley, MD, Indiana University School of Medicine
- 8:19 a.m. – 8:23 a.m.      *Artificial Intelligence More Accurately Measures Acetabular Component Orientation Than Hand Measurements*  
Michael Murphy, MD, Loyola University Medical Center
- 8:23 a.m. – 8:27 a.m.      *Elective Joint Replacement Should Be Delayed by One Month After COVID Infection to Prevent Postoperative Complications*  
Enrico Forlenza, MD, Rush University Medical Center
- 8:27 a.m. – 8:31 a.m.      *Reduced Fracture Rate and Stem Subsidence at 6 Months with Collared Stems in Direct Anterior Cementless Total Hip Arthroplasty*  
Avinash Inabathula, MD, Southern Illinois University School of Medicine
- 8:31 a.m. – 8:35 a.m.      *Documented Penicillin Allergies Should Not Preclude Use of Pre-Operative Cefazolin in Hip and Knee Arthroplasty*  
Anthony Joseph Nestler, MD, Southern Illinois University School of Medicine
- 8:35 a.m. – 8:45 a.m.      **Question and Answer**

***Excited about today’s research? Share it with your colleagues!***  
***Post on social media with [#Orthosymposia](#)***

**OREF Midwest Region Resident Research Symposium**  
**DETAILED AGENDA**  
Monday, October 10, 2022

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I  
**Session II – Resident Research Presentations and Discussion**  
**Moderators: Faculty: Alexander W. Aleem, MD, MSc**  
**Residents: Andrea Tian, MD and Justin Hicks, MD**

- 8:45 a.m. – 8:49 a.m. *Acetabular Cup Placement in Fluoroscopic-Aided Anterior versus Non-Image Guided Posterior Total Hip Arthroplasty*  
Kevin M. Weisz, MD, Beaumont Health Royal Oak and Taylor
- 8:49 a.m. – 8:53 a.m. *Isolated Morbid Obesity Is Not Associated with Increased Early Postoperative Complications Following Primary Total Hip Arthroplasty*  
Michael Foy, MD, University of Illinois, Chicago (**Scheduling Conflict**)
- 8:53 a.m. – 8:57 a.m. *Prior Authorization is Burdensome for Total Joint Arthroplasty Surgeons: A Survey of the American Association of Hip and Knee Surgeons Membership*  
Daniel Pereira, MD, Washington University Orthopedics
- 8:57 a.m. – 9:01 a.m. *Lower Extremity Stress Fractures in the National Basketball Association, 2013-2014 through 2018-2019*  
Andrew Rizzi, MD, University of Chicago
- 9:01 a.m. – 9:05 a.m. *Risk for Total Knee Arthroplasty Following Anterior Cruciate Ligament Reconstruction*  
Paul M. Inclan, MD, Washington University in St. Louis
- 9:05 a.m. – 9:15 a.m. **Question and Discussion**
- 9:15 a.m. – 9:25 a.m. **Break - please submit your scores from Sessions 1 & 2 to OREF Staff**

**Session III – Resident Research Presentations & Discussion**  
**Moderator: Faculty: Martin I. Boyer, MD, FRCS(C)**  
**Residents: Kate Buesser, MD and Quante Singleton, MD**

- 9:25 a.m. – 9:29 a.m. *Diabetic Sequelae and Ankle Fractures: Significant Associations with Postoperative Complications*  
William Polachek, MD, University of Chicago
- 9:29 a.m. – 9:33 a.m. *Biplanar Reduction Influences Fracture Collapse and Immediate Post-Operative Ambulation in Intertrochanteric Hip Fractures Fixed with a Cephalomedullary Nail*  
Tomas Liskutin, MD, Loyola University Medical Center
- 9:33 a.m. – 9:37 a.m. *Development of a Patient Decision Aid for Distal Radius Fractures in Patients Sixty-Five Years of Age and Older*  
Elizabeth A. Graesser, MD, Washington University/Barnes Jewish Hospital
- 9:37 a.m. – 9:41 a.m. *Dual Versus Lateral Locked Plating in Elderly Cadaveric Bicondylar Tibial Plateau Fractures: Does Medial Comminution Matter*  
Dencel A. Garcia Velez, MD, Saint Louis University Hospital
- 9:41 a.m. – 9:45 a.m. *The Ballistic Articular Structure Injury Classification (BASIC) System: Clarifying Ballistic Articular Injuries*  
Daniel Portney, MD, University of Chicago
- 9:45 a.m. – 9:55 a.m. **Question and Answer**

**OREF Midwest Region Resident Research Symposium  
DETAILED AGENDA (continued)  
Monday, October 10, 2022**

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

**Moderators: Faculty: Martin I. Boyer, MD, FRCS(C)**

**Residents: Kate Buesser, MD and Quante Singleton, MD**

- 9:55 a.m. – 9:59 a.m.. *Treatment of 4<sup>th</sup> and 5<sup>th</sup> Carpometacarpal Fracture Dislocations in Punching Injuries with Motion-Sparing Hamate Fixation Spring-Plates: “Rabbit Ears” Plating*  
Shelby Smith, MD, Rush University Medical Center
- 9:59 a.m. – 10:03 a.m. *Comparison of Direct Surgical Cost and Outcomes Elbow Injuries: Internal Joint Stabilizer versus External Fixation*  
Malynda Wynn, MD, University of Iowa Hospital and Clinics
- 10:03 a.m. – 10:07 a.m. *Metabolic Abnormalities Underlying Nonunion in the Adult Fracture Patient*  
Nicolas Revelt, MD, Southern Illinois University, SOM & Affiliated Hospitals
- 10:07 a.m. – 10:11 a.m. *Surface Pressures in Lower Extremity Splints – Minimizing Insult After Injury*  
Davin Gong, MD, University of Michigan
- 10:11 a.m. – 10:21 a.m. **Question and Answer**
- 10:21 a.m. – 10:31 a.m. **Break – please submit your scores from Sessions 3 & 4 to OREF Staff**

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

**Moderators: Faculty: Simon Tang, PhD**

**Residents: David Clever, MD, PhD and Sarah Ballatori, MD**

- 10:31 a.m. -10:35 a.m. *Does Disc Distraction After Cervical Total Disc Arthroplasty Impact Range of Motion and Patient Reported Outcomes?*  
Vincent Federico, MD, Rush University Medical Center
- 10:35 a.m. – 10:39 a.m. *Serum Titanium Levels Remain Persistently Elevated but Urine Titanium is Undetectable in Children with Early-Onset Scoliosis (EOS) Undergoing Growth-Friendly Surgical Treatment: A Prospective Study*  
Kameron Shams, MD, University of Michigan
- 10:39 a.m. – 10:43 a.m. *The Impact of Families of Congenital Upper Extremity Differences*  
Sarah Ballatori, MD, Washington University in St. Louis
- 10:47 a.m. – 10:51 a.m. *Does Synovial Sarcoma Grade Predict Oncologic Outcomes, and Does a Low-Grade Variant Exist*  
Michael Fice, MD, Rush University Medical Center
- 10:51 a.m. – 10:55 a.m. *Sarcopenia in Soft Tissue Sarcoma Patients*  
Michael Russell, MD, University of Iowa (**Scheduling Conflicting**)
- 10:55 a.m. – 11:05 a.m. **Question and Answer**



# The Influence of Dorr Type and Femoral Fixation on Outcomes Following Total Hip Arthroplasty for Acute Femoral Neck Fractures: A Multicenter Study

Julian Emerson Dilley, MD  
Indian University School of Medicine

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**Purpose:** We hypothesize that cementless stems for acute femoral neck fractures (FNF) will have higher revision and periprosthetic fracture (PF) rates.

**Significance:** The AAOS strongly recommends cementing femoral stems during arthroplasty for FNFs. However, the evidence for this derives mainly from hemiarthroplasty literature. This is the first non-registry study comparing outcomes of cemented versus cementless THA for acute FNFs and examining the influence of various patient factors, including bone quality.

**Methods:** A multi-center retrospective study was performed of 199 cemented, and 510 cementless THAs for FNF from 2006-2021. Demographics and perioperative characteristics were reviewed. Radiographs were examined to assess bone quality using the Dorr classification. Kaplan-Meier survivorship curves were generated for PF, aseptic revision, and dislocation. For univariate and multivariate statistical analyses,  $p \leq 0.05$  denoted significance.

**Results:** Cementless stems had a higher all-cause aseptic femoral revision ( $p=0.002$ ) and PF rates ( $p=0.001$ ). Logistic regression confirmed that cementless stems and Dorr C bone are associated with PF ( $p<0.05$ ); collared stems and prophylactic cables did not confer additional protection against PFs. There was no difference in mortality, dislocation, and septic revision rates between groups.

**Conclusions:** Cementless stems utilized during THA for FNF have a significantly higher PF, and all-cause aseptic femoral revision rates. While PF occurred in all types of bone quality, Dorr C bone was particularly prone when using cementless stems. Cemented stems may minimize PF risk, regardless of patient and surgical characteristics.

# Artificial Intelligence More Accurately Measures Acetabular Component Orientation Than Hand Measurements

Michael Murphy, MD  
Loyola University Medical Center

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**Purpose:** Several radiological methods of measuring acetabular component anteversion and inclination after total hip arthroplasty (THA) have been described. All current methods are time consuming and have low reproducibility.

**Significance:** This study designs a program to autonomously determine cup orientation from a given radiograph and compare its accuracy to hand and CT measurements.

**Methods:** 2,945 THA patients were reviewed between 2012 and 2019, 504 of which had post-operative CT and 5,201 associated plain radiographs. 3D reconstruction was performed with Materialize Mimics, where cup orientation was measured in reference to the anterior pelvic plane and the patient's sagittal plane. An AI program was developed with 25% of patients isolated for testing to compare AI, hand, and CT measurements.

**Results:** The AI predictions averaged  $0.47 \pm 0.06$  seconds to run on an iPhone 6s. AI measurements were not statistically different from CT ( $p=.675$ ), while Hand measurements were statistically different from CT ( $p=.002$ ) and AI measurements ( $p=.013$ ). The AI algorithm identified 17 x-ray radiographs as having retroverted cups with 100% accuracy, 37.8% sensitivity, and 100.0% specificity in the unique patient series.

**Conclusion:** AI algorithms may offer timely and accurate solutions to conveniently measure cup orientation. This is the first algorithm to accurately identify retroverted cups in two-dimensional radiographs.

## Elective Joint Replacement Should be Delayed by One Month After COVID Infection to Prevent Postoperative Complications

Enrico Forlenza, MD  
Rush University Medical Center

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**Background:** It remains unclear whether a history of recent COVID-19 infection affects the outcomes and risk of complications of total joint arthroplasty (TJA). The purpose of this study was to compare the outcomes of TJA in patients with and without a recent COVID-19 infection.

**Methods:** The PearlDiver database was queried for patients undergoing total hip (THA) and total knee arthroplasty (TKA). Patients with a diagnosis of COVID-19 within 90-days preoperatively were matched to patients without a history of COVID-19 based on age, gender, Charlson Comorbidity Index (CCI), and procedure. Ninety-day complications were compared between patients with and without a diagnosis of COVID-19 at 1, 2, and 3 months preoperatively. Multivariate analysis was used to further control for potential confounders.

**Results:** A total of 31,453 patients undergoing TJA were identified, of which 616 (2.0%) had a preoperative diagnosis of COVID-19. Of these, 281 COVID-19 positive patients were matched with 277 patients without COVID-19. Multivariate analysis of the matched cohorts showed that COVID-19 infection within 1 month prior to TJA was associated with an increased rate of postoperative deep vein thrombosis (DVT, odds ratio [OR] 6.50, 95% confidence interval [CI], 1.48-28.45,  $p=0.010$ ) and venous thromboembolic events (VTE, OR 8.32, CI 2.12-34.84),  $p=0.002$ ). COVID-19 infection within 2 and 3 months prior to TJA did not significantly affect outcomes.

**Conclusion:** COVID-19 infection within 1 month prior to TJA significantly increases the risk of postoperative thromboembolic events, however complication rates returned to baseline after that time point. Surgeons should consider delaying elective THA and TKA until one month after a COVID-19 infection.

**Table 1.** Demographic comparison of patients with and without COVID-19 within 3 months prior to total joint arthroplasty

	Matched				p-value	Unmatched				p-value
	TJA, COVID+ (N, %)		TJA, NO COVID (N, %)			TJA, COVID+ (N, %)		TJA, NO COVID (N, %)		
Total	281		281		Ref	616		30837		Ref
THA	118	42.0	118	42.0	1.000	295	47.9	11670	37.8	<0.001*
<b>DEMOGRAPHICS</b>										
Age, mean, SD	65.4	8.9	65.3	8.9	1.000	66.5	10.8	66.1	9.9	<0.001*
Gender					1.000					0.389
Female	174	61.9	171	61.7		394	64.0	19174	62.2	
Plan					0.904					0.531
Commercial	180	64.1	179	63.7		381	61.9	19377	62.8	
Medicaid	12	4.3	14	5.0		33	5.4	1228	4.0	
Medicare	83	29.5	77	27.4		191	31.0	9545	31.0	
CCI					1.000					<0.001*
0	64	22.8	64	22.8		78	12.7	8342	27.1	
1	66	23.5	66	23.5		111	18.0	6889	22.3	
2	56	19.9	56	19.9		126	20.5	5143	16.7	
≥3	95	33.8	95	33.8		301	48.9	10463	33.9	
<b>COMORBIDITIES</b>										
Hypertension	147	52.3	131	46.6	0.271	357	58.0	15116	49.0	<0.001*
COPD	16	5.7	29	10.3	0.055	65	10.6	2735	8.9	0.167
CHF	0	0.0	6	2.1	0.038*	0	0.0	405	1.3	0.007*
Smoking	39	13.9	27	9.6	0.168	102	16.6	2490	8.1	<0.001*
CKD	19	6.8	15	5.3	0.626	76	12.3	2025	6.6	<0.001*
Diabetes	59	21.0	56	19.9	0.902	151	24.5	6876	22.3	0.208
Obesity	48	17.1	43	15.3	0.701	112	18.2	3966	12.9	<0.001*
Depression	36	12.8	12	4.3	<0.001*	104	16.9	2785	9.0	<0.001*
Hypothyroidism	29	10.3	27	9.6	0.933	85	13.8	2994	9.7	<0.001*
PVD	12	4.3	14	5.0	0.812	50	8.1	1634	5.3	0.002*
Coagulopathy	11	3.9	5	1.8	0.215	35	5.7	705	2.3	<0.001*
Cancer	39	13.9	44	15.7	0.585	108	17.5	3879	12.6	<0.001*
Iron deficiency anemia	17	6.0	9	3.2	0.171	44	7.1	1099	3.6	<0.001*
Liver disease	6	2.1	9	3.2	0.581	22	3.6	620	2.0	0.010*
Alcohol use	5	1.8	4	1.4	1.000	13	2.1	342	1.1	0.033*

\*indicates statistical significance of p<0.05

**Table 2.** Univariate comparison of complications within 90-days following total joint arthroplasty in patients with and without preoperative COVID-19

	Matched				p-value	Unmatched				p-value
	TJA, COVID+ (N, %)		TJA, NO COVID (N, %)			TJA, COVID+ (N, %)		TJA, NO COVID (N, %)		
Total patients	281		281		Ref	616		30837		Ref
Superficial surgical site infection	2	0.7	2	0.7	1.000	13	2.1	386	1.3	0.088
Prosthetic joint infection	4	1.4	0	0.0	0.136	6	1.0	109	0.4	0.029*
Deep vein thrombosis	6	2.1	4	1.4	0.767	16	2.6	628	2.0	0.407
Pulmonary embolism	3	1.1	0	0.0	0.252	7	1.1	289	0.9	0.767
PE	8	2.8	4	1.4	0.395	22	3.6	820	2.7	0.207
Acute kidney injury	11	3.9	7	2.5	0.492	27	4.4	1259	4.1	0.787
Cardiac arrest	3	1.1	0	0.0	0.252	3	0.5	28	0.1	0.014*
Wound disruption	4	1.4	1	0.4	0.378	12	1.9	525	1.7	0.758
Postoperative hematoma	0	0.0	1	0.4	0.994	0	0.0	224	0.7	0.059
Urve Injury	0	0.0	0	0.0	1.000	0	0.0	1	0.0	1.000
Pneumonia	9	3.2	10	3.6	0.975	27	4.4	756	2.5	0.003*
Transfusion	4	1.4	10	3.6	0.167	14	2.3	1019	3.3	0.191
Urinary tract infection	8	2.8	15	5.3	0.189	45	7.3	2210	7.2	0.958
Reoperation	11	3.9	5	1.8	0.215	20	3.2	1017	3.3	1.000
ED visit	39	13.9	53	18.8	0.119	111	18.0	5426	17.6	0.826
Re-admission	22	7.8	27	9.6	0.515	55	8.9	2839	9.2	0.868
Any complication	73	26.0	88	31.3	0.157	197	32.0	9595	31.1	0.678

\*indicates statistical significance of p<0.05

VTE, venous thromboembolic event; ED, emergency department.

**Table 3.** Univariate comparison of complications in patients diagnosed with COVID-19 at various pre-operative time points.

	1 month	%	2 months	%	3 months	%	p-value
Total, n	92		460		64		
Superficial surgical site infection	1	1.1	12	2.6	0	0.0	0.479
Periprosthetic joint infection	1	1.1	5	1.1	0	0.0	0.862
Deep vein thrombosis	5	5.4	9	2.0	2	3.1	0.078
Pulmonary embolism	3	3.3	4	0.9	0	0.0	0.153
VTE	7	7.6	13	2.8	2	3.1	0.052
Acute kidney injury	6	6.5	18	3.9	3	4.7	0.683
Cardiac arrest	1	1.1	2	0.4	0	0.0	0.802
Wound disruption	4	4.3	8	1.7	0	0.0	0.131
Postoperative hematoma	0	0.0	0	0.0	0	0.0	1.000
Nerve Injury	0	0.0	0	0.0	0	0.0	1.000
Pneumonia	1	1.1	24	5.2	2	3.1	0.148
Transfusion	1	1.1	12	2.6	1	1.6	0.793
Urinary tract infection	5	5.4	38	8.3	2	3.1	0.321
Reoperation	4	4.3	16	3.5	0	0.0	0.449
ED visit	19	20.7	80	17.4	12	18.8	0.895
Re-admission	11	12.0	38	8.3	6	9.4	0.686
Any complication	34	37.0	145	31.5	18	28.1	0.666

VTE, venous thromboembolic event; ED, emergency department.

**Table 4:** Multivariate analysis of complications following total joint arthroplasty in unmatched cohorts of patients with and without a diagnosis of COVID-19 at various pre-operative time points.

Time between COVID-19 diagnosis and TJA	1 month		2 months		3 months	
	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
Superficial surgical site infection	0.86 (0.05-3.90)	0.883	1.85 (0.45-4.96)	0.296	-	-
Periprosthetic joint infection	3.06 (0.17-14.0)	0.268	<b>4.47 (1.73-14.37)</b>	<b>0.038*</b>	-	-
Deep vein thrombosis	<b>2.75 (1.96-6.14)</b>	<b>0.029*</b>	1.59 (0.48-3.77)	0.374	1.54 (0.25-4.97)	0.548
Pulmonary embolism	<b>3.54 (1.87-9.53)</b>	<b>0.032*</b>	0.84 (0.05-3.77)	0.860	-	-
VTE	<b>2.99 (1.25-6.05)</b>	<b>0.006*</b>	1.50 (0.53-3.33)	0.376	1.17 (0.19-3.77)	0.828
Acute kidney injury	1.69 (0.65-3.60)	0.218	0.71 (0.22-1.72)	0.510	1.02 (0.24-2.86)	0.980
Cardiac arrest	-	-	-	-	-	-
Wound disruption	2.57 (0.78-6.22)	0.065	1.89 (0.58-4.52)	0.215	-	-
Postoperative hematoma	-	-	-	-	-	-
Nerve Injury	-	-	-	-	-	-
Pneumonia	0.44 (0.02-1.96)	0.409	0.30 (0.02-1.36)	0.234	1.21 (0.20-3.93)	0.797
Urinary tract infection	0.70 (0.24-1.56)	0.436	0.62 (0.24-1.30)	0.254	0.43 (0.07-1.38)	0.239
Reoperation	1.35 (0.41-3.24)	0.561	0.74 (0.18-1.98)	0.617	-	0.948
ED visit	1.19 (0.69-1.94)	0.509	0.75 (0.43-1.22)	0.269	1.07 (0.54-1.96)	0.842
Re-admission	1.32 (0.66-2.39)	0.382	0.76 (0.36-1.42)	0.428	1.02 (0.39-2.20)	0.960
Any Complication	1.19 (0.76-1.83)	0.429	0.82 (0.54-1.22)	0.336	0.86 (0.47-1.48)	0.590

- indicates insufficient data for analysis

\*indicates statistical significance of p<0.05

VTE, venous thromboembolic event; ED, emergency department.

**Table 5.** Multivariate analysis of complications following total joint arthroplasty in matched cohorts of patients with and without a diagnosis of COVID-19 at various pre-operative time points.

Time between COVID-19 diagnosis and TJA	1 month		2 months		3 months	
	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
Superficial surgical site infection	-	-	-	-	-	-
Periprosthetic joint infection	-	-	-	-	-	-
Deep vein thrombosis	<b>6.50 (1.48-28.45)</b>	<b>0.010*</b>	1.36 (0.07-9.46)	0.782	-	-
Pulmonary embolism	-	-	-	-	-	-
VTE	<b>8.32 (2.12-34.84)</b>	<b>0.002*</b>	1.36 (0.07-9.46)	0.782	-	-
Acute kidney injury	1.75 (0.26-7.54)	0.493	1.57 (0.23-6.74)	0.578	1.33 (0.7-7.85)	0.793
Cardiac arrest	-	-	-	-	-	-
Wound disruption	6.13 (0.24-156.97)	0.203	5.52 (0.22-141.12)	0.230	-	-
Postoperative hematoma	-	-	-	-	-	-
Nerve Injury	-	-	-	-	-	-
Pneumonia	-	-	-	-	0.92 (0.05-5.07)	0.938
Urinary tract infection	0.39 (0.02-1.99)	0.365	0.35 (0.02-1.78)	0.314	-	-
Reoperation	2.47 (0.34-11.87)	0.288	1.09 (0.06-6.93)	0.939	-	-
ED visit	0.88 (0.37-1.93)	0.780	0.67 (0.26-1.49)	0.361	0.84 (0.27-2.14)	0.743
Re-admission	1.13 (0.37-2.88)	0.814	0.58 (0.13-1.72)	0.384	1.03 (0.24-3.17)	0.965
Any complication	1.15 (0.58-2.18)	0.686	0.59 (0.28-1.17)	0.148	0.78 (0.31-1.76)	0.568

- indicates insufficient data for analysis

\*indicates statistical significance of p<0.05

VTE, venous thromboembolic event; ED, emergency department.

## Reduced Fracture Rate and Stem Subsidence at 6 Months with Collared Stems in Direct Anterior Cementless Total Hip Arthroplasty

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**Purpose:** We hypothesize that collared femoral stems reduce risk of intra-op and post-op periprosthetic Vancouver A<sub>L</sub> or B femur fractures and stem subsidence at 6 months compared to collarless designs in direct anterior (DAA) total hip arthroplasty (THA).

**Significance:** To date, no studies exist regarding effects of a collar on periprosthetic fracture or subsidence. Collared stems are a re-emerging trend in THA which may reduce fracture risk by both blocking subsidence and acting as a cue for sufficient stem advancement.

**Methods:** A 348 patient retrospective study of DAA THAs from 2017-2020 was done. 3 cementless hips were studied: Zimmer ML Taper, Avenir & the Avenir-Complete with collar. Incidence of intraoperative or post-operative Vancouver A<sub>L</sub> or B fractures in collared stems and non-collared stems were recorded. Radiographic subsidence was measured by 3 independent observers. Fischer-exact and chi-square tests were done to compare outcomes and groups with  $p < 0.05$  as significant.

**Results:** DAA cementless hips the collared stem had significantly fewer femur fractures compared to collarless designs (0/99 vs. 11/249) ( $p = 0.043$ ). Radiographic subsidence was significantly lower in the collared stem group ( $p < 0.001$ ).

**Conclusion:** The use of a collared stem resulted in a statistically significant drop-in rate of periprosthetic femur fractures and subsidence compared to collarless stems in DAA THA.

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

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**Purpose:** We hypothesize that those with a documented penicillin allergy can safely be given cephalosporin for preoperative prophylaxis in hip and knee arthroplasty.

**Significance:** Perioperative cefazolin administration for total joint arthroplasty is a first line antibiotic recommended by the AAOS guidelines. This will be to the first study to analyze the clinical viability of giving patients with a documented penicillin allergy a perioperative full-strength cefazolin “test dose” under anesthesia.

**Methodology:** This is a retrospective chart review of 2451 total joint arthroplasties from a high-volume fellowship trained arthroplasty orthopedic surgeon. Data collected included demographics, allergies, antibiotics administered, allergic reactions that occurred, and post-operative infections.

**Results:** Cefazolin was given to 87.1% (1996) of all patients and 42.4% (131) of patients with a penicillin allergy. Of those receiving cefazolin, 0.4% (8/1988) had an allergic reaction compared to 1.02% (3/294) of those receiving second line antibiotics. Only one patient with a document penicillin allergy who received cefazolin had an allergic reaction. The reaction was not severe and did not require any additional treatment.

**Conclusion:** This study found that utilization of a full strength “test dose” of cefazolin in patients with a document penicillin allergy is feasible, safe, and effective.

## Acetabular Cup Placement in Fluoroscopic-Aided Anterior versus Non-Image Guided Posterior Total Hip Arthroplasty

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**Purpose:** Fluoroscopic-aided direct anterior approach improves component positioning and reduces variability versus non-image guided posterior total hip arthroplasty.

**Significance:** Using the direct anterior supine intermuscular approach (DAA) in THA, the ease of utilizing fluoroscopy has enabled surgeons to monitor their component position intraoperatively. Rathod et al. showed a significant reduction in variability of acetabular cup position with a fluoroscopic-guided, DAA compared to traditional posterior approach (PA).

**Methods:** 45 cases of DAA and 41 cases of PA were compared. Measurements on 3 week postoperative AP pelvis radiograph included acetabular cup inclination, acetabular cup anteversion, change in length, and change in offset.

**Results:** In this 86-case series, there were 63 female and 23 male subjects, average age 68 years. Comparing DAA and PA cohorts, there were significant differences in cup inclination ( $p \leq 0.0001$ ; averages, 36.81 vs. 42.92 degrees) and change in offset ( $p = 0.006$ ; averages; 0.02 vs. -0.35). There was no significant difference in anteversion or length.

**Conclusion:** There were significant differences in cup inclination ( $p \leq 0.0001$ ; averages, 36.81 vs. 42.92 degrees) and change in offset ( $p = 0.006$ ; averages; 0.02 vs. -0.35) between fluoroscopic-guided DAA and PA. Furthermore, data show wider distributions, or higher variability, for all measures in PA compared to DAA cohort.

# Isolated Morbid Obesity is Not Associated with Increased Early Postoperative Complications Following Primary Total Hip Arthroplasty

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**Purpose:** To investigate the effects of isolated obesity on complications following primary total hip arthroplasty (THA)

**Significance:** Some surgeons are hesitant to perform a THA on patients with morbid obesity because of the perceived increase in postoperative complications. However, a THA can provide lasting pain relief and quality of life improvement. This study aims to investigate the effects of isolated morbid obesity on perioperative complications of THA.

**Methodology:** Patients were selected using the American College of Surgeons National Quality Improvement Program database who underwent primary THA. Patients were separated into one of three cohorts BMI (18.5-30, 40-45, or 45-50) and matched exactly based on preoperative characteristics. These cohorts were then evaluated on the incidence of 30-day complications using chi-squared tests of independence.

**Results:** Compared to the 18.5-30 group, both obese groups had a greater number of wound complications ( $p < 0.0001$ ). However, the 18.5-30 group had a greater number of total complications compared to the 40-45 group ( $p < 0.0001$ ) and a greater number of transfusions relative to both obese groups ( $p < 0.0001$ ).

**Conclusion:** This study found no significant difference in most complications relating to THA between the obese groups and the non-obese group. This research should serve to further advise patients when discussing THA.

# **Prior Authorization is Burdensome for Total Joint Arthroplasty Surgeons: A Survey of the American Association of Hip and Knee Surgeons Membership**

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**Purpose:** The purpose of this study is to survey the impact that prior authorization has on the members of the American Association of Hip and Knee Surgeons (AAHKS). We hypothesize that surgeons will indicate that prior authorization is a burden to both physician practices and patient outcomes.

**Significance:** Controversy remains regarding the cost-effectiveness and outcomes of prior authorization on practices and patient clinical outcomes.

**Methodology:** A 24-question survey was distributed to all 2802 board-certified adult reconstruction members of AAHKS in March 2022.

**Results:** There were 353 responses. A majority (71%) of practices employ staff to exclusively work on prior authorization a mean of 15 hours/week for a mean of 18 claims/week. Surgery (99%), diagnostic imaging (94%), and medications (69%) were the most common reasons for prior authorization; commonly, because conservative treatment had not been tried (71%) or for enough time (67%). A majority (57%) rarely/never changed treatment. Most (56%) indicated that prior-authorization rarely/never followed evidence-based guidelines. Prior authorization is very burdensome (93%) and negatively impacted clinical outcomes (87%) leading to care delays (96%) at least sometimes.

**Conclusions:** Prior authorization is burdensome for TJA surgeons and results in negative clinical outcomes including delaying access to care resulting in low value care.

## Lower Extremity Stress Fractures in the National Basketball Association, 2013-2014 Through 2018-2019

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**Purpose:** The purpose of this study was to provide insight on the identification, management, and risk factors associated with lower extremity stress fractures in NBA athletes.

**Significance:** Stress fractures are injuries that occur in athletes as a result of repetitive submaximal stress overloading a vulnerable bony area. Basketball players are at risk for lower extremity stress fractures due to the high intensity demand on the lower body on a regular basis.

**Methods:** A retrospective study was conducted using the NBA EMR database for all players who were on an NBA roster from the 2013-2014 through 2018-2019 seasons. Player and season demographics, and treatment methodology were analyzed.

**Results:** There were 22 stress fractures identified in 20 NBA players over 6 years, with an average of 3.67 stress fractures per year. Most stress fractures occurred in the foot (17/22). 45% (10/22) of stress fractures were treated operatively, with the most common site of operation being the navicular.

**Conclusion:** The overall incidence of stress fractures in NBA players was low and there were a high percentage of players that returned to NBA activity following injury. There was a relatively even distribution between high-risk stress fractures treated operatively and non-operatively. We found no significant difference in average time to return to play in the NBA between stress fractures treated operatively vs non-operatively.

## **Risk for Total Knee Arthroplasty Following Anterior Cruciate Ligament Reconstruction**

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**Purpose:** The purpose of this study is to define the incidence of and risk factor for total knee arthroplasty (TKA) in patient with prior anterior cruciate ligament reconstruction (ACLR).

**Significance:** ACLR is common in youth and young adult patients, but little data exists defining incidence of subsequent TKA in this population.

**METHODS:** The UK Biobank was utilized to define and compare age-specific cumulative incidence of TKA in patients with and without a history of ACLR. Cox regression modeling was utilized to calculate hazard ratios for undergoing TKA in this cohort.

**Results:** 2,517 individuals with prior ACLR were identified. Patients with prior ACLR demonstrated a cumulative incidence of 27.7% between 40 and 80 years of age. Patients with prior ACLR were 5.6x more likely to undergo TKA by age 60, when compared to individuals without prior ACLR. Body mass index  $>30 \text{ kg/m}^2$  (hazard ratio (HR) = 3.52,  $p < 0.001$ ), performing heavy physical labor (HR = 2.68  $p < 0.001$ ), and having a job that always involved walking or standing (HR = 2.50,  $p < 0.001$ ) were associated with an increased risk for undergoing TKA.

**Conclusion:** Individuals face a substantially increased risk of TKA following ACLR and may be counseled on risk factors at time of ACLR.

## Diabetic Sequelae and Ankle Fractures: Significant Associations with Postoperative Complications

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**Purpose:** We aimed to evaluate the social determinants of health (SDOH) which are associated with perioperative opiate use among lumbar spine patients.

**Significance:** Socioeconomic and environmental factors, termed SDOH, have been demonstrated to significantly impact health outcomes in spine patients. To decrease opioid utilization, these factors must be understood.

**Methodology:** This retrospective case-control study included patients undergoing spine surgery for lumbar degeneration in 2019. Preoperative opioid users (OU) were compared with opioid-naïve (ON) patients regarding SDOH including demographics like age and race, and clinical data such as activity and tobacco use. Multivariate logistic regression was used.

**Results:** Ninety-eight patients were opioid-naïve and 90 used opioids preoperatively. All OU had  $\geq 3$  months of use, had more prior spine surgeries (1.07 vs. 0.44,  $p < 0.001$ ) and more comorbidities including diabetes, hypertension, and depression ( $p = 0.021, 0.043, 0.017$ ). Unemployment [odds ratio (OR): 5.29,  $p < 0.001$ ], lower levels of activity (OR: 3.34,  $p = 0.007$ ), and community median income between \$60,000-79,999 (OR: 3.55,  $p = 0.019$ ) were risk factors for preoperative opioid use. At one year postoperatively, OU had higher rates of opiate use [72.2% vs. 15.3%,  $p < 0.001$ ].

**Conclusion:** Unemployment, low physical activity level, and low community median income were associated with preoperative opioid use and longer-term opioid use postoperatively.

# **Biplanar Reduction Influences Fracture Collapse and Immediate Post-Operative Ambulation in Intertrochanteric Hip Fractures Fixed with a Cephalomedullary Nail**

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**Purpose:** To investigate the role that quality of biplanar reduction has on fracture collapse and post-operative mobilization.

**Significance:** Although myriad studies examine the role of coronal plane reduction, few consider sagittal alignment. No other studies to our knowledge examine bi-planar reduction and its impact on collapse and postoperative mobilization.

**Methods:** Retrospectively identified low energy intertrochanteric hip fractures treated with a Cephalomedullary nail were assessed for previously described parameters of reduction, implant position, and fracture collapse. Chart review provided data on postoperative mobilization and clinical outcome.

**Results:** 139 patients with an average age of 80.0 years (SD= 9.7) sustained 52 radiographically stable and 87 unstable fractures. 31 fractures with a *good* reduction (i.e. corrected neck shaft angle >135° and Ikuta type N) slid 5.0mm (SD=3.3); 62 *acceptably* reduced fractures meeting one criterion slid 7.5mm (SD=6.1), and 44 *poorly* reduced fractures slid 7.5mm (SD=4.9,  $p=.045$ ). *Optimally* placed implants (biplanar central tip position and a tip-apex-distance<25mm) collapsed an average 6.3mm compared to 8.5mm in *sub-optimally placed implants* ( $p=.011$ ). Patients with a *good* or *acceptable* reduction were more likely to ambulate in the first three days following surgery ( $p=.026$ ).

**Conclusions:** Bi-planar reduction significantly influenced fracture collapse and mobilization in the acute post-operative period.

# Development of a Patient Decision Aid for Distal Radius Fractures in Patients Sixty-Five Years of Age and Older

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**Purpose:** The purpose of this study was to develop a patient decision aid (PDA) for the treatment of distal radius fractures (DRF) in patients  $\geq 65$ .

**Significance:** The ideal management of DRF in patients  $\geq 65$  is debated. There is evidence that many patients tolerate residual deformity with minimal functional deficit, yet there are no age-specific parameters defining indications for surgery. Acknowledging those factors and evidence that both nonoperative and operative treatment yield similar outcomes 1 year after injury, a PDA could facilitate patient engagement in the decision.

**Methods:** The DRF PDA was developed using established decision sciences framework, and included an overview of DRF, treatment options (casting versus surgery), risk/benefits, and a values clarification section. Hand surgeons and patients reviewed the PDA and completed the Decision Support Acceptability Scale (DSAS) survey. Next, semi-structured interviews were performed with participants to elicit feedback on the DRF PDA.

**Results:** 11 patients and 11 hand surgeons participated. All patients found the PDA useful and almost all stated it would make the decision easier. Most patients felt it contained enough information, but one desired more information about surgery risks. Almost all surgeons stated that the PDA would be easy for patients to use and understand, and about half felt it would help patients make an informed decision. Most surgeons expressed the PDA would complement their usual approach to counseling patients, but some noted it would involve significant changes to their workflow.

**Conclusion:** All patients expressed that the PDA was informative, comprehensive, easy to understand, and would be helpful if they were making a decision about DRF treatment. The results will be used to revise the PDA for field testing in clinics to assess the usability and efficacy.

## Dual Versus Lateral Locked Plating in Elderly Cadaveric Bicondylar Tibial Plateau Fractures: Does Medial Comminution Matter?

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**Purpose:** The purpose of this study was to compare the mechanical stability of lateral-only versus dual plating of an unstable AO/OTA 42C1/2 bicondylar tibial plateau fracture with and without medial bone loss in an osteoporotic cadaveric model.

**Significance:** Dual plating with dual incisions is the gold standard for bicondylar tibial plateau fractures. However, lateral locked plating alone has been proposed to limit surgical morbidity.

**Methods:** Ten pairs of elderly fresh frozen tibias were randomized to 4 different groups: dual versus lateral plating with and without medial bone loss. Models were first cyclically loaded equally through both tibial condyles and then loaded to failure.

**Results:** No statistically significant difference was noted for average force, axial displacement, maximal displacement, and coronal alignment changes.

**Conclusion:** Dual incisions with dual plating remain the “gold standard” for repairing bicondylar tibial plateau fracture fixation. Still, lateral plating alone may be called upon to limit surgical morbidity in specific fracture patterns.

# The Ballistic Articular Structure Injury Classification (BASIC) System: Clarifying Ballistic Articular Injuries

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**Purpose:** To devise a system for ballistic articular injuries focused on (1) simplicity and practical application, (2) reliable and reproducible, and (3) one that guides surgical decision making.

**Significance:** Ballistic trauma accounts for a growing burden to the health care system, and there is no practical classification system to guide treatment for ballistic articular fractures.

**Methods:** The BASIC system was devised to focus on the location of the bullet, and the stability and complexity of the fracture (Figures 1 and 2). 169 ballistic of the knee, hip, and shoulder were included. X-Ray and CT's were reviewed, and fractures were classified according to the AO/OTA classification and BASIC System. Interrater agreement and correlation with treatment decisions were compared between the two systems.

**Results:** There were 73 knee, 62 hip, and 34 shoulder ballistic fractures. Overall, the AO/OTA Classification had 'poor' agreement ( $k=0.373$ ) while the BASIC System had 'good' agreement ( $k=0.444$ ). The BASIC System was strongly associated with surgical treatment decisions (84% concordant), whereas the AO/OTA demonstrated no clear correlation to surgical decision making.

**Conclusion:** The BASIC System is a pragmatic system that provides guidance for treatment of ballistic injuries of the knee, hip, and shoulder. Further study is necessary to validate its reproducibility and its association with patient outcomes.

# Treatment of 4<sup>th</sup> and 5<sup>th</sup> Carpometacarpal Fracture Dislocations in Punching Injuries with Motion-Sparing Hamate Fixation Spring-Plates: “Rabbit Ears” Plating

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**Purpose:** We describe a novel plating technique that can be useful for both acute and delayed, unstable fourth and fifth carpometacarpal (CMC) fracture-dislocations in punching injuries of the hand.

**Significance:** Fourth and fifth CMC fracture-dislocations are unstable, and chronic injuries can be difficult to treat. A technique to preserve physiologic joint motion and fast return to functional hand range of motion (ROM) is valuable to the practicing orthopaedic hand surgeon.

**Methods:** A retrospective review was performed between April 2016 and March 2022 from single surgeon at a level 1 trauma center. All patients over 18 with unstable fourth and fifth CMC fracture-dislocations were included following punching injury. Reported outcomes include functional ROM, need for revision, and complications.

**Results:** A cohort of 55 cases of fourth and fifth CMC joint fracture-dislocations included were from two days to 16-weeks old. All patients had immediate return to full flexion and extension of their fingers within one-week postoperatively. Only one patient underwent revision for hardware removal. There were no subsequent arthritis or secondary need for arthrodesis in this cohort.

**Conclusion:** Dorsal plating is an effective technique with good outcomes for treating fourth and fifth CMC fracture-dislocations that preserves physiologic motion at the CMC joints.

## Comparison of Direct Surgical Cost and Outcomes for Unstable Elbow Injuries: Internal Joint Stabilizer versus External Fixation

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**Purpose:** Determine whether clinical outcome and surgical encounter total direct costs (SETDC) differ between External fixation (ExF) and Internal Joint Stabilizer (IJS) for unstable elbow injuries. Our hypothesis is IJS will have similar SETDC and improved clinical outcomes.

**Significance:** Unstable elbow injuries sometimes require ExF or and IJS to maintain joint reduction. No studies have compared the clinical outcomes and surgical costs of these treatment modalities.

**Methods:** Unstable elbow injures treated by ExF or IJS between 2010-2019 were included. Three postoperative patient reported outcome measures were collected, motion measured, and complications tallied. SETDCs were determined and compared between the two groups.

**Results:** 23 patients identified, 12 in each group. Clinical and radiographic follow-up for the IJS group averaged 24 and 6 months, respectively, and ExF group 78 and 5 months, respectively. Both groups had similar final ROM and outcome measures. IJS patients had fewer complications and required less additional surgery. SETDCs were similar between groups, but relative contributors to cost differed.

**Conclusions:** Patients treated with ExF or IJS had similar clinical outcomes, but complications and second surgeries were more likely in ExF patients. Overall SETDC was also similar for ExF and IJS, but relative contributions of the cost subcategories differed.

# Metabolic Abnormalities Underlying Nonunion in the Adult Fracture Patient

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**Purpose/Significance:** Studies suggest that patients who experience nonunion without obvious etiology should be evaluated for metabolic abnormalities. Many metabolic parameters impact fracture union and we sought to identify how they are related to fracture and nonunion characteristics. Doing so may help elucidate if metabolic relationships exist that can highlight early targeted interventions.

**Methods:** A retrospective chart review of patients diagnosed with nonunion by one orthopaedic trauma surgeon after fracture fixation was performed from 01/01/2012 – 7/31/2021. We recorded basic demographics, fracture, injury, and nonunion characteristics, along with metabolic lab data to draw statistical conclusions.

**Results:** Nonunion was diagnosed in 94 patients. The femur was most the most commonly diagnosed bone (48% of total cohort) and the distal femur, femoral shaft, and tibial shaft represented 50% of the cohort. The most common metabolic abnormalities were low hemoglobin (62.3%), elevated neutrophil percentage (61.9%), elevated ESR in women (51.8%), low testosterone (46.9%), and hypovitaminosis D (44.3%).

**Conclusion:** Our study supports current literature about nonunion most commonly involving the tibia and femur. Metabolic abnormality prevalence among nonunion patients is high among all nonunion types. With higher predicted morbidity and healthcare costs, future prospective studies are warranted to define the prevalence of metabolic abnormalities among adult nonunion patients and identify effective preventive treatments.

## Surface Pressures in Lower Extremity Splints – Minimizing Insult After Injury

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**Purpose** The purpose of this study is to determine the effect of various short leg splint application techniques on anterior ankle surface pressure in the development of iatrogenic skin pressure ulcers in lower extremity splinting.

**Significance** Poor splinting techniques are common and contribute undue pain, malreduction, skin breakdown, increased healthcare costs, and poor clinical outcomes.

**Methods** Various constructs of short-leg splints were applied to 6 limbs with an underlying pressure transducer film centered on the tibialis anterior tendon. Contact forces were analyzed with ankle position beginning in plantarflexion or neutral position with subsequent placement of padding, plaster application, and post-application padding removal encompassing clinically relevant scenarios. Percent change in peak forces at the tibialis anterior were recorded.

**Results** Forces at the anterior ankle were shown to increase over 300% when splint padding material was applied in maximum plantarflexion and then positioned in neutral dorsiflexion *with or without* plaster. Peak forces at the anterior ankle can be reduced once plaster has set by approximately 50%, regardless of initial padding position

**Conclusion** The present study quantifies clinically relevant technical pearls that can be useful in reducing risk of iatrogenic risk of skin breakdown at the anterior ankle when placing short leg splints.

## Does Disc Distraction After Cervical Total Disc Arthroplasty Impact Range of Motion and Patient Reported Outcomes?

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**Purpose:** Excess distraction in TDA diminishes both ROM and patient reported outcomes.

**Significance:** TDA has been established as an effective alternative to ACDF. There remains a paucity of literature regarding the amount of disc height distraction in TDA that can be tolerated biomechanically.

**Methods:** Retrospective review of patients who underwent TDA with lateral flexion/extension radiographs and PROMs at preoperative and final postoperative follow-up.

**Results:** Distraction <2mm was seen at 24 levels, while distraction >2mm was observed at 26 levels. <2mm distraction resulted in greater C2-C7 ROM at 6 weeks postoperatively ( $51.18 \pm 14.51^\circ$  vs  $38.32 \pm 12.10^\circ$ ,  $p = 0.022$ ) and final follow up ( $54.28 \pm 13.75^\circ$  vs  $36.23 \pm 12.31^\circ$ ,  $p = 0.004$ ), as well as a greater increase from preoperative to final postoperative time points ( $11.36 \pm 21.19^\circ$  vs  $-6.96 \pm 16.86^\circ$ ,  $p = 0.009$ ). No differences in segmental ROM. Distraction <2mm resulted in greater improvement in VAS Neck and NDI.

**Conclusion:** Patients with <2mm disc height difference had increased C2-C7 ROM at both 6 weeks and final follow-up and significantly greater improvement in VAS neck, and NDI after controlling for baseline differences. Limiting distraction to <2mm affected C2-C7 ROM, but not segmental ROM.

# **Serum Titanium Levels Remain Persistently Elevated but Urine Titanium is Undetectable in Children with Early-Onset Scoliosis (EOS) Undergoing Growth-Friendly Surgical Treatment: A Prospective Study**

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**Purpose:** Compare serum titanium levels in children with EOS treated with growth-friendly instrumentation (GFI) to age-matched controls and collect urine titanium and serial serum titanium in EOS patients. We hypothesized that EOS patients with GFI will have elevated serum titanium that persists over time with low urine titanium.

**Significance:** EOS patients with GFI are exposed to titanium early in life for an extended duration but the systemic effects are unclear. End-organ deposition of titanium and peri-implant chronic inflammation leading to osteolysis, pseudoarthrosis, and infection have been reported in adults with titanium implants.

**Methods:** Prospective case-control study. EOS patients with growing rods or VEPTR underwent urine titanium and serial serum titanium collection. Controls underwent serum titanium collection prior to fracture fixation. ANOVA and Chi-Square tests were performed.

**Results:** 20 EOS patients and 12 controls were analyzed. Mean serum titanium was significantly elevated in EOS patients compared to controls (5.4 vs. 0 ng/mL,  $p < 0.001$ ). Mean serum titanium at the second endpoint was 11 ng/mL. No EOS patients had detectable urine titanium.

**Conclusion:** EOS patients treated with GFI have elevated serum titanium levels compared to controls that persist over time with no renal excretion, raising concerns for end-organ accumulation with unknown long-term effects.

# The Impact on Families of Congenital Upper Extremity Differences

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**Purpose:** To investigate the caregiver burden of caring for a child with congenital upper extremity differences.

**Significance:** Congenital upper extremity differences often carry inherent functional limitations, aesthetic concerns, and the need for surgical treatment. It is well-established in the literature that caring for a child with disabilities can impact the patient's family.

**Methods:** Caregivers of patients enrolled in the multi-institutional Congenital Upper Limb Difference registry were contacted. Demographic information and the Impact on Family Scale (IOFS) were collected. Data were analyzed using Tukey post-hoc tests and linear regressions.

**Results:** 299 caregivers participated. Factors with significant correlation with IOFS: household income; public health insurance; bilateral involvement; syndrome association; one adult caregiver, distant vs local travel. PODCI and PROMIS demonstrated expected correlations with IOFS. The IOFS for this cohort was greater than for brachial plexus injury and cerebral palsy cohorts in the literature.

**Conclusion:** Caregivers of children with congenital upper extremity differences report a significant impact on family life that is greater than brachial plexus injury and cerebral palsy. Socioeconomic and clinical factors correlate with family impact, which represent opportunities to identify at-risk families and underscore the importance of caring for the whole family through a multidisciplinary approach.

# Does Synovial Sarcoma Grade Predict Oncologic Outcomes, and Does a Low-Grade Variant Exist

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**Purpose:** We surmised that a low-grade synovial sarcoma (SS) variant exists.

**Significance:** SSs are high-grade soft tissue sarcomas (STSs) that historically have a propensity for distant metastasis and regional lymph node spread. The current French Federation of Cancer Centers Sarcoma Group (FNCLCC) grading criteria results in only intermediate or high-grade SS tumors. We questioned whether there exists a low-grade SS variant.

**Methods:** Thirty-five cases from 2010 to 2019 were retrospectively reviewed. We used the FNCLCC grading criteria to score each tumor and re-assigned a tumor differentiation score of 2 to each tumor in order to create a theoretical Grade 1 SS tumor. Clinicopathological data were analyzed, and Kaplan-Meier assessed survival.

**Results:** Among a theoretical Grade 1 group, the OS and recurrence free survival (RFS) profiles were improved compared to Grade 2 and 3 SS, respectively ( $p=0.014$  and  $p=0.030$ ). The Grade 1 group had a 15.8% ( $n = 3$ ) metastatic rate and 80% 10-year survival.

**Conclusions:** A theoretical Grade 1 group showed improved OS and RFS vs. Grade 2 and 3 SS, with metastatic rates and long-term survival resembling the historical literature for other low-grade soft tissue sarcomas.

## Sarcopenia in Soft Tissue Sarcoma Patients

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**Purpose:** To evaluate the impact of nutritional supplementation on wound healing in soft tissue sarcoma population

**Significance:** Wound healing is particularly important for sarcoma patients who undergo neoadjuvant radiation therapy. Previous studies have demonstrated wound complications in this population approaching 35%. With this high rate of wound healing issues, identifying treatment modalities to minimize these complications is of paramount importance.

**Methods:** All soft tissue sarcoma patients undergoing mass resection at the lead author's institution received two weeks of twice daily amino acid supplementation starting in the immediate post-operative period. Primary outcome of wound healing was analyzed at all follow up appointments. The Prospective cohort group was compared with a similar historical patient cohort using the chi-square test. Secondary outcome measurements included lean body muscle mass and psoas index.

**Results:** 26% of patients in the historical cohort experienced wound complications compared to 30% in the supplemented group. ( $p=0.72$ ) Supplementation was found to be protective with regards to decreasing muscle wasting with no difference in psoas index measurements throughout the study period compared to a 20% muscle loss in the historical cohort ( $p=0.02$ ).

**Conclusion:** We observed no difference in wound healing complications between sarcoma patients who received post-operative nutritional supplementation compared to a historical cohort who were not supplemented. Patients who did not receive supplementation had a significant decline in post-operative psoas index following operative sarcoma removal.

## Pregnancy in Orthopedic Residents: Peripartum Barrier Identified

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**Purpose:** To determine the most prominent barriers to pursuing pregnancy during orthopaedic surgery residency.

**Significance:** While there are multiple barriers that may discourage women from choosing a career in orthopaedics, one area of concern is pregnancy in the midst of residency. This is important given that women are least represented of all surgical subspecialties.

**Methodology:** A 63-item survey was distributed to female orthopaedic surgeons in the US, including current residents and those who had completed training in an ACGME accredited US orthopaedic surgery training program.

**Results:** 328 women responded to the survey. The three most prominent barriers to pursuing pregnancy during orthopaedic residency included concerns about the ability to balance clinical duties and duties that come with being a new mother (67%), fear of how the resident would be viewed by those in the program (60%) and being unable to ensure optimal prenatal/postpartum care given an unpredictable schedule (38%).

**Conclusion:** The results raise concern that qualified female applicants may be deterred from orthopaedics given difficulties that come with being pregnant as a resident. If policies are created to support women who desire to have children as a resident, more females may be encouraged to pursue a career in orthopaedics.

# Bone Cutting Efficiency and Heat Generation Using a Novel Resurfacing Tool

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**Purpose:** Compare heat generation and cutting rate between a traditional fluted burr (FB) and a new fluteless resurfacing tool (RT).

**Significance:** Bone removal is a critical step in many orthopaedic procedures. Powered instrumentation can generate heat that can impede healing or induce thermal osteonecrosis.

**Methods:** Twenty metatarsals were used for analysis. With a constant operating speed, heat generation and cutting rate were evaluated for the FB and RT (80 trials). Cutting rate was calculated from displacement transducer data. Heat generation was measured using thermal imaging and imbedded thermocouples.

**Results:** At 1.0 N and 1.7 N of cutting force, the thermal osteonecrosis threshold was reached at comparable times when using the RT (10 seconds and 10 seconds) and FB (15 seconds and 10 seconds). The bone removed by the RT was on average five times greater than FB at 1.0 N and over twice as great at 1.7 N. At similar forces, the RT had significantly higher cutting rates ( $P < 0.01$ ). The FB produced higher temperatures for the same amount of bone removal ( $P < 0.01$ ).

**Conclusion:** Compared to a FB, the RT demonstrated higher bone cutting rates and lower heat generation for the same amount of bone removed.

# Elective Orthopaedic Procedures Before and During the COVID-19 Pandemic: Complications and Delays from 146,430 American Seniors

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**Purpose:** We hypothesized that American seniors experienced increased complication rates following elective orthopaedic procedures during the pandemic.

**Significance:** COVID-19 lockdown restrictions and public health mandates affected access to elective orthopaedic procedures for American seniors, but effects of these measures on patient outcomes are unclear.

**Methods:** We queried the American College of Surgeons-National Surgical Quality Improvement Program (ACS-NSQIP) database for patients over age 65 who underwent elective orthopaedic procedures in 2019 (pre-pandemic) and April to December 2020 (during the pandemic). We recorded readmission rates, reoperation, and 30-day postoperative complications. We compared pre-pandemic and pandemic groups and adjusted for baseline features with standard multivariate regression.

**Results:** We included 146,430 procedures (94,289 pre-pandemic and 52,141 pandemic). Patients during the pandemic were 5.787 times more likely to experience delayed wait times to the operating room ( $p<0.001$ ), 1.204 times more likely to be readmitted ( $p<0.001$ ), 1.454 times more likely to experience any complication ( $p<0.001$ ), and 1.439 times more likely to have any wound complication ( $p<0.001$ ) compared to pre-pandemic patients.

**Conclusion:** During the COVID-19 pandemic, American seniors experienced longer wait times and increased odds of complications after elective orthopaedic procedures than patients before the pandemic. This study informs orthopaedic surgeons about patient outcomes and implications of pandemic policies.

## Value Challenge: A Bottom-Up Approach to Minimizing Cost and Waste in Orthopaedic Surgery

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**Purpose:** This study aims to 1) investigate cost containment opportunities within orthopaedic surgery at an urban academic institution and 2) provide a framework for educating and incorporating residents into cost-savings initiatives.

**Significance:** The astronomical rise in health expenditures and medical waste in the US has widespread financial and environmental impacts. Even minor changes to minimize these costs within orthopaedics, the most frequently utilized surgical subspecialty in the US, could result in substantial cost savings.

**Methodology:** Orthopaedic surgical residents from an academic program with an urban, level I trauma center were queried during 2019-2022 regarding suggestions for cost containment opportunities. Eight responses were selected based on initial impressions of feasibility and estimated impact to undergo cost-savings analysis with respect to payments made by the hospital.

**Results:** The proposed initiatives fell into two categories: minimizing equipment waste and optimizing patient care. Eliminating unnecessary physical therapy/occupational therapy consults led to the greatest estimated cost-savings (\$3.3M per year), followed by conserving reusable drill bits (\$2.2M per year), and opting for cheaper surgical dressings (\$201K per year).

**Conclusion:** Efforts to mitigate the growing financial and environmental costs of healthcare should include encouraging and incorporating resident feedback into cost reduction strategies within their institutions

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