# FINAL PROGRAM November 5-8. 2020 Dallas, T<u>exas</u>





November 5-8, 2020 -



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# Education

#### **EDUCATIONAL ACTIVITY SCOPE**

The 30<sup>th</sup> AAHKS Annual Meeting is designed to provide practicing orthopaedic surgeons with research based, state-of-the-art information on diagnosis, surgical and non-surgical treatment options and overall management of hip and knee conditions. This educational activity includes the review of the most current scientific research study findings, faculty and participant discussions and interactive symposia. It covers multiple clinical topics such as primary and revision total hip arthroplasty, primary and revision total knee arthroplasty, non-arthroplasty, infection, complications other than infection as well as health policy. It is aimed at improving overall surgeon competence related to the care of patients with arthritis and degenerative disease.

#### **OBJECTIVES**

Upon completion of this educational activity, participants will be able to:

- Synthesize the most current research study findings in hip and knee condition management
- Evaluate various surgical and non-surgical treatment options (e.g., primary total joint arthroplasty, revision total joint arthroplasty, non-arthroplasty) in hip and knee condition management
- Assess the efficacy of new treatment options through evidence-based data
- Interpret relevant healthcare policy



#### **ACCREDITATION AND CME CREDIT**

The American Association of Hip and Knee Surgeons (AAHKS) is accredited by the Accreditation Council for Continuing Medical

Education (ACCME) to provide continuing medical education for physicians.

The American Association of Hip and Knee Surgeons (AAHKS) designates this live activity for a maximum of *18 AMA PRA Category 1 Credits*<sup>™</sup>. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

#### **CLAIM CME CREDITS**

Once the meeting concludes, AAHKS will send an **email and an app notification** with a link to the Annual Meeting evaluation. At the end of the evaluation, you will be redirected to claim CME credit. It is the meeting attendee's responsibility to claim credits based on the hour-for-hour participation actually spent in the educational activity.

#### DISCLAIMER

The material presented at this Annual Meeting has been made available by AAHKS for educational purposes only. This material is not intended to represent the only, nor necessarily the best methods or procedures appropriate for the medical situations discussed; but rather, is intended to present an approach, view, statement or opinion of the faculty, which may be helpful to others who face similar situations. AAHKS disclaims any and all liability for injury or other damages resulting to any individual attending a course and for all claims, which may arise out of the use of the techniques, demonstrated there in by such individuals, whether these claims shall be asserted by a physician or any other person.

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For their generous educational grants that make the Annual Meeting possible.

# Education

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#### Costs of Unicompartmental Knee Arthroplasty Compared to Total Knee Arthroplasty Over 10 Years

**Robert A. Burnett, MD**, JaeWon Yang, BA, Craig J. Della Valle, MD, Charles P. Hannon, MD, P. Maxwell Courtney, MD, Elizabeth B. Terhune, MD

**Introduction:** Unicompartmental knee arthroplasty (UKA) has been shown to be an effective procedure for endstage arthritis of the medial or lateral compartments, but concerns exist regarding higher rates of revision compared to total knee arthroplasty (TKA). The purpose of this study is to compare outcomes, revision rates, and longitudinal healthcare costs for patients undergoing UKA and TKA.

**Methods:** The Humana database was utilized to compare 2383 patients undergoing UKA from 2007-2016 who were matched 1:1 from a cohort of 63,036 primary TKA patients based on demographics and comorbidities. Medical and surgical complications were tracked longitudinally for one year following surgery. Rates of revision surgery and total related health care claims costs per patient were recorded out to 10 years postoperatively and compared between the groups.

**Results:** Revision rates were higher for UKA at 5 years (6.0% vs. 4.2%, p=0.007) and 10 years following the index surgery (6.5% vs. 4.4%, p=0.002). TKA patients had higher rates of arthrofibrosis requiring manipulation (3.9% vs. 0.9%, p<0.001), deep vein thrombosis (5.0% vs. 3.1%, p<0.001), pulmonary embolism (1.5% vs. 0.8%, p=0.001) and renal failure (4.2% vs. 2.2%, p<0.001). Longitudinal related health care costs for patients undergoing TKA were greater than those undergoing UKA at one year (\$24,771 vs. \$22,071, p<0.001) and 5 years following surgery (\$26,549 vs. \$25,730, p<0.001); however, average costs of UKA and TKA patients were comparable at 10 years (\$26,877 vs. \$26,891, p=0.425).

**Conclusions:** Despite higher revision rates, UKA patients had lower average related healthcare costs than TKA patients up to 10 years following the index procedure, at which point costs were comparable between the groups. In the era of value-based care, patients, surgeons, and policymakers should be aware of cost-effectiveness when deciding between these two procedures.



#### Despite Equivalent Medicare Reimbursement, Facility Costs for Outpatient TKA Are Higher than UKA

**Emanuele Chisari, MD**, Michael Yayac, MD, Chad A. Krueger, MD, Jess H. Lonner, MD, P. Maxwell Courtney, MD

**Introduction:** With the recent removal of total knee arthroplasty (TKA) from the Centers for Medicare and Medicaid Services (CMS) Inpatient Only (IPO) list, facility reimbursement for outpatient TKA now falls under the Outpatient Prospective Payment System (OPPS) at the same rate as unicompartmental knee arthroplasty (UKA). The purpose of this study was to compare true facility costs of patients undergoing outpatient TKA with those undergoing UKA.

**Methods:** We reviewed a consecutive series of 2,310 outpatient TKA and 231 UKA patients from 2015-2019 performed by 31 surgeons at two hospitals within our institution. Outpatient status was determined if the hospital stay was less than two midnights. Facility costs were calculated using a time-driven activity-based costing (TDABC) algorithm. Implant costs, supplies, medications, and personnel costs were compared between outpatient TKA and UKA patients. A multivariate analysis was performed to control for confounding medical and demographic variables.

**Results:** When compared to patients undergoing UKA, outpatient TKA patients had higher mean implant costs (\$3,403 vs. \$3,081, p<0.001) and overall hospital costs (\$6,350 vs. \$5,594, p<0.001). Outpatient TKA patients had a greater length of stay (1.2 vs 0.5 days, p<0.001) and greater postoperative personnel costs (\$783 vs \$166, p<0.001) than UKA patients. TKA patients did have higher body mass index and older age when compared to UKA patients (p<0.05). When controlling for comorbidities, outpatient TKA was associated with an \$803 (95% CI: \$641-\$966, p<0.001) increase in overall facility costs compared to UKA.

**Conclusions:** Despite outpatient TKA now being reimbursed from CMS at the same rate as UKA, TKA has increased facility costs to the hospital. While implant costs can vary greatly by institution, CMS should consider appropriately reimbursing outpatient TKA for the additional personnel costs due to a longer length of hospital stay when compared to UKA.



#### Prior Knee Arthroscopy Increases the Failure Rate of Subsequent Unicompartmental Knee Arthroplasty

**Safa C. Fassihi, MD**, Alex Gu, MD, Lauren Wessel, MD, Savyasachi C. Thakkar, MD, Ryan M. Nunley, MD, Peter K. Sculco, MD, Michael P. Ast, MD

**Introduction:** In selected patients with early knee osteoarthritis, knee arthroscopy may be performed to delay arthroplasty, treat symptomatic mechanical pathology, and assess the knee compartments. The purpose of this study was to determine if knee arthroscopy within two years prior to UKA is associated with an increased rate of UKA failure.

**Methods:** Data from 2007-2017 was collected from a large national database. Patients who underwent knee arthroscopy within two years prior to UKA were identified and propensity matched with controls based on age, sex, Charlson Comorbidity Index, smoking status, and obesity. Rates of failure for various causes, as well as rates of conversion to TKA, were compared between cohorts.

**Results:** Prior to propensity matching, 8,353 patients underwent UKA and met criteria for inclusion. Of these, 1,112 patients (13.3%) underwent knee arthroscopy within two years prior to UKA. Following propensity matching, 2,158 patients were included. Among these, 1,079 (50.0%) patients had knee arthroscopy within two years prior to UKA and 1,079 (50.0%) did not. All subjects were successfully matched, and no differences existed among cohorts. The knee arthroscopy cohort was significantly more likely to require conversion to TKA within two years of UKA when compared to the control cohort (10.4% vs. 4.9%; p<0.001). In addition, the knee arthroscopy cohort was significantly more likely to the control cohort (2.4% vs. 1.1%; p=0.044).

**Conclusions:** Knee arthroscopy within two years prior to UKA is associated with significant increases in subsequent conversion of UKA to TKA and revision of UKA due to aseptic loosening. Clinicians should be mindful of these risks when electing to perform knee arthroscopy in patients who may be indicated for future UKA. Additionally, patients who have undergone prior arthroscopy and are indicated for UKA should be counseled that they may be at increased risk for failure following arthroplasty.



# Is Conversion TKA a Primary or a Revision? Complication Risks Approximate Revision TKA

Matthew Sloan, MD, Gwo-Chin Lee, MD

**Introduction:** Conversion total knee arthroplasty (convTKA) is associated with increased resource utilization and costs compared to primary TKA. The purpose of this study is to compare 1) surgical time, 2) complications, 3) hospitalization length (LOS), 4) surgical site infection, and 5) readmissions/reoperations in patients undergoing convTKA to both primary TKA and revision TKA patients.

**Methods:** The American College of Surgeons National Surgical Quality Improvement Project (ACS-NSQIP) database was queried from 2008-2018. Patients undergoing convTKA (n=1,666, 0.5%) were defined by selecting those with CPT codes 27447 (TKA) and 20680 (removal of deep implant). Patients were excluded if they carried the diagnosis codes for fracture, tumor, or non-elective surgery. We compared the outcomes of interest to patients undergoing primary TKA (CPT 27447) (n=348,624) and to patients undergoing aseptic revision TKA (CPT 27487, excluding infection and fracture) (n=8,213). Univariate and multivariate logistic regression was performed to identify the relative risk of postoperative complications among these 3 patient groups.

**Results:** Compared to patients undergoing primary TKA, convTKA patients were younger (p<0.001), had lower BMI (p<0.001), and were less likely to be ASA class III/IV (p<0.001). Notwithstanding, these patients had significantly longer operative times (122.6 vs. 90.3 min, p<0.001), increased LOS (p<0.001), increased risks for any complication (OR 1.94), surgical site infection (OR 1.84), reoperation (OR 2.18) and readmissions (OR 1.60) after controlling for confounders. Compared to aseptic revision TKA patients, operative times were shorter (122.6 vs. 148.2 min, p< 0.001), but LOS (2.91 vs. 2.95 days, p=0.698) was similar. Furthermore, adjusted relative risk for any complication (p=0.350), surgical site infection (p=0.964), reoperation (p=0.296), and readmissions (p=0.844) did not significantly differ.

**Conclusions:** Conversion TKA procedures share more similarities with revision TKA rather than primary TKA procedures. Without a distinct procedural code and DRG, there are financial disincentives to care for these complex patients.



#### Allergies and Preoperative Narcotic Use Predict Failed Same-Day Discharge After Joint Replacement

Elizabeth G. Lieberman, MD, Charles M. Lawrie, MD, Ryan M. Nunley, MD, John C. Clohisy, MD

**Introduction:** Identification of predictors of failure of sameday discharge (SDD) is critical for selecting appropriate candidates. In this study, we evaluated patient factors associated with failure of SDD in patients undergoing elective primary total joint arthroplasty (TJA) in a hospital setting.

**Methods:** We performed a retrospective review of all consecutive patients who underwent primary total knee arthroplasty (TKA) and total hip arthroplasty (THA) at a multi-specialty hospital between January 2018 and February 2020 by one of three surgeons. All preoperatively designated Same Day Rapid Discharge Protocol (SDRP) patients were included. Patient demographics, co-morbidities, and clinical data were collected. Analysis was performed to assess risk factors for failed SDD.

**Results:** Of the 2,615 TJA (1,425 TKA, 1,190 THA) performed over the study period, 271 were SDRP patients (80 TKA, 191 THA). SDRP designation was lower for TKA than THA (5.6% vs. 16.1%, p<0.001). Overall, 45 patients failed SDRP (16.6%). The failure rate was similar in TKA and THA (18.8%, 15.7%, p=0.54). The most common reasons for failure of SDRP were hypotension (11, 24.4%), long-acting spinal anesthetic (11, 24.4%) and nausea (5, 11.1%). Greater than 2 self-reported drug allergies (OR 3.9) and preoperative narcotic use (OR 2.3) were associated with failure of SDRP. Age, gender, BMI, ASA class, and prior TJA were not significantly associated with failure of SDRP (p>0.05).

**Conclusions:** Success of SDD after primary THA and TKA with protocolized patient selection in a hospital setting was greater than 80%. Hypotension, long-acting spinal anesthetic and nausea accounted for 60% of failures of SDD. Patients who had more than 2 self-reported drug allergies or used preoperative narcotics were at high risk for failure of a planned SDD after primary THA or TKA.



# Same-Day Discharge Total Hip Arthroplasty: Rate and Timing of Complications and Catastrophic Events

Nithin C. Reddy, MD, Heather A. Prentice, PhD, Liz W. Paxton, PhD, Ronald A. Navarro, MD, Adrian D. Hinman, MD

**Introduction:** Same-day discharge (SDD) total hip arthroplasty (THA) has grown in utilization, though concerns exist regarding early post-discharge complications and catastrophic events. We sought to compare the risk of complications and catastrophic events for SDD and inpatient stay after THA.

Methods: A large US healthcare system's total joint replacement registry was used to conduct a cohort study. Primary elective unilateral THA were identified (2017-2018). The exposure of interest was in-hospital length of stay: SDD vs. 1-4-night inpatient stay. Propensity score-weighted Cox proportional hazards regression was used to evaluate risk for 90-day incident events, including; cardiac complication (defined as atrial fibrillation, heart failure, myocardial infarction, or ventricular fibrillation), deep infection, venous thromboembolism (VTE), emergency department (ED) visit, unplanned readmission, and mortality. Propensity scores were calculated using multivariable logistic regression and included age, sex, race/ethnicity, body mass index, smoking status, ASA, medical comorbidities, anesthetic technique, surgical approach, fixation, head size, and bearing surface.

**Results:** The study sample comprised 13,982 THA, 6033 (43.4%) SDD. Median days-to-events for SDD vs. inpatient was 38 vs. 14 for cardiac complication, 28 vs. 26 for deep infection, 13 vs. 21 for VTE, 11 vs. 13 for ED, 23 vs. 19.5 for readmission, and 7 vs. 28 for mortality. In propensity score-weighted models, SDD THA had a lower risk for 90-day cardiac complication (HR=0.57, 95% CI=0.45-0.72), ED visit (HR=0.81, 95% CI=0.71-0.92), and unplanned readmission (HR=0.73, 95% CI=0.59-0.89), compared to inpatient stay THA. No difference was observed for deep infection (HR=1.33, 95% CI=0.74-2.38), VTE (HR=0.78, 95% CI=0.48-1.28), and mortality (HR=0.84, 95% CI=0.29-2.43).

**Conclusions:** We observed a lower or similar risk for complications or catastrophic events for SDD THA compared to an inpatient stay. Catastrophic events were more likely to occur early in the 90-day period, but an inpatient stay did not preclude this risk or improve outcomes



# Successful Outcomes of 1,200 Outpatient Total Hip and Knee Arthroplasties in a Community Hospital

Curtis T. Adams, MD, JD, Casey M. O'Connor, MD, Afshin A. Anoushiravani, MD, Frank Congiusta, MD, Joseph R. Young, MD

**Introduction:** Same-day discharge (SDD) total joint arthroplasty (TJA) is increasingly performed in ambulatory surgery centers and in hospital settings. Despite the popularity of outpatient TJA, there remain concerns regarding patient safety, complication rates, and unforeseen overnight admission (failure to launch [FTL]). We examined a large consecutive SDD-TJA series with the aim of critically evaluating if SDD-TJA can be safely performed in a community hospital setting.

**Methods:** We retrospectively reviewed 1,200 consecutive SDD-TJA candidates between March 2017 and December 2019 by five surgeons at a community hospital. Patient demographics, comorbidities, perioperative data including anesthesia type, perioperative complications, and postoperative unplanned care were recorded and analyzed for outcomes and trends.

**Results:** 1,200 patients participated in the SDD program (582 THA, 618 TKA), representing 21% of 4,705 TJAs performed during this period at the community hospital. Mean patient age was 62.1 years, with 595 females and 604 males. Spinal anesthesia was more common than general anesthesia (1,087 vs. 113). There were 85 FTLs (7.1%), 58.8% female, with a mean age of 62.4. General anesthesia increased the risk of FTL (OR 2.93). Complications resulting in FTL included block-induced neuropraxia (32.1%), orthostatic hypotension (26.1%), urinary retention (19.0%), and nausea (13.1%). 16 patients were readmitted within 30 days (1.3%). 6 patients had return to the operating room: 4 for periprosthetic fracture, 1 for wound dehiscence, and 1 for superficial surgical site infection.

**Conclusions:** Outpatient TJA may be performed safely in a community hospital setting, with outcomes comparable to published inpatient reports. General anesthesia increases risk of FTL and should be avoided if possible. In-hospital SDD programs may provide a safe alternative to ambulatory surgery centers for young surgeons beginning careers or older surgeons wishing to gain experience in SDD-TJA while retaining overnight admission as a safety net for their patients.



#### Increased Complication Rates in Octogenarians Undergoing Same-Day Discharge Following TKA

Peter Z. Berger, BS, Alex Gu, MD, Safa C. Fassihi, MD, Seth N. Stake, MD, Patawut Bovonratwet, MD, Joshua C. Campbell, MD, Savyasachi C. Thakkar, MD

**Introduction:** Same-day discharge pathways in total knee arthroplasty (TKA) are gaining popularity as a means to increase patient satisfaction and reduce overall costs, but these pathways have not been thoroughly evaluated in potentially at-risk populations, such as patients ≥80 years old. The purpose of this study was to compare 90-day complications and mortality following same-day discharge after primary TKA in patients ≥80 years old and those <80 years old.

Methods: Patients who underwent unilateral TKA, were discharged on postoperative day 0, and had a minimum 90-day follow-up were identified in a national insurance claims database (PearlDiver Technologies) using CPT code 27447. These patients were stratified into two cohorts based upon age: 1) non-octogenarians (<80 years old) and 2) octogenarians (≥80 years old). These cohorts were propensity matched based upon sex, Charlson Comorbidity Index, and obesity status. Univariate analysis was performed to determine differences in 90-day complications and mortality between the two cohorts.

**Results:** In total, 1,111 patients were included in each cohort. Both cohorts were successfully matched, with no observed differences in matched parameters for demographics or comorbidities. There was no significant difference in 90-day mortality between the two cohorts (p=0.896). However, octogenarians were at significantly increased risk of postoperative atrial fibrillation (20.8% vs. 10.4%; p<0.001), non-atrial fibrillation arrhythmias (8.4% vs. 5.6%; p=0.009), pneumonia (4.5% vs. 2.2%; p=0.002), stroke (3.1% vs. 1.7%; p=0.037), heart failure (10.5% vs. 7.5%; p=0.012), and urinary tract infection (14.3% vs 9.4%; p<0.001) compared to the non-octogenarian cohort.

**Conclusions:** Relative to matched controls, octogenarians were at significantly increased risk of numerous 90-day medical complications following same-day primary TKA, including cardiopulmonary complications, stroke, and urinary tract infection. Clinicians should be cognizant of these complications and counsel patients appropriately when electing to perform same-day TKA in the octogenarian population.



# Symposium I

# Outpatient Total Joint Arthroplasty: The New Reality – From Experience to Safety and Economics, A Practical Primer to Ensure Success

**Faculty:** Michael P. Ast, MD, Craig J. Della Valle, MD, William A. Jiranek, MD, FACS, Raymond H. Kim, MD

Ambulatory surgery centers (ASC) may now be needed to become the preferred setting for safe, elective total joint arthroplasty in the post-COVID-19 era. This dramatic shift away from the classic hospital model that has and will be necessary for increased capacity for the medically ill will challenge surgeons, administrators, and patients alike in the search for a safe haven to administer pinnacle care. Strategic partnerships with classical medical/non-medical industry, payors, or hospitals are now being tested to help ensure patient optimization, economic success, and predictable outcomes. This symposium will explore the successes seen by early innovators to help us all transition to outpatient total joint arthroplasty. The faculty will engage and challenge each other while discussing patient safety, appropriate discharge planning, relationship building, and predictable outcomes with financial success in mind.

#### Learning Objectives:

- **1.** To understand the data supporting outpatient hip and knee arthroplasty.
- 2. To understand strategic partnerships with your hospital and ASCs, including the business and legal issues related to ASCs that may impact implementation and execution.
- **3.** To understand the critical teamwork and coordination anesthesia, medical and surgical teams to execute protocols that enable top level patient satisfaction and outcomes in outpatient TJA.

#### **Outline:**

Introduction Craig J. Della Valle, MD

Data Supporting Outpatient TJA Craig J. Della Valle, MD

ASCs Are the Location for Majority of TJA in the Future? Business and Legal Aspects Michael P. Ast, MD

Aligning with Your Hospital for Outpatient TJA William A. Jiranek, MD, FACS

#### Teams are Critical to Outpatient Success: Anesthesia, Medical and Surgical

Raymond H. Kim, MD

**Discussion** All Faculty

# Symposium II

#### Multimodal Anesthesia & Analgesia in Total Hip and Total Knee Arthroplasty: Where Do We Stand in 2020? A Collaborative Clinical Practice Guideline

**Faculty:** Matthew S. Austin, MD, Yale A. Fillingham, MD, William G. Hamilton, MD, J. Bohannon Mason, MD, Mark J. Spangehl, MD

Effective pain control after total joint arthroplasty (TJA) has been shown to improve outcomes including faster recovery, lower complication rates, reduced costs of care, and improved patient satisfaction. There are many anesthetic and analgesic options to control pain after TJA. Historically, opioids were a cornerstone of controlling pain after TJA. However, opioids have substantial side effects and risks including dependence, which has led to the opioid epidemic the United States is fighting today. Multimodal analgesic regimens in TJA have garnered substantial interest because they limit the use of opioids perioperatively; yet, today there is no consensus regarding the optimal anesthesia and anesthetic regimen for TJA that maximizes postoperative pain control while minimizing the risks associated with prescribing opioids. This symposium will present and discuss the findings of the Anesthesia & Analgesia in Total Joint Arthroplasty Clinical Practice Guidelines, which is a collaboration between the American Association of Hip and Knee Surgeons, American Academy of Orthopaedic Surgeons, American Society of Regional Anesthesia and Pain Medicine, and the Hip and Knee Societies. This will be the second of a two-part series presenting the findings on injectable medications including corticosteroids, ketamine, periarticular injections, and regional blocks of the hip and knee. We will discuss the current evidence for each of the analgesic methods and address current controversies such as intravenous steroids in diabetic patients, critical components of a periarticular injection, and should both hip and knee arthroplasty patients get a peripheral block..

#### Learning Objectives:

- 1. To discuss the current controversies and the current evidence on the use of corticosteroids and ketamine for the treatment of pain during and after total hip and total knee arthroplasty.
- 2. To understand the current evidence for periarticular injections and the components utilized in the "cocktail" during total hip and total knee arthroplasty.
- **3.** To understand the utility of peripheral blocks in total hip and total knee arthroplasty while recognizing the potential pitfalls of motor blockade from specific peripheral blocks.

#### **Outline:**

Introduction William G. Hamilton, MD

Intravenous Corticosteroids and Ketamine: Should These Medications Be Universally Administered to Hip and Knee Arthroplasty Patients? J. Bohannon Mason, MD

Periarticular Injections: How Effective Are They and Which Medication Should We Use? Mark J. Spangehl, MD

**Hip Peripheral Blocks: What Is the Value of a Peripheral Hip Block; Should Everyone Get a Peripheral Block?** Yale A. Fillingham, MD

Knee Peripheral Blocks: What Peripheral Knee Block Balances Pain Control and Motor Function? Matthew S. Austin, MD

**Discussion** All Faculty

#### Elevated Fructosamine Levels Are Associated with Increased Risk for PJI

**Noam Shohat, MD**, Karan Goswami, MD, D'Andrew Gursay, BS, Leigham Breckenridge, BS, Ran Schwarzkopf, MD, MSc, Javad Parvizi, MD, FRCS

**Introduction:** Based on a recent study, fructosamine was shown to have a promising role in predicting adverse outcomes following total knee arthroplasty. The purpose of this study was to assess the utility of fructosamine in predicting adverse outcome in general, and periprosthetic joint infection (PJI) in particular, following total hip arthroplasty (THA).

**Methods:** A prospective multi-institutional study was conducted. All primary THA were evaluated for glycemic control using fructosamine and HbA1c levels prior to surgery. Adverse outcomes were assessed at a minimum of 1 year from surgery. The primary outcome of interest was PJI, defined per the 2018 criteria. Based on previous studies on the subject, a fructosamine level above 293 µmol/L was used to define inadequate glycemic control and as a predictor for adverse outcomes. Univariate and multivariate regression were conducted to evaluate the association between preoperative fructosamine levels and the development of adverse outcomes and PJI.

**Results:** Overall 960 patients participated in the present study and were available for follow-up at a minimum 1 year from surgery. Of these, 3.5% (34/960) exhibited inadequate glycemic control based on fructosamine values and these patients were 6.8 times more likely to develop PJI compared to patients who were well controlled (8.8% vs. 1.3%, p=0.014). The association between high fructosamine levels and increased risk for PJI remained significant after adjusting for age, comorbidities and preoperative HbA1c levels in a regression analysis (adjusted OR 5.04, 95%CI 1.2-21.1).

**Conclusions:** Fructosamine is a good proxy for glycemic control and elevated levels correlate with the risk for subsequent PJI in patients undergoing THA. A strong consideration should be given to the use of fructosamine as a glycemia screening tool in patients undergoing surgery.



#### Do TJA PJI Organism Profiles Change with Vancomycin Powder and Dilute Povidone-iodine Lavage?

Daniel B. Buchalter, MD, Greg M. Teo, MD, David J. Kirby, MD, Ran Schwarzkopf, MD, MSc, Vinay K. Aggarwal, MD, **William J. Long, MD, FRCSC** 

**Introduction:** Vancomycin powder and dilute povidoneiodine lavage (VIP) is associated with a reduction in periprosthetic joint infections (PJIs) following total joint arthroplasty (TJA). However, it is unknown if VIP negatively affects the organism profile of PJIs by increasing rates of resistant pathogens. This study evaluates the organism profiles of PJIs before and after the implementation of a VIP protocol for all primary TJAs at our institution.

**Methods:** We retrospectively reviewed a database of 18,299 primary TJAs at a metropolitan, single-specialty orthopaedic hospital to identify patients with PJI. Criteria used for diagnosis of PJI were the Musculoskeletal Infection Society guidelines. Demographics, overall organism incidence (n/TJAs), and relative organism incidence (n/PJIs) were compared before and after the implementation of a VIP protocol at our institution.

**Results:** Following the introduction of VIP, the overall and relative incidence of coagulase-negative staphylococcal TJA PJIs significantly decreased (overall: 0.20% to 0.04%, p=0.004; relative: 25.00% to 8.45%, p=0.031). In response, the relative incidence of MSSA TJA PJIs significantly increased (relative: 18.75% to 40.85%, p=0.042). Broken down by arthroplasty type, VIP was associated with a significantly lower overall incidence of coagulase-negative staphylococcal total knee arthroplasty (TKA) PJIs (overall: 0.27% to 0.06%, p=0.015), a significantly lower overall incidence of MRSA TKA PJIs (overall: 0.18% to 0.03%, p=0.031), and a nonsignificant trend towards a lower overall incidence of gram-negative TKA PJIs (overall: 0.18% to 0.04%, p=0.059). No organism profile changes were found in total hip arthroplasty PJIs.

**Conclusions:** VIP is not associated with more difficult to treat primary TJA PJIs. In fact, VIP is associated with significantly fewer coagulase-negative staphylococcal TJA PJIs, significantly fewer MRSA TKA PJIs, and a strong trend towards fewer gram-negative TKA PJIs. While promising, these findings require a prospective randomized controlled trial for confirmation.



# Acute Postoperative Infections after Total Knee Arthroplasties: ESR, CRP, and Aspiration Thresholds

**Mason E. Uvodich, MD**, Evan M. Dugdale, MD, Douglas R. Osmon, MD, Mark W. Pagnano, MD, Daniel J. Berry, MD, Matthew P. Abdel, MD

**Introduction:** Diagnosing acute postoperative periprosthetic joint infections (PJIs) after primary total knee arthroplasties (TKAs) remains difficult. Published diagnostic thresholds for ESR, CRP, and synovial fluid analysis have not been replicated. We aimed to validate the optimal cutoffs for detecting acute postoperative PJIs in a large series of primary TKAs.

**Methods:** We retrospectively identified 27,066 primary TKAs performed between 2000-2019. Within 12 weeks, 171 knees (170 patients) had a synovial fluid aspiration. Patients were divided into two groups: evaluation <6 weeks or 6-12 weeks. The 2011 MSIS criteria for PJI diagnosed infection in 22 knees. Included knees had a mean 4.5 years follow-up after the index surgery. Mann-Whitney U tests compared medians; ROC analyses determined optimal thresholds.

**Results:** Within 6 weeks, CRP (101 mg/L vs. 35 mg/L; p=0.01), synovial WBCs (58,295 cells/µL vs. 2121 cells/  $\mu$ L; p≤0.001), and synovial neutrophils (%PMNs) (91% vs. 71% p<0.001) were significantly higher in infected TKAs. ESR did not differ between groups at <6 weeks. Between 6-12 weeks, CRP (85 mg/L vs. 6 mg/L; p<0.001), ESR (33 mm/h vs. 15 mm/h; p=0.015), synovial WBCs (62,247 cells/µL vs. 596 cells/µL; p<0.001), and %PMNs (93% v. 54%; p<0.001) were significantly higher in infected TKAs. Optimal thresholds at <6 weeks were: CRP ≥81 mg/L (sensitivity 80%, specificity 77%), synovial WBCs ≥8515 cells/µL (sensitivity 92%, specificity 90%), and %PMNs ≥86% (sensitivity 92%, specificity 72%). Between 6-12 weeks, thresholds were: CRP  $\geq$  32 mg/L (sensitivity 100%, specificity 93%), synovial WBCs ≥7450 cells/µL (sensitivity 80%, specificity 98%), and %PMNs ≥84% (sensitivity 80%, specificity 89%).

**Conclusions:** Acute PJI after TKA should be suspected within 6 weeks if CRP is  $\geq$ 81 mg/L, synovial WBCs are  $\geq$ 8500 cells/µL, and/or %PMNs  $\geq$ 86%. Between 6-12 weeks, concerning thresholds include a CRP  $\geq$ 32 mg/L, synovial WBC  $\geq$ 7450, and %PMNs  $\geq$ 84%.



#### Closed Incision Negative Pressure Therapy in Revision Knee Arthroplasty: A Randomized Clinical Trial

**Carlos A. Higuera, MD**, Yeni Nieves-Malloure, BS, Herbert J. Cooper, MD, Michael B. Cross, MD, George N. Guild, MD, Denis Nam, MD, MSc, Michael Nett, MD, Giles R. Scuderi, MD, Fred D. Cushner, MD, Ronald Silverman, MD

**Introduction:** Surgical site complications (SSC) are pervasive among high-risk revision total knee arthroplasty (rTKA). This multicenter, randomized, clinical trial compared the 90-day 1) incidence of SSCs, 2) health care utilization (number of dressing changes, readmission, and reoperation), and 3) patient-reported outcomes (PRO) in high-risk rTKA patients with postoperative closed incision negative pressure wound therapy (ciNPT) versus a standard of care (SOC) silver-impregnated occlusive dressing.

Methods: 294 rTKA patients (15 centers) at high-risk for wound complications were prospectively randomized to SOC or ciNPT (n=147 each) and stratified by revision type (aseptic vs. septic). The ciNPT system was adjusted at 125 mmHg of suction. Treatment duration was ≥5 days and outcomes were assessed until 90 days after surgery. SSC rates were assessed using intention to treat (ITT) and modified intention to treat analyses. Healthcare utilization and PRO were assessed solely on an ITT basis.

Results: A total of 242 patients completed the followup (ciNPT: n=124 [84.4%]; SOC: n=118 [80.3%]). Demographics, baseline comorbidities, causes of revision, and duration of treatment were similar between cohorts (p>0.05). ITT analysis demonstrated lower SSC rates with ciNPT vs. SOC (3.4% [5/147] vs. 14.3% [21/147]; OR: 0.22; 95%CI [0.08, 0.59]; p=0.0013). Similar outcomes were obtained with the modified ITT analysis (ciNPT: 4% (5/125) vs. SOC: 16.4% (21/128); OR: 0.22, 95%CI [0.08, 0.59]; p=0.0013). The ciNPT cohort exhibited lower readmission rates (3.4% [5/147] vs. 10.2% [15/147]; p=0.0208), and number of dressing changes  $(1.1\pm0.29 \text{ vs.})$  $1.3\pm0.96$ ; p=0.0003). There were no significant differences in postoperative improvement of Knee Injury and Osteoarthritis Outcome Score subtypes nor the PROMIS global-10 mental and physical health scores (p>0.05 for all).

**Conclusions:** ciNPT mitigates 90-day SSC and readmission rates among high-risk rTKA patients. The lower frequency of dressing changes within the ciNPT cohort may provide added value for healthcare utilization without compromising pain and function.

| NOTES |      |      |
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#### In-Vitro Analysis of Anti-Biofilm Effect of Intraoperative Irrigation Solutions

Ajay Premkumar, MD, MPH, Sita N. Nishtala, PhD, Mathias P.G. Bostrom, MD, Alberto V. Carli, MD, FRCSC

**Introduction:** A diverse array of antibacterial solutions are utilized by orthopaedic surgeons in an attempt to disperse bacterial biofilm. These solutions vary significantly in their cost and toxicity profile. To date, there are very few studies that compare these agents against biofilm grown on clinically relevant orthopaedic surfaces. This study examined in-vitro effect of commercially available intraoperative antibacterial solutions against biofilm-based Methicllin-sensitive Staphylococcus aureus (MSSA) growing on plastic, cement and porous titanium.

Methods: MSSA derived from a clinical isolate (Xen36, Perkin Elmer) was utilized. Three clinically relevant materials were chosen to establish biofilm: plastic Falcon® 48-well plates, PMMA cement beads (SimplexTM P; Stryker) and grit blasted Ti-6Al-4V acetabular screw caps (G7®: Zimmer-Biomet). Antibacterial solutions included: isotonic saline, vancomycin (1mg/mL), diluted polymyxin-bacitracin (500,000 U/L - 50,000 U/L, respectively), povidoneiodine 0.3%, povidone-iodine 10%, a 1:1 combination of povidone iodine 10% and 4% hydrogen peroxide, Irrisept® (Irrimax), Prontosan® (B.Braun), and Bactisure® (Zimmer Biomet). Antibacterial solutions were tested according to manufacturer specifications/guidance. 24-hour and 72-hour Xen36 biofilms were exposed to antibacterial solutions for 3 minutes to reproduce intraoperative conditions. Solution efficacy was measured through sonication of treated surfaces followed by counting colony forming units (CFUs). Experiments were performed in triplicate and repeated at least once. A three-fold log reduction in CFU counts vs. controls was considered as a measure of solution efficacy.

**Results:** Povidone-iodine 10% and a 1:1 combination of povidone iodine 10% and 4% hydrogen peroxide were the only effective solutions across all three surfaces. Bactisure® was effective against 24-hour biofilm grown on cement and titanium, and only titanium at 72 hours. Irrisept® was effective against biofilm grown on titanium for 24 hours.

**Conclusions:** Commercial antibacterial solutions vary significantly in their efficacy against MSSA biofilm. Efficacy globally decreased as biofilm maturity increased. Increased solution cost did not confer increased efficacy.

# Does Smoking Cessation Prior to Elective Total Joint Arthroplasty Result in Continued Abstinence?

**James R. Hall, MD**, Rory Metcalf, BS, Emma Leisinger, BS, Nicholas A. Bedard, MD, Timothy S. Brown, MD

**Introduction:** Smoking tobacco is a common modifiable risk factor for complications in total joint arthroplasty (TJA) patients. It is common practice to require patients to quit smoking prior to TJA. After the early postoperative period, little is known about the long-term implications of this preoperative behavioral change. Our aims were to 1) identify TJA patients that had negative nicotine screen prior to elective TJA and 2) determine the long-term rates of continued nicotine abstinence following their procedure.

**Methods:** At our institution, TJA patients who self-report tobacco use undergo urine anabasine testing prior to surgery. Between 2009 and 2018, all patients that had elective primary TJA with preoperative urine anabasine tests were queried. Patients were called postoperatively to discuss tobacco use at mean 51 months (range 15 – 126 months). Long-term smoking cessation rates were then analyzed along with relapse time frame. Additional analysis explored the use of quit aid and patient perspective on importance of quitting.

**Results:** 250 smokers that had elective TJA were identified, and 124 (50%) participated in the survey. 31 patients had already quit in the time leading up to surgery, and 93 patients quit specifically to facilitate surgery. Of those 93 that quit for surgery, 21 (23%) never resumed smoking, and 31 (33%) maintained abstinence >3 months. Almost half of the patients began smoking in the acute postoperative period (44%). There were no differences in quit aid or patient perspectives between these groups.

**Conclusions:** With an increased focus on smoking cessation prior to elective TJA, orthopaedics contributes to an important public health initiative. Although national quit rates in the general public are in the single digits, 56% of our patients remain smoke free for at least 3 months after surgery and 23% of patients were able to quit for good.

# Symposium III

#### Tips and Tricks to Save You During Revision TKA: Video-Based Demonstrations

**Faculty:** David G. Lewallen, MD, Mark W. Pagnano, MD, Gregory G. Polkowski II, MD, MSc, Scott M. Sporer, MD, MS

This symposium will provide the latest information on managing patients with failed total knee arthroplasties (TKA) that require complex exposures, metaphyseal fixation to manage bone loss and improve biologic fixation, intraoperative infection management, and extensor mechanism reconstructions.

#### Learning Objectives:

- 1. To understand how to safely expose complex revision TKAs with a variety of surgical techniques based upon video demonstrations.
- 2. To understand the principles and surgical techniques behind utilizing metaphyseal sleeves, metaphyseal cones, and stems to manage bone loss during revision TKAs.
- **3.** To understand the technical features related to antibiotic spacers and extensor mechanism reconstructions.

#### **Outline:**

Introduction Mark W. Pagnano, MD

Exposures and Component Removal: It Is an Art! Gregory G. Polkowski II, MD, MSc

**Cones, Sleeves, and Stems: How to Manage Bone Loss and Optimize Fixation** David G. Lewallen, MD

Articulating and Non-Articulating Spacers: What Are the Options in 2020? Scott M. Sporer, MD, MS

Extensor Mechanism Disruptions: A Synthetic Mesh Reconstruction Mark W. Pagnano, MD

**Discussion** All Faculty

#### Varus-Valgus Constrained Liners in Revision Total Knee Arthroplasty: Mean **Clinical Follow-up 6 Years?**

Nicholas M. Hernandez, MD, Christine J. Wu, BS, Zoe W. Hinton, BS, Samuel S. Wellman, MD, William A. Jiranek, MD, FACS, Thorsten M. Seyler, MD, PhD

Introduction: There is scant literature evaluating varusvalgus constrained (VVC) prostheses in contemporary revision TKA. Therefore, we aimed to evaluate the durability of VVC revision TKA with selective use of cones.

Methods: A retrospective review of 194 revision TKAs with VVC was performed from 2005 through 2018 at a single institution. The mean follow-up was 6 years. Stems were used in all but one knee. Tibial cones were used in 48% of knees, while femoral cones were used in 19% of knees, AORI classification in femurs was 1 in 34%, 2A in 20%, 2B in 37%, 3 in 10%; and in tibias was 1 in 25%, 2A in 17%, 2B in 48%, and 3 in 10%. Kaplan-Meier analysis was used to evaluate survivorship. Hazard ratios were used to evaluate for risk factors. A radiographic review was performed.

**Results:** The survival analyses at 6 years showed 93% free of revision for aseptic component loosening, 76% free of revision for any reason, and 74% free of reoperation. Cemented femoral stem fixation (vs. uncemented) was associated with a lower risk of revision for femoral aseptic loosening (p<0.05). Age less than 65 years and progressive radiographic changes were associated with an increased risk of revision for aseptic loosening (p<0.05). The use of tibial or femoral cones was not associated with revision for aseptic loosening (p>0.05), albeit cones were used preferentially in cases with more severe bone loss. Progressive radiographic changes were seen in 19% of femoral constructs and 16% of tibial constructs. The most common reason for re-revision was PJI (65% of rerevisions).

**Conclusions:** WC revision TKA with selective use of cones provided a durable outcome, as 93% were free of revision for aseptic loosening at 6 years. We recommend close observation of those who are younger and those with progressive radiographic changes.



#### Predictors of Outcomes Following Revision Surgery for Flexion Instability in Total Knee Arthroplasty

Payton K. Arnold, MS, Joseph A. Madden, BS, Mary Ziemba-Davis, BA, R. Michael Meneghini, MD

**Introduction:** Flexion instability remains a poorly understood cause of total knee arthroplasty (TKA) failure, sometimes referred to as a "wastebasket" diagnosis for unexplained pain. It remains a challenging diagnosis, with less predictable outcomes following revision surgery. This study identified predictors of successful outcomes following revision for flexion instability.

**Methods:** 115 consecutive TKAs revised for flexion instability at a single center were retrospectively reviewed. Diagnosis and treatment were according to established clinical criteria and surgical principles. Activity level, walking and stair pain, whether the knee feels normal, and knee satisfaction were prospectively obtained preoperatively and at minimum one-year follow-up. Multiple potential predictors of outcomes were collected including presenting symptoms, patient demographics, and medical comorbidities. Multivariate analyses were utilized with p<0.05 significant.

**Results:** The sample was 63% female with mean age of  $65\pm10$  and BMI of  $33\pm6$  kg/m2. Moderate to large knee effusions increased preoperative pain while walking on a level surface (p=0.007). Revision of a CR implant was associated with increased walking pain postoperatively (p=0.026). For males, increasing age was associated with a reduction in preoperative pain while climbing stairs (p<0.001). Postoperatively, patients who felt their knee was unstable preoperatively were 5.7 times less likely to report that their knee always feels normal (p=0.028) and 2.9 times less likely to be satisfied or very satisfied with revision surgery (p=0.040).

**Conclusions:** Instability is one of the most common reasons for TKA failure leading to revision surgery. To our knowledge, this is the largest flexion instability cohort analyzed to date and reveals certain patient demographic variables are predictive of outcomes. These findings suggest that many factors related to outcomes may be beyond the control of the arthroplasty surgeon.



# Contemporary Distal Femoral Replacements for Periprosthetic TKA Femoral Fractures

**Brian P. Chalmers, MD**, Marie Syku, BA, Elizabeth B. Gausden, MD, MPH, David J. Mayman, MD, Jason L. Blevins, MD, Peter K. Sculco, MD

**Introduction:** There is a paucity of data on the outcomes of contemporary distal femoral replacements (DFRs) in patients with total knee arthroplasty (TKA) periprosthetic fractures. We sought to characterize their outcomes, analyzing 1) survivorship free from revision and aseptic loosening, 2) risk factors for early revision, and 3) complications.

**Methods:** We retrospectively identified 43 patients (9 after revision TKA, 34 after primary TKA) that underwent DFR for a periprosthetic femur fracture from 2010-2017 at a single institution. Mean age was 75 years and 35 patients (81%) were female. Mean follow-up was 4 years. Femoral fixation included: 38 cemented stems (88%), 5 cementless stems (12%), and no adjunctive metaphyseal fixation. Survivorship free from revision and aseptic loosening was characterized by the Kaplan-Meier method. Cox proportional regression was utilized to analyze risk factors for re-revision.

**Results:** Survivorship free from any re-revision at 5 years in the primary and revision cohort was 91% and 32%, respectively. DFR after revision TKA had a 4.3-fold lower re-revision-free survival compared to DFR after primary TKA (p=0.04). Survivorship free from re-revision for aseptic loosening at 5 years in the primary and revision cohort was 94% and 71%, respectively. Cementless femoral stem fixation had a significantly higher risk for aseptic loosening (HR=12.2, p=0.007). DFRs in prior primary TKAs with cemented femoral fixation (n=33 patients) had a 97% 5-year survivorship free from any revision. Five patients (12%) sustained perioperative medical complications, but no patients died within 1 year.

**Conclusions:** DFRs with cemented femoral fixation for periprosthetic femur fractures in primary TKAs have a 5-year re-revision-free survival of 97%. DFRs for periprosthetic femur fractures around revision TKAs had a 4-fold increased risk of re-revision compared to those performed in fractures around primary TKAs. Cementless femoral stems had a 12-fold increased risk for aseptic loosening compared to cemented fixation.



#### The Impact of Preoperative Tramadol-Only Use on Outcomes Following Total Knee Arthroplasty

**Jacob M. Wilson, MD**, Andrew M. Schwartz, MD, Kevin X. Farley, BS, Greg A. Erens, MD, Thomas L. Bradbury, MD, George N. Guild, MD

**Introduction:** Opioid use prior to total knee arthroplasty (TKA) is known to have detrimental influence on postoperative outcomes. However, tramadol, an "atypical opioid", has previously been grouped with traditional opioids in studies that have established preoperative opioids as detrimental to outcomes. This is an important relationship to clarify as tramadol is currently recommended by the AAOS clinical practice guidelines for the nonoperative management of symptomatic knee arthrosis. Therefore, the purpose of this study is to investigate this relationship.

**Methods:** This is a retrospective cohort study using the Truven Marketscan® databases. Patients undergoing primary TKA were identified and divided into cohorts based on preoperative medication status (i.e. opioid naïve, tramadol-only, or non-tramadol opioids). Patients having revision surgery, those <18 years old, and those without 6-month preoperative and 90-day postoperative enrollment were excluded. Patient demographics, comorbidities, and 90-day outcomes were collected and compared between cohorts. Revision rates were analyzed at 1- and 3-years postoperatively for those with adequate follow-up. Univariate and multivariate analysis was performed.

**Results:** 336,316 patients were included and 23,097 (6.9%) used tramadol-only preoperatively. Tramadol-only patients (vs. opioid naïve) had increased odds of 90-day readmission (OR 1.07, 95%Cl 1.02-1.12, p=0.004), wound complication (OR 1.13, 95%Cl 1.01-1.27, p=0.34), and 1-(OR 1.20, 95%Cl 1.06-1.36, p=0.005) and 3-year revision rates (OR 1.35, 95%Cl 1.19-1.53, p<0.001). However, when compared to the preoperative opioid cohorts, tramadol-only patients had equivalent or significantly decreased odds of all outcomes. Over the study period, preoperative opioid use decreased while tramadol-only use increased.

**Conclusions:** While tramadol-only use has lower risk than traditional opioids, tramadol-only use preceding TKA is associated with increased rates of readmission, wound complication and revision surgery. This is important information for prescribers who may be using tramadol to treat symptomatic knee arthrosis prior to arthroplasty referral and for thought leaders producing clinical practice guidelines.



#### Evaluating Success of Perioperative Self-Guided Meditation in Reducing Sleep Disturbance After TKA

Michael S. Cremins, PhD, Robert Belniak, MD, Rebecca Teng, BA, Smitha S. Vellanky, MS

**Introduction:** Disruptions in sleep are a frequent complaint after total knee arthroplasty (TKA). These disturbances are multifactorial, ranging from pain to circadian rhythm disruption. Most sleep disturbances improve within 4-6 weeks of surgery but may contribute to the pace and quality of recovery. The purpose of this study was to evaluate the effectiveness of self-guided meditation for improving sleep hygiene after TKA.

**Methods:** Primary unilateral TKA patients between August 2019 and March 2020 were exposed to a meditation video 2 weeks preoperatively to 2 weeks postoperatively through a patient-engagement platform. Patients were given an institutionally designed questionnaire about their sleep patterns. T-tests were performed to compare changes in bedtime, wake-time, total sleep time, and Likert responses for general and pain-related sleep between video and non-video groups. Anesthesia, multimodal analgesia, and rehabilitation pathways were standardized.

**Results:** A total of 381 patients (49% female) across 5 surgeons were evaluated. The mean age was 68 years (95% CI: 67.07-68.76). Forty patients failed to watch the video completely. No associations were found between age, gender, or surgeon and the tested outcome variables. The mean preoperative actual sleep time was 396 minutes (95% CI: 388-440 minutes). Postoperatively, the video group improved an average of 52 minutes more than the non-video group (95% CI: 49.8-52.8 minutes, p<0.001). Postoperatively, patients tended to shift bedtimes to an earlier hour, but this was not significantly different between groups (p=0.995). Wake-times did not alter postoperatively. The video group showed significant decreases in sleep awakenings (p<0.001, but not pain-related awakenings (p=0.528).

**Conclusions:** Sleep hygiene is an important component of TKA recovery. The results reveal that adding patient-engagement measures, such as guided self-meditation techniques via video, improves actual hours slept and decreases awakenings, but has little impact on pain-related awakenings. Further study is needed to understand patient pain levels and opioid consumption.



# Musculoskeletal Health Literacy Correlates with Outcome and Satisfaction of Total Knee Arthroplasty

Arvind S. Narayanan, MD, Kurt E. Stoll, MD, Lincoln F. Pratson, MD, Christopher W. Olcott, MD, Daniel J. Del Gaizo, MD

**Introduction:** The purpose of this study was to investigate if there is a correlation between musculoskeletal health literacy and outcome and satisfaction after total knee arthroplasty (TKA).

**Methods:** A cross-sectional study was performed at our tertiary center to include patients between 1- and 5-years postoperatively after primary TKA. Patients in this cohort were provided a survey including basic demographics, validated musculoskeletal health literacy scale (LiMP), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and TKA satisfaction (whether they would choose to undergo the same operation again). Patients were categorized as either low or normal health literacy based on number of questions (cutoff six out of nine) answered correctly on the LiMP. Statistical analysis included unpaired student t-test with significance set at p<0.05.

**Results:** 455 individuals fully completed the survey of eligible participants. 297 individuals (65.3%) had normal health literacy and 158 individuals (34.7%) had low health literacy. Average WOMAC (/96) was 17.9±19.8 in the low and 12.1±15.4 in the normal health literacy groups. Patients with low health literacy had significantly higher WOMAC (worse function) compared to those with normal health literacy (p=0.012). 27 out of 297 patients (9.1%) in the normal health literacy group would not undergo the same operation again. Patients in the low musculoskeletal health literacy group were significantly less likely to undergo the same operation again (p=0.007, OR 2.248).

**Conclusions:** Health literacy has been determined to be an important predictor of health-related outcomes. This study shows that patients with a low musculoskeletal health literacy have worse outcome scores and are less likely to be satisfied with their TKA. By identifying these patients preoperatively, emphasis can be placed on enhancing procedure expectations and understanding to improve outcome measures and overall satisfaction.



#### Machine Learning Algorithms Identify Optimal Sagittal Component Position in Total Knee Arthroplasty

Hassan Farooq, BS, Evan R. Deckard, BS, Nicholas Arnold, MD, R. Michael Meneghini, MD

**Introduction:** Advanced technologies, like robotics, provide enhanced accuracy and precision implanting total knee arthroplasty (TKA); however, the optimal target for implant position specifically in the sagittal plane does not exist. This study identified implant position in the sagittal plane which may correlate with improved outcomes using advanced modeling techniques.

**Methods:** A retrospective review of 1,091 consecutive TKAs was performed. All TKAs were PCL retaining or sacrificing with anterior lipped (49.4%) or conforming bearings (50.6%) performed with modern perioperative protocols. Preoperative and postoperative tibial slope and postoperative femoral component flexion were measured with standardized radiographic protocols. Patients were grouped by satisfaction at latest follow-up, and asked the question: "How often does your knee feel normal?" Support vector machine (SVM) learning algorithms were used to identify optimal sagittal alignment zones correlated with satisfaction and knees always feeling normal.

**Results:** Mean age and BMI were 66 years and 34 kg/ m2 with 67% being female. PCL status and bearing type did not affect outcomes (p $\geq$ 0.249) with numbers available. Patients whose tibial component slope more closely approximated native slope demonstrated higher satisfaction and greater numbers whose knee always felt normal (p=0.046). Femoral flexion alone did not impact these metrics with numbers available (p=0.268). However, change in tibial slope closer to native (±10°) in combination with femoral flexion up to 15° correlated with improved satisfaction and knees always feeling normal. Worst outcomes were associated with excessive femoral flexion >15° or any femoral component extension and/or adding or removing >10° of native tibial slope.

**Conclusions:** Superior patient-reported outcomes correlated with approximating native tibial slope and incorporating some femoral flexion. Deviation from native tibial slope and excessive femoral flexion or any femoral component extension correlated with worse outcomes. Further study is warranted to externally validate and elucidate the effects of sagittal alignment on other outcomes.



#### A Minimal Clinically Important Difference in Robotic-Assisted TKA vs. Standard Manual TKA

**Jonathan H. Shaw, MD**, Kevin Lindsay-Rivera, MD, Patrick Buckley, BS, Robb M. Weir, MD, Trevor R. Banka, MD, Jason J. Davis, MD

**Introduction:** Robotic-assisted total knee arthroplasty (R-TKA) has theoretic soft-tissue and alignment advantages that remain of current debate. The purpose of this study was to determine whether R-TKA showed evidence of improvement in minimal clinically important differences (MCID) in early (<4 weeks) and intermittent (4-8 month) patient-reported outcomes compared to manual total knee arthroplasty (M-TKA).

**Methods:** A prospectively collected database was reviewed from a three-surgeon cohort of 1,158 consecutive patients undergoing R-TKA or M-TKA over a 2-year period at a tertiary medical center (259 R-TKA, 899 M-TKA). Primary outcomes consisted of Knee Injury and Osteoarthritis Outcome Score (KOOS-JR) and Patient-Reported Outcomes Measurement Information System (PROMIS) Global Health Measures of Physical Health (PH) and Mental Health (MH). Statistical analysis included MCID via the distribution method and chi-square analysis to evaluate postoperative MCID.

**Results:** The initial analysis demonstrated similar preoperative condition and short-term outcomes. Early 4-week outcomes yielded similar PROMIS MCID achievement (PH 33.2% vs. 36.0%; p=0.44 and MH 23.6% vs. 26.7%; p=0.35) for R-TKA and M-TKA respectively, but statistically significant improvement favoring the M-TKA for KOOS-JR (62.3% vs. 70.1%; p=0.03). Achievement of MCID at the 6-month point illustrated no differences. Mean comparison at the mid-year point favored R-TKA for PROMIS-MH (54.8 vs. 51.6; p= 0.01), but no difference in KOOS-JR or PROMIS-PH.

**Conclusions:** R-TKA demonstrated comparable improvement to M-TKA. It was less likely to surpass MCID in KOOS-JR at the first postoperative visit with similar results in both PROMIS global health domains. This conflicting data was further highlighted with no difference in KOOS-JR or PROMIS-PH at mid-year follow-up but favored R-TKA in PROMIS-MH. Confounding variables such as surgeon technique, implant fixation, and responsiveness of an outcome measure may be as important as simply what tools are used in surgery. Such granular data should be sought out in future studies with larger volume.



#### Anterior Stabilized vs. Cruciate-Retaining Bearing in Primary Total Knee Arthroplasty

David A. Crawford, MD, Joanne B. Adams, BA, Jason M. Hurst, MD, Michael J. Morris, MD, Jesua Law, BS, Adolph V. Lombardi Jr., MD, FACS, Keith R. Berend, MD

**Introduction:** There are several bearing options available for primary total knee arthroplasty (TKA). The purpose of this study is to compare outcomes and survivorship between the ultra-congruent anterior stabilized (AS) and cruciate-retaining (CR) bearing.

**Methods:** A retrospective review was performed from 2010 through 2014 of all patients who underwent primary TKA with the Vanguard (Zimmer Biomet) implant with 2-year minimum follow-up and/or failure, revealing a cohort of 3,323 patients (4,164 knees). The AS bearing was used in 1,471 knees (35%) while the CR bearing was used in 2,693 knees (65%). Outcomes assessed were knee range of motion (ROM), Knee Society pain (KSP) scores, Knee Society clinical (KSC) scores, Knee Society functional (KSF) scores and UCLA activity scores. The need for manipulation under anesthesia (MUA), non-revision surgery and revisions were assessed.

**Results:** Mean follow-up was 5.2 years for the AS group and 5.6 years for the CR group (p<0.001). The AS group had significantly higher improvements in knee ROM, KSC, KSF and KSP scores. MUA's were performed on 120 knees (8.2%) in the AS group compared to 158 knees (5.9%) in the CR group (p=0.005). The AS group had significantly less all-cause failure (p=0.004), aseptic failures (p<0.001), revisions for instability (p<0.001) and revisions for isolated polyethylene wear (p=0.003). The 10-year all-cause survival for AS was 97.4% (95% CI, 96.6% to 98.2%) and for CR was 91.1% (95% Cl, 89.3% to 93%) (p=0.02). The 10vear aseptic survival for AS was 98.3% (95% CI, 97.5% to 99.1%) and for CR was 92.3% (95% CI, 91% to 94%) (p=0.002).

**Conclusions:** These early to mid-term results demonstrate that the AS bearing had significantly higher improvements in clinical and functional outcomes as well as greater survivorship compared to the CR bearing.



#### Survivorship, Clinical and Radiographic Outcomes of a Novel Cementless Metal Back Patella Design

Luis C. Grau, MD, Santiago Restrepo, BS, Sean Z. Griffiths, DO, William J. Hozack, MD, Eric B. Smith, MD

**Introduction:** Enhanced implant longevity through biological fixation is achievable using cementless total knee arthroplasty (TKA); however, concerns about patellar component failure have lingered because of prior experiences with older total knee and patellar component designs. A new metal backed patella (MBP) design was released which features a 3-dimensional (3D) printed porous titanium metal backing to improve biologic fixation potential and a unique compression molding technique to create a stronger interlock layer between the polyethylene and metal backing. This study aims to determine the clinical and radiographic outcomes and survivorship of this novel cementless MBP.

**Methods:** Our institutional registry identified cementless MBPs: 329 with minimum 2-year follow-up and 128 with minimum 5-year follow-up. KOOS JR. and VR/SF-12 scores were used to evaluate clinical outcomes. Aseptic loosening noted on radiographs as well as revision for any reason were the end points used to determine survivorship.

**Results:** The average KOOS score increased from 34.73 preoperatively to 59.61 (6 months), 53.91 (2 years) and 73.32 (5 years). The average VR/SF-12 PH score increased from 31.11 preoperatively to 47.32 (6 months), 44.89 (2 years) and 46.45 (5 years). The average VR/SF-12 MH score increased from 39.00 preoperatively to 52.59 (6 months), 53.13 (2 years) and 56.31 (5 years). On radiographs, 3.80% (10) were lucent, but 100.00% had osseous integration of the patella. Patellar all-cause survivorship at 2 years was 99.00% and at 5 years was 98.43%. Other than for PJI, no patellar revisions were performed. Survivorship for aseptic loosening was 100.00%.

**Conclusions:** This 3D printed cementless patellar component shows excellent survivorship at 2 and 5-year follow-up. The design of this implant and the ability to obtain cementless fixation offers promise for excellent long-term durability.



#### Tourniquet Use Improves Cement Penetration and Reduces Radiolucent Line Progression After TKA

**Vishal Hegde, MD**, Daniel N. Bracey MD, PhD, Roseann M. Johnson, BS, Anna C. Brady, BS, Douglas A. Dennis, MD, Jason M. Jennings, MD

**Introduction:** Although the effect of tourniquet use on functional outcomes during total knee arthroplasty (TKA) is controversial, there is little data examining cementation. We aim to study the effect of tourniquet use on cement penetration and radiolucent lines (RLL).

**Methods:** Between September 2011 and October 2015, patients undergoing primary TKA with a single surgeon, implant and cement with minimum 5-year follow-up were retrospectively reviewed at a single institution. Tourniquet use was defined as a minimum 30 minutes, while no tourniquet was 0 minutes. Patients were 1:1 matched (n=61 per group) by age (±5), gender, BMI (±5) and duration of follow-up (±2 years). Cement penetration and RLL were measured on the tibia at 6 weeks, and RLL at 1-, 2- and 5-years postoperatively using the Knee Society Radiographic Evaluation System. Outcomes were evaluated using Student's t-tests.

**Results:** There was no difference in postoperative tibial component axis (0.68 vs. 0.5 degrees valgus, p=0.43). Cement penetration was significantly increased in the tourniquet group in AP zones 1 (2.16mm vs. 1.03mm, p<0.0005), 2 (2.23 vs. 1.51, p<0.0005) and 5 (8.56 vs. 6.3, p=0.009), and lateral zones 1 (2.89 vs. 2.17, p<0.0005), 2 (2.86 vs. 2.12, p<0.0005), 3P (3.99 vs. 3.5, p=0.039) and 5 (8.18 vs. 5.93, p=0.006). There was no difference in AP zones 3M (4.18 vs. 4.3, p=0.656) and 3L (4.48 vs. 3.95, p=0.073), or lateral zone 3A (3.8 vs. 3.6, p=0.304). Progression of RLL >2mm was observed in 27.8% (17/61) vs. 11.4% (7/61) in the tourniquet group (p<0.005). There were two failures for aseptic tibial loosening in the no tourniquet group vs. zero in the tourniquet group.

**Conclusions:** Tourniquet use improves cement penetration and reduces RLL progression. Dryer surfaces without blood and marrow contents during cementation may improve penetration, resulting in an improved cement mantle and potentially reducing the risk of aseptic loosening.

#### The Effect of Blood Pressure on Cement Depth Penetration in Tourniquet-less Total Knee Arthroplasty

Luke G. Menken, DO, MS, Jean Q. Fleuriscar, BS, Travis M. Weiner, Jose A. Rodriguez, MD

**Introduction:** Cement penetration into trabecular bone appears to be an important factor in determining the longevity of an implant in total knee arthroplasty (TKA). Maintenance of hypotensive anesthesia is preferred by many orthopaedic surgeons when performing tourniquetless TKA in an effort to reduce bleeding and improve cement depth penetration (CDP), but the effectiveness of this practice is not well-established. Our study explored the effect of systolic blood pressure (SBP) at the time of cementation on cumulative tibial metaphyseal CDP. We hypothesized that increased SBP would decrease CDP.

**Methods:** In this retrospective consecutive cohort study, we evaluated tibial metaphyseal CDP, according to the Modern Knee Society Radiographic Evaluation System (MKSRES), on the first postoperative radiograph available for tourniquet-less TKAs performed by the senior author (n = 203; mean age = 68.1; 58.6% female; mean BMI = 30.4 kg/m2). Two independent reviewers measured each zone at the location of least CDP and the average of both readings was taken. Averages for all zones were summed to determine cumulative CDP in each patient. Using operative records, we extracted SBP at the estimated time of cementation—3/4 of the way through the surgery. Linear regression was utilized to investigate the relationship between these two variables.

**Results:** Among patients, mean cumulative metaphyseal CDP was 31.76mm and median SBP at cementation was 104mmHg. There was no statistically significant association between SBP at the time of cementation and CDP ( =- 0.0012, p=0.968, 95% CI [-0.063-0.060]). Notably, 99% of knees had measured SBP <150mmHg.

**Conclusions:** Cement fixation is technique dependent. In patients undergoing tourniquet-less TKA, and with a systolic blood pressure maintained below 150 mmHg, no benefit in cement penetration was evident with additional hypotension.


# Symposium IV

# Practice Norms in Primary Hip and Knee Arthroplasty: What Is Everyone Else Doing?

### Moderator: Daniel J. Berry, MD

The moderator will conduct a poll of the membership using an audience response system (ARS) with real time display of results and commentary, and will ask the audience a series of questions about their current practices in perioperative and intraoperative management of primary total hip arthroplasty (THA) and total knee arthroplasty (TKA). The audience will respond using the ARS and results will be displayed immediately. The moderator will weave in comparison of the current year's responses to data gathered in previous years to demonstrate areas of practice evolution. The symposium will place emphasis on areas of rapid practice change.

### Learning Objectives:

- 1. Identify what AAHKS peers are currently doing for perioperative management of primary THA and TKA and how this has changed in the key areas in the past two years.
- 2. Identify what AAHKS peers are currently doing with respect to intraoperative decisions, choices, and practices in primary THA and TKA and how this has changed in the past two years.

### **Outline:**

Introduction

**Primary THA: Perioperative Management** 

Primary THA: Intraoperative Decisions, Choices, Practices

**Primary TKA: Perioperative Management** 

Primary TKA: Intraoperative Decisions, Choices, Practices

### Discussion

### Is the Outpatient Prospective Payment System Classification for Total Hip Arthroplasty Appropriate?

Jeffrey C. Lynch, DO, Michael Yayac, MD, Chad A. Krueger, MD, P. Maxwell Courtney, MD

**Introduction:** Starting in 2020, the Centers for Medicare & Medicaid Services (CMS) removed total hip arthroplasty (THA) from the Inpatient Only List, resulting in payment through the Outpatient Prospective Payment System (OPPS) with an average \$1,637 per case reduction in facility reimbursement. The purpose of this study was to determine if the reduction in rates is justified by comparing the difference in true facility costs between inpatient and outpatient THA.

**Methods:** We identified a consecutive series of 5,271 primary THA procedures at two hospitals by one of 31 surgeons from 2015-2019. Itemized procedural costs were calculated using a time-driven activity-based costing algorithm. Outpatient procedures were defined as those with less than 24-hour length of stay. We compared patient demographics, comorbidities, and itemized costs between inpatient and outpatient procedures. A multivariate analysis was performed to determine the independent effect of outpatient status on facility costs.

**Results:** Of the 783 (15%) outpatient patients, they were more likely to be male (62% vs. 46%, p<0.001), but there were no significant differences in comorbidities between the groups. The outpatient THA patients had lower mean reduced personnel costs (1,428 vs. 2,226, p<0.001) and overall total facility costs (6,141 vs. 6,965, p<0.001). Supply costs were significantly lower for outpatient procedures, by a margin of 26 (4,713 vs. 4,739, p<0.001). When controlling for confounding variables, outpatient status was associated with a reduction in total facility costs of 825 (95% CI 734-916, p<0.001).

**Conclusions:** TThe \$825 per patient savings in facility costs for performing THA as an outpatient does not justify the \$1,637 reduction in CMS reimbursement rates. CMS should reconsider the OPPS classification of THA to better incentivize surgeons to perform THA as a lower-cost outpatient procedure when safe and appropriate.

# Out-of-Network Facility Charges for Patients Undergoing Outpatient Total Joint Arthroplasty

Nathan H. Varady, BS, Ahab Chopra, Troy B. Amen, BA, David M. Freccero, MD, Antonia F. Chen, MD, MBA, Eric L. Smith, MD

**Introduction:** The utilization of both outpatient (OP) total joint arthroplasty (TJA) and ambulatory surgery centers (ASC) continues to rise. While many arthroplasty surgeons and hospitals have longstanding agreements with commercial insurance companies, it may take time for ASCs to establish in-network agreements. The purpose of this study was to investigate trends in out-of-network facility charges for patients undergoing OP-TJA as well as to compare rates of out-of-network facility between ASC and hospital-based OP-TJA.

**Methods:** This was a retrospective study of the MarketScan® commercial-claims database of all episodes of OP-TJAs from 2007-2017. Outpatient was defined as same-day discharge surgery. Detailed demographic, geographic, operative, insurance, temporal, and financial details were collected. Rates of out-of-network facility charges were trended over time with Cochran-Armitage trend tests. Chi-squared tests and logistic regressions controlling for year were used to compare the prevalence of out-of-network facilities between ASC and hospital-based OP-TJA.

**Results:** There were 23,076 OP-TJAs (65% TKA). The proportion of OP-TJAs performed at out-of-network facilities significantly decreased over time, from 17.0% in 2007 to 7.6% in 2017 (p<0.001). In 5.8% of cases that the surgeon was in-network, the hospital was not; in 0.4% of cases that the hospital was in-network, the surgeon was not (p<0.001). Patients undergoing OP-TJA at ASCs were significantly more likely to experience out-of-network facility charges than those undergoing OP-TJA at hospitals (15.1% vs. 6.7%, p<0.001). Results held across all years (p<0.001, 2007: OR 2.22 [95%CI 1.03-4.755]; 2017: OR 2.4 [95%CI 1.79-3.2]).

**Conclusions:** While rates of out-of-network facility charges are decreasing with time, approximately 6% of patients receiving care by in-network surgeons face out-of-network facility charges, which may often come as a surprise. As OP-TJA is often more cost-effective in appropriate patients, insurance companies should work to expedite contracting with ASCs.

### Trends in Hospital and Surgeon Charges and Reimbursements for Revision Total Knee Arthroplasty

Nicole E. Durig Quinlan, MD, MS, Alyssa Althoff, MD, Dennis Q. Chen, MD, Thomas E. Brown, MD, Brian C. Werner, MD, James A. Browne, MD

**Introduction:** The objective of this study is to report trends and variation in hospital charges and payments compared to surgeon's for stage 1 (S1) vs. stage 2 (S2) revision of septic TKA and aseptic revision (AR) TKA.

**Methods:** The 5% Medicare sample was used to capture hospital and surgeon charges and payments for revision TKA from 2005-2014. The charge multiplier (CM), ratio of hospital to surgeon charges, and the payment multiplier (PM), ratio of hospital to surgeon payments, were calculated. Year to year variation and regional trends in patient demographics, Charlson Comorbidity Index (CCI), length of stay (LOS), CM and PM were evaluated. Statistical significance of trends was evaluated using simple linear regression analysis. Correlations between the financial multipliers and LOS were evaluated using a Pearson correlation coefficient (r).

**Results:** 4,570 AR TKA patients were included, as well as 1,323 S1 and 863 S2 revision patients. Hospital charges were significantly higher than surgeon charges for all cohorts and increased over time: CM increased from 8.1 to 13.8 for AR (p<0.001), from 21.0 to 22.5 (p=0.07) for S1, and from 11.8 to 22.0 (p<0.001) for S2. PM followed a similar trend: increasing 8.1 to 13.8 (p<0.001) for AR, 19.8 to 27.3 (p=0.005) for S1, and 14.7 to 30.7 (p<0.001) for S2. Surgeon reimbursement decreased over time for all cohorts. LOS decreased for AR from 3.8 to 2.8 days, for S1 from 12.8 to 6.9 days, and for S2 from 4.5 to 3.9 days. CCI remained stable for the AR cohort but increased significantly for the S1 and S2 cohorts.

**Conclusions:** Hospital charges and payments relative to surgeon charges and payments have significantly increased for AR, S1 and S2 revision TKA despite stable or increasing patient complexity and decreasing LOS.



# Bilateral Total Knee Arthroplasty May Not Be Safe even in the Healthiest of Patients

Jared A. Warren, DO, Ahmed Siddiqi, DO, Viktor E. Krebs, MD, **Robert M. Molloy, MD**, Carlos A. Higuera, MD, Nicolas S. Piuzzi, MD

**Introduction:** Bilateral total knee arthroplasty (BTKA) has been shown to increase both mortality and complications; however, it has potential benefits including decreased length of stay, rehabilitation time, and costs. The purpose of this study was to use data from a nationally representative database to identify if there is a population of TKA patients in which BTKA can be safely performed by comparing 30day mortality and complication rates to unilateral total knee arthroplasty (UTKA) patients.

**Methods:** The National Surgical Quality Improvement Program (NSQIP) was queried to compare 30-day mortality, any complication, and major complication between BTKA and UTKA. 8,291 BTKA patients were 1:1 matched with UTKA control cohort (n=315,219) by morbidity probability, a cumulative variable encompassing demographics, comorbidities, and laboratory values. Patients were divided in tow quartiles based on morbidity probability. Binary logistic regression comparing BTKA to UTKA for the same quartiles was performed to establish if any population could safely have BTKA performed.

**Results:** BTKA had an increased risk for all complications and major complications when compared to UTKA regardless of health status. For all complications, there was an over 3-fold increase for the 1st quartile (healthiest patients) (p<0.001), greater than 4-fold increase for the 2nd (p<0.001) and 3rd quartiles (p<0.001) and an over 3-fold increase for the 4th quartile (least healthy patients) (p<0.001). For major complications, there was an over 2-fold increase for the 1st quartile (p=0.001) and 2nd (p<0.001) quartiles, an almost 3-fold increase for the 3rd quartile (p<0.001), with a 57% increase for the 4th quartile (p=0.005). There was no difference in mortality between BTKA and UTKA regardless of health status (p>0.05).

**Conclusions:** This study will assist shared decision making between orthopaedic surgeons and patients by suggesting that BTKA may not be a safe option for even healthy individuals compared to unilateral TKA.



### Potential Effects of Imposing Body Mass Index Thresholds on Patient Reported Outcome Measures in TKAs

Hiba K. Anis, MD, Alexander Roth, MD, Alison K. Klika, MS, Michael R. Bloomfield, MD, Jonathan L. Schaffer, MD, Viktor E. Krebs, MD, Wael K. Barsoum, MD, Robert M.Molloy, MD, Carlos A. Higuera, MD, **Nicolas S. Piuzzi, MD** 

**Introduction:** Obese patients can benefit from total knee arthroplasty (TKA), however surgeons often impose operative thresholds using body mass index (BMI) that may deprive obese patients of improvements in pain/ function. The purpose of this study was to 1) investigate the relationship between BMI and improvements in patient reported outcome measures (PROMs), and 2) evaluate the trade-off in enforcing BMI-based eligibility criteria.

**Methods:** Data were prospectively collected on a cohort of orthopaedic patients from 2015-2018 in a single healthcare system, yielding 4,126 TKAs of which 3,214 had 1-year follow-up. Demographic data and preoperative and postoperative Knee Injury and Osteoarthritis Outcome Scores (KOOS) pain, Physical Function Shortform (PS), and knee-related Quality-of-Life (KRQOL) scores were collected. Clinically meaningful improvement was defined as a 15-point change for Pain and PS, and 14-point for KRQOL. Median BMI-stratified scores were obtained for the aforementioned PROMs and, using various BMI thresholds, the number of surgeries denied to avoid failed improvements were calculated.

**Results:** An increasing BMI was associated with increases in median improvements in PROMs. For KOOS pain scores, improvements were greater for a BMI ≥40 kg/m2 compared to those with a BMI of 30-34.9 kg/m2 (47.44 vs. 44.44). Similar findings were seen for KOOS PS (28.4 vs. 26.1) and KRQOL (50 vs. 48.96). With a BMI cut-off of 30kg/m2, for every patient that failed to improve their KOOS pain score after surgery, 9 patients would have improved, while with a BMI cut-off of 40 kg/m2, 11 patients would have improved. For both for KOOS-PS, (3.2 vs 3.6) and for KOOS-KRQOL (6.8 vs. 7.4) there were similar findings.

**Conclusions:** As BMI increases, there is also an increase in median PROM improvement. There appears to be little effect on PROMs by enforcing a BMI threshold for surgery as patients improve more as their BMI increases.



### Increased Revisions in Conversion TKA After ORIF Compared to Primary TKA: A Matched Cohort Analysis

Safa C. Fassihi, MD, Alex Gu, MD, **Seth N. Stake, MD**, Savyasachi C. Thakkar, MD, Gregory J. Golladay, MD

**Introduction:** Conversion total knee arthroplasty (cTKA) has been increasingly studied in efforts to determine appropriate billing for this procedure. Due to the relative infrequency of cTKA, much of the previous work has been low-powered and lacked stratification by subtype of conversion procedure. The purpose of this study was to compare two-year postoperative complication/revision rates between patients undergoing cTKA after prior periarticular open reduction and internal fixation (ORIF) and those undergoing primary total knee arthroplasty (TKA).

**Methods:** Patients who underwent cTKA after prior periarticular ORIF of the ipsilateral knee (cTKA-ORIF cohort) were identified in a national insurance claims database (PearlDiver Technologies) using CPT and ICD codes. This cTKA-ORIF cohort was propensity matched to patients undergoing primary TKA based upon age, sex, Charlson Comorbidity Index, and obesity status. Univariate analysis was performed to analyze differences in two-year complications/revisions between cohorts.

**Results:** Following propensity matching, 823 patients were included in the cTKA-ORIF cohort, and 1,640 patients were successfully matched, with no differences in demographics or comorbidities between cohorts. Relative to the primary TKA cohort, the cTKA-ORIF cohort was significantly more likely to experience revision for any cause (5.47% vs. 2.47%, p=0.001), periprosthetic joint infection (PJI; 4.74% vs. 1.34%, p<0.001), and intraoperative/postoperative periprosthetic fracture (1.58% vs. 0.55%, p=0.01) at two years postoperatively. There was also a non-significant trend towards increased rates of aseptic loosening (1.82% vs. 0.91%, p=0.052) in the cTKA-ORIF cohort at two years postoperatively.

**Conclusions:** Relative to primary TKA, cTKA after periarticular ORIF is associated with significantly increased rates of all-cause revision, PJI, and periprosthetic fracture at two years postoperatively. Clinicians should counsel these patients about their increased risk of postoperative complications and consider treating them as "high risk" for PJI in the perioperative period.



# The James A. Rand Young Investigator's Award

# Are Intraoperative Cultures Necessary if the Aspiration Culture Is Positive? A PJI Concordance Study

**K. Keely Boyle, MD**, Milan Kapadia, BS, Michael Henry, MD, Andy O. Miller, MD, Alberto V. Carli, MD, FRCSC

**Introduction:** It remains unknown if preoperative synovial fluid culture is equivalent to multiple intraoperative tissue cultures for identifying relevant PJI causative organisms. Our aim was to determine the prevalence of discordance between synovial fluid and tissue cultures, polymicrobial infections, and antibiotic susceptibility patterns among discordant cultures.

**Methods:** A total of 326 patients (169 hips, 157 knees) who met MSIS diagnostic criteria for PJI following primary TJA were identified from a longitudinally maintained PJI database. Inclusion criteria required a positive preoperative intra-articular synovial fluid and intraoperative tissue culture(s) at time of revision surgery. Patients were divided into two categories: concordant and discordant. Discordant cultures were further subcategorized into "similar" and "different" according to antibiotic sensitivities.

**Results:** Concordance was identified in 274 (84.0%) patients with similar rates among THAs and TKAs (85.2% vs. 82.8%; 2 0.351, p=0.55). Culture discordance occurred in 52 (16%) patients; 34 (10.4%) in the discordant-similar group and 18 (5.6%) in the discordant-different group. THAs had significantly greater proportion of discordant-different results compared to TKAs (52% vs. 18.5%; 2 6.43, p=0.01). MRSA demonstrated the highest concordance rate (95.0%; 20 of 21), while C. acnes demonstrated the lowest (52.9%; 9 of 17). Within the discordant-similar group, S. epidermidis and C. acnes most commonly were co-infecting organisms. In the discordant-different group, Enterococcus species (22.2%) most commonly grew independently from aspiration and became polymicrobial on tissue culture.

**Conclusions:** The majority of aspiration and tissue cultures in culture positive PJI are concordant, but this concordance varies based on bacterial species. Both aspiration and tissue cultures should be collected for accurate pathogen identification, especially if aspiration culture is positive for low virulent organisms or for enterococci. Conversely, aspiration cultures positive for MRSA have a very high rate of monomicrobial culture concordance, suggesting that clinicians could commence antibiotic therapy preoperatively in these cases.



# The Lawrence D. Dorr Surgical Techniques & **Technologies Award**

### Is it Safe? Using Big Heads and Small Acetabular Components in Total Hip Arthroplasty

Courtney Baker, MD, Brandon R. Bukowski, MD, Robert T. Trousdale, MD

Introduction: Modern total hip arthroplasty (THA) increasingly employs larger femoral heads to optimize hip stability. However, the combination of large heads and small acetabular component poses a potential risk for implant failure secondary to catastrophic liner fracture or liner wear and its sequela. The purpose of this study was to evaluate early failure and long-term outcomes including wear rates in THA using large heads and small acetabular components.

Methods: 825 patients undergoing primary THAs from 2000-2016 with 36mm heads and cups. ≤52mm with highly crosslinked polyethylene liners, and minimum 2-year follow-up were identified through a total joint registry. Mean age was 66 years, 88% were females, and mean body mass index (BMI) was 30 kg/m2. Competing risk analysis with death as competing risk was utilized to evaluate the cumulative incidences of dislocation, all-cause reoperation, and revision. All patients with minimum 10-year radiographic follow-up (n=18) were analyzed for femoral head penetration and osteolysis. Mean follow-up was 4 years (range, 2-12 years).

Results: There were 12 revisions (0.8%) within one year of THA. There were no liner fractures. The 10-year cumulative incidences of dislocation, reoperation and revision rates were 3.2%, 9.3%, and 5.6%, respectively. Mean femoral head penetration was 0.378mm (95% CI 0.76-0.68) and mean steady-state femoral head penetration was 0.043mm/yr (95% CI 0.0039-0.082) at mean follow-up of 11 years.

Conclusions: Pairing large femoral heads with small acetabular components has minimal risk of early catastrophic failure with similar long-term rates of dislocation, all-cause reoperation, and revision surgery compared to other component size pairings. 10-year radiographic follow-up demonstrated excellent wear characteristics and durability, with no evidence of osteolysis.

| Notes |      |      |
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# The AAHKS Clinical Research Award

# Extended Oral Antibiotics Prevent PJI in High-Risk Cases: 3,855 Patients with 1-Year Follow-Up

Michael M. Kheir, MD, Julian E. Dilley, MD, Mary Ziemba-Davis, BA, R. Michael Meneghini, MD

**Introduction:** Surgical and host factors predispose patients to periprosthetic joint infection (PJI) following primary total knee (TKA) and hip (THA) arthroplasty. While surgical factors are modifiable, host factors can be challenging and there are limited data demonstrating that preoperative optimization decreases risk of PJI. This study expanded the follow-up period and sample size of our prior study demonstrating that extended oral antibiotic prophylaxis reduces 90-day infection rates in high-risk patients.

**Methods:** 3,855 consecutive primary TKAs and THAs performed 2011-2019 at a suburban academic hospital with modern perioperative and infection-prevention protocols were retrospectively reviewed. Beginning January 2015, a 7-day oral antibiotic prophylaxis protocol was implemented after discharge for patients at high risk for PJI. Percentage of high-risk patients diagnosed with PJI within 1 year were compared between groups that did and did not receive extended antibiotic prophylaxis. Univariate and logistic regression analyses were performed; p≤0.05 statistically significance.

**Results:** Overall 1-year infection rates were 0.85% (after TKA) and 2.26% (after THA). High-risk patients with extended antibiotic prophylaxis had a significantly lower rate of PJI compared to high-risk patients without extended antibiotic prophylaxis (0.89% vs. 2.64%, respectively; p<0.001). There was no difference in the infection rate between high-risk patients who received antibiotics and low-risk patients (0.89% vs. 1.29%, respectively; p=0.348) with numbers available.

**Conclusions:** Extended postoperative oral antibiotic prophylaxis for 7 days led to a statistically significant and clinically meaningful reduction in 1-year infection rates of patients at high risk for infection. In fact, the PJI rate in high-risk patients who received antibiotics was less than the rate seen in low-risk patients. Thus, extended oral antibiotic prophylaxis may be a simple measure to effectively counteract poor host factors. Moreover, the findings of this study may mitigate the incentive to "cherry pick" patients in outcome-based reimbursement models. Further study with a multi-center randomized control trial is needed to further validate this protocol.



# Symposium V

### **Optimizing Hip and Knee Arthroplasty in the COVID Era**

**Faculty:** C. Lowry Barnes, MD, James A. Browne, MD, James I. Huddleston III, MD, R. Michael Meneghini, MD

The COVID-19 pandemic of 2020 created a unique and challenging environment in which to provide safe care for hip and knee arthroplasty patients. This symposium will discuss the latest data-driven and evidence-based recommendations involving preoperative testing, optimal personal protective equipment (PPE), perioperative care, protocols and methodologies to minimize personal contact such as outpatient same day discharge and utilizing telehealth and remote monitoring technology. Further, practice and surgical efficiencies will be detailed for surgeons to provide low-cost and high-quality care essential to accommodate the backlog of elective hip and knee arthroplasty patients created by cessation of elective surgeries during the peak of the COVID-19 pandemic. Finally, an exploration of the Medicare claims database will be detailed to understand the impact of the pandemic on total hip and knee arthroplasty in the United States.

### Learning Objectives:

- 1. To understand the latest data-driven protocols that enable elective hip and knee arthroplasty with optimal safety for surgeons, surgical teams and patientsy.
- 2. To understand the latest strategies to minimize personal contact during patient care including telemedicine and early discharge outpatient environments.
- **3.** To understand the latest safe strategies in efficient office throughput and surgical and operating room efficiency to care for the COVID-induced backlog of elective TJA patients.
- **4.** To understand what Medicare claims data reveals about the impact of COVID-19 on total joint arthroplasty.

### **Outline:**

### Introduction

R. Michael Meneghini, MD

Perioperative Medical and Surgical COVID Issues: Keeping Surgeons, OR Teams and Patients Safe! James I. Huddleston III, MD Techniques and Strategies to Optimize Efficiencies in the Office and OR: Getting Through the Patient Backlog

R. Michael Meneghini, MD

Leveraging Early Discharge and Telehealth Technology to Safely Conserve Resources and Minimize Personal Contact James A. Browne, MD

### What Comprehensive Medicare Claims Data Reveals About the Impact of COVID-19 on Total Hip and Knee Arthroplasty

C. Lowry Barnes, MD

**Discussion** All Faculty

### Effects of Cannabis Use Disorder Following Primary Total Hip Arthroplasty

**Rushabh M. Vakharia, MD**, Angelo Mannino, MD, Hytham S. Salem, MD, Samuel J. Swiggett, MD, Martin W. Roche, MD, Michael A. Mont, MD, Che Hang Jason Wong, MD

**Introduction:** With the continued legalization of cannabis use within the United States, studies evaluating the effects of cannabis use disorder (CUD) following primary total hip arthroplasty (THA) are limited. Therefore, the purpose of this study was to utilize a nationwide administrative database and determine whether CUD patients undergoing primary THA have higher rates of 1) in-hospital lengths of stay (LOS); 2) medical complications; and 3) costs of care.

**Methods:** CUD patients undergoing primary THA were identified and matched to controls in a 1:5 ratio by age, sex, and medical comorbidities by utilizing International Classification of Disease, Ninth Revision (ICD-9) codes. The query yielded 44,154 patients within the CUD (n=7,361) and control (n=36,793) cohorts. Primary endpoints of the study included comparing in-hospital LOS, 90-day medical complications, and 90-day episode of care (EOC) costs. Mann-Whitney-U tests were used to compare LOS and costs. Multivariate logistic regression analyses were used to calculate the odds (OR) of developing complications adjusting for age, sex, geographic region, and Elixhauser-Comorbidity Index. A p-value less than 0.001 was considered statistically significant.

**Results:** The study found CUD patients had significantly longer in-hospital LOS (4- vs. 3-days, p<0.0001) compared to controls. Additionally, CUD patients were found to have significantly higher incidence and odds (11.23 vs. 4.82%; OR: 1.47, p<0.0001) of developing medical complications within 90-days following the index procedures, such as pneumonia (1.30 vs. 0.27%; OR: 2.87, p<0.0001), respiratory failure (1.24 vs. 0.26%; OR: 2.28, p<0.0001), cerebrovascular accidents (1.10 vs. 0.30%; OR: 2.01, p<0.0001) in addition to other complications. Furthermore, CUD patients incurred significantly higher 90-day EOC costs (\$24,585.96 vs. \$23,725.93, p<0.0001).

**Conclusions:** With the continued legalization of cannabis use, the study is vital as it can allow orthopaedists and other healthcare professionals to adequately educate CUD patients of the potential complications following their procedure.



### Do Runners Return to Running After Total Joint Arthroplasty?

Brielle J. Antonelli, BS, Rebecca Teng, BA, Rebecca G. Breslow, MD, Danielle Y. Ponzio, MD, Sarah Ulcoq, OTC, Antonia F. Chen, MD, MBA

**Introduction:** Currently, there are no evidence-based recommendations about returning to running after total joint arthroplasty (TJA). This study examines whether patients who ran prior to TJA were able to return to running.

**Methods:** This prospective, cross-sectional study of a multi-institutional patient database identified 4,492 primary total hip arthroplasty (THA), total knee arthroplasty (TKA) or partial knee arthroplasty (UKA) patients from June 2015 to June 2020. TJA patients completed an online survey capturing patient demographics, pre-TJA running experience, expectations, surgeon recommendations about return to running, postoperative running, cross-training practices, and satisfaction. Follow-up ranged from 6 months to >10 years.

Results: Of 4,492 TJA patients (57.9% female, 44.4% THA, 51.4% TKA, 4.2% UKA), 549 were runners preoperatively (12.2%: 53.4% THA, 39.7% TKA, 6.9% UKA; 36.3% female, 61.3±11.4 years, 26.9±4.6kg/m2 body mass index (BMI). 59 (10.7%) of pre-TJA runners did weekly muscle strength training. Most (98.3%) ran >2 years before TJA, and 46.5% ran >20 years. 164 (30.5%) expected to return to running, and 374 (69.5%) did not. Surgeon recommendations (528 patients) included no return to running (29.5%), maintain low-impact activities (35,2%), return to their preoperative running level (5,1%), and no recommendations (30.1%). Among 549 TJA preoperative runners, 65 (11.8%, 49 THA, 9 TKA, 7 UKA) returned to running: 64.6% between 2-6 months post-TJA, and 86.2% within 12 months post-TJA. 67.2% were satisfied with their return to running while 32.8% were not; 30.8% reported pain with running. 40 (1.0%) patients (27 THA, 13 TKA) who were not preoperative runners started running post-TJA; 22.2% reported pain with running and 63.9% were satisfied with their weekly amount of postoperative running.

**Conclusions:** 12% of preoperative runners were able to return to running, and most returned within one year of TJA. Larger-scale studies are needed to guide surgeons to provide standardized or realistic recommendations for patients wishing to resume running after TJA.



### Contemporary Total Hip Arthroplasty in Patients less than 30 Years: 10 Year Outcomes Are Encouraging

Christopher A. Anthony, MD, Wahid Abu-Amer, MD, Serena Freiman, MD, Gail Pashos, BS, John C. Clohisy, MD

**Introduction:** Contemporary total hip arthroplasty (THA) in very young patients is controversial, yet increasingly performed. There remains a major need for mid to long-term data on this population to inform surgeon and patient decision-making. The purpose of this study was to analyze primary THA with a HXLPE bearing surface in patients ≤30 years. We investigated implant survivorship, PROs, and polyethylene wear rates.

**Methods:** This investigation was a retrospective review of prospective data. 127 hips that underwent primary THA with a HXLPE liner were reviewed at mean 10.2 years follow-up. Mean patient age was 22 years (range 11-30). PROs included the modified Harris Hip (mHHS), WOMAC, UCLA, SF-12 physical and SF-12 mental scores. Linear and volumetric wear rates were measured (Martell Hip Analysis Suite).

**Results:** At an average 10.2 years 95.3% of the THAs survived and 4.7% had been revised. Reasons for revision included instability (2), infection (2), aseptic loosening (1), and liner disassociation (1). The mHHS increased from 47 to 85 (p<0.001). WOMAC pain (45 to 79), stiffness (42 to 70) and physical function (47 to 78) all had clinically important improvements (p<0.001). The average UCLA score increased from 3.8 to 5.9 (p<0.01). SF-12 physical score improved (31 to 41, p<0.01) while SF-12 mental score did not change (49 to 44, p=0.25). Mean linear wear rate was 0.03 mm/yr (SD 0.129) and mean volumetric wear rate was 29.00 mm3/yr (SD 42.58).

**Conclusions:** THA with a HXLPE bearing surface performed in very young patients (≤30 years) demonstrates survivorship of 95% at 10 years follow-up. Marked improvements in pain, function, and activity, combined with low failure and polyethylene wear rates strongly support this procedure in very young patients with disabling end stage hip disease.



### Taper Geometry and Head Size Both Affect Taper Fretting Corrosion in Total **Hip Arthroplasty**

Zein S. El-Zein, MD, J. Sawyer Croley, MD, Corinn Gehrke, MS, Matthew P. Siljander, MD, James J. Verner, MD, Michael A. Flierl, MD, Erin Baker, PhD

Introduction: Decreased fretting and corrosion at the taper interface of ceramic-on-polyethylene (CoP) vs. metal-onpolyethylene (MoP) total hip arthroplasties (THA) has been reported. Analyses have also indicated that smaller taper geometries and large femoral head sizes are associated with decreased or increased fretting and corrosion damage, respectively.

Methods: Eight cohorts were established from 157 retrieved CoP or MoP THA implants based on femoral head composition (n=95, zirconia-toughened alumina [ZTA]; n=62, cobalt chromium alloy [CoCr]); femoral head size (n=56, 32mm or n=101, 36mm); and taper geometry (n=84, 12/14 or n=73, V40). THA implants were evaluated and graded for fretting, corrosion, and damage at the taper interface. Data were statistically analyzed with significance defined as p<0.05. Mean age at index THA was 63 years, 61% were female, and mean body mass index was 29.3 kg/m2. The mean duration of implantation was 17 months (range: 0-138 months).

Results: Lower rates of moderate-to-severe fretting and corrosion damage were exhibited on ZTA heads (ZTA=13%, CoCr=38%); smaller heads (32mm=18%, 36mm=26%); and 12/14 tapers (12/14=13%, V40=35%). ZTA+32mm heads demonstrated the lowest rates of moderate-tosevere fretting and corrosion damage [2% (12/14 taper), 7% (V40 taper)]; while, CoCr heads with V40 tapers demonstrated the highest rates of moderate-to-severe fretting and corrosion at 47% (32mm head) and 59% (36mm head).

**Conclusions:** In this series, implants with 32mm heads, 12/14 tapers, and ZTA heads exhibited lower rates of moderate-to-severe damage scores. Isolating implant features may provide additional information regarding the factors leading to fretting and corrosion damage in THA.

### Comparison of Asymptomatic and Symptomatic ALTR in Patients with Head-Neck Taper Corrosion

**Kalain K. Workman, DO**, Margaret A. Weber, BS, Mattew J. Snyder, BS, Deepak Kumar, BS, Akshay V. Daji, BS, Camilo Borrero, MD, Andrew C. Cordle, MD, PhD, Anthony M. DiGioia, MD, Brian R. Hamlin, MD, Kenneth L. Urish, MD, PhD

**Introduction:** Diagnosis of adverse local tissue reactions (ALTR) in metal-on-polyethylene (MoP) total hip arthroplasty (THA) secondary to head-neck taper corrosion is challenging. The purpose of this study was to compare differences between asymptomatic and symptomatic ALTR in an observational cohort, including presentation, metal ion differences, and Metal Artifact Reduction Sequence (MARS) MRI findings.

**Methods:** We performed a retrospective review of an observational cohort of 492 MoP THA patients at increased risk for developing ALTR. 94 patients underwent revision arthroplasty for ALTR. Patients were stratified into symptomatic and asymptomatic ALTR groups. Presentation, metal ion levels, and imaging findings were compared.

**Results:** For patients with confirmed ALTR, 41% were asymptomatic. There was a statistically significant difference in the serum chromium levels between symptomatic and asymptomatic ALTR patients (2.2 $\mu$ g/L vs. 3.1  $\mu$ g/L, p=0.05). There was no statistically significant difference between the serum cobalt levels or MRI findings in these two groups. We observed that extracapsular disease associated with ALTR could be misinterpreted as trochanteric bursitis.

**Conclusions:** Almost half of the MoP THA ALTR cases identified were asymptomatic. Cobalt levels could not differentiate between symptomatic and asymptomatic pseudotumor formation. Symptomatic and asymptomatic MoP ALTR have similar MARS MRI characteristics. Our findings suggest that it is essential to risk stratify patients who could potentially have ALTR based on implant type, symptoms, ion levels, and MARS MRI.

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# Is There a Problem with Modular Dual Mobility Components in Revision THA at Mid-term Follow-up?

Nicholas M. Hernandez, MD, Zoe W. Hinton, BS, Christine J. Wu, BS, Paul F. Lachiewicz, MD, Sean P. Ryan, MD, Samuel S. Wellman, MD

**Introduction:** Modular dual mobility (MDM) acetabular components are often used to prevent dislocation in revision total hip arthroplasty (THA). As there is insufficient data on these components, the outcomes were evaluated in a cohort with a mean follow-up time greater than five years.

**Methods:** Using the database of a single academic center, 126 revision THAs (117 patients) with one MDM were retrospectively reviewed. There were 94 hips in 88 patients with a mean follow-up time of 5.5 years. Survivorship analysis was performed with the endpoints of dislocation, reoperation for dislocation, cup revision for aseptic loosening, and cup revision for any reason. The secondary endpoints were perioperative complications and radiographic review.

**Results:** The overall rate of dislocation was 11%, with a 6-year survival of 91%. Reoperation for dislocation was performed in 7 patients (7%), with a 6-year survival of 94%. The dislocations were early (mean 33 days) in 6 patients, and late (mean 4.3 years) in 4 patients. There were 3 intraprosthetic dissociations. An outer head diameter of 48 mm or greater was associated with a lower risk of dislocation (p=0.013). Four hips (4%) were revised for aseptic cup loosening, and 14 (15%) cups were revised for infection. Two hips had visible metallic changes of the backside of the cobalt chromium liner.

**Conclusions:** Using this MDM component in revision THA, at mean follow-up time of 5.5 years, there was a higher rate of dislocation (11%) than previously reported. Outer bearing size was related to the risk of dislocation. There was a low rate of aseptic cup loosening. Longer follow-up of this MDM component and evaluation of other designs is warranted.



# Symposium VI

### Dual Mobility THA: A Durable Game-Changer or the Next Cause for Concern?

Faculty: P. Maxwell Courtney, MD, Atul F. Kamath, MD, Gwo-Chin Lee, MD, Steven M. Kurtz, PhD

Instability following total hip arthroplasty (THA) remains a leading cause of revision and presents a treatment dilemma for orthopaedic surgeons. Dual mobility (DM) bearing articulations have been used in Europe for decades with success but have only recently been introduced in the United States. Recent data from the American Joint Replacement Registry (AJRR) has shown a marked increase in the use of DM among surgeons from 2011 to 2018. While some studies have shown that DM may decrease the risk of dislocation following both primary and revision THA, concerns exist regarding accelerated wear, corrosion with modular liners, and intraprosthetic dislocation. Recent data from the AJRR has shown a marked increase in the use of DM among surgeons from 2011 to 2018. This symposium will follow a case-based format to review the appropriate indications and outcomes following DM in THA. An expert in biomedical engineering will review the tribology and mechanisms of corrosion with modular dual mobility liners. The panelists will also provide several cases for discussion including recognizing complications from DM bearings, novel uses of DM in primary and revision THA, and tips when revising DM patients.

### Learning Objectives:

- 1. Understand the indications and evidenced-based outcomes of dual mobility in primary and revision THA.
- 2. Discuss the unique complications associated with dual mobility bearings including modular corrosion, intraprosthetic dislocation, and femoral neck impingement.
- **3.** Learn the basic science behind corrosion with modular dual mobility acetabular liners.
- **4.** Review novel uses of dual mobility though case presentations in complex primary and revision THA.

### **Outline:**

Introduction Gwo Chin Lee, MD Dual Mobility Reduces Dislocations – Why I Use It in All Revisions

P. Maxwell Courtney, MD

Spine Fusions, Yoga Instructors, and Hip Fractures – The Role of Dual Mobility in Primary THA Atul F. Kamath, MD

Metallosis Is Real – The Basic Science of Corrosion with a Modular Liner Steven M. Kurtz, PhD

Clinical Concerns with Dual Mobility – Why I Avoid It at All Costs Gwo-Chin Lee. MD

**Discussion** All Faculty



### Spinal Fusion and Total Hip Arthroplasty: Why Timing Is Important

**Nequesha S. Mohamed, MD**, Ethan A. Remily, DO, Wayne A. Wilkie, DO, Sahir S. Pervaiz, MD, Scott J. Douglas, MD, Justin A. Stafford, DO, Johannes F. Plate, MD, Qais Naziri, MD, MBA, James Nace, DO, Ronald E. Delanois, MD

**Introduction:** In recent years, there has been much debate over the relationship between low back spinal fusion and total hip arthroplasty (THA). The timing of both procedures has been brought into question, as several studies have documented "hip spine syndrome" with concurrent degenerative disease in both the hip and lumber spine. Few large studies have directly compared the results of patients who undergo fusion prior to THA to those who undergo fusion after THA. Thus, the current study matched THA patients with a prior lumbar spinal fusion to patients that underwent lumbar spinal fusion after THA to assess postoperative outcomes.

**Methods:** The Symphony database was retrospectively reviewed with the PearlDiver Supercomputer to identify all patients undergoing THA between 2010 and 2018 (n=716,084). Patients who underwent a lumbar fusion prior to THA and after THA were then matched 1:1 on demographics. Categorical and continuous variables were analyzed utilizing analyses of variance and chi-square, respectively.

**Results:** Between pre-THA and post-THA fusion patients, age (p=0.246), male sex (p=0.999), CCI (p=0.999) and morbid obesity (p=0.999) were evenly matched. The length of stay for pre-THA patients was slightly shorter (p=0.015). There was a similar number of revisions performed (p=0.183). Pre-THA fusion patients experienced significantly more dislocations in the postoperative period compared to post-THA fusion patients (p=0.048). All other complications were nonsignificant.

**Conclusions:** Prior spinal fusion has been demonstrated to increase the risk of postoperative dislocation in patients undergoing THA. The results of the present study demonstrate increased dislocations in prior spinal fusion compared to post-THA fusion. For patients with "hip spine syndrome" requiring both a spinal fusion and a THA, it may be more beneficial to undergo THA prior to lumbar fusion. Arthroplasty surgeons may wish to collaborate with spinal surgeons to ensure optimal outcomes for this group of patients.



### Pelvic Tilt and the Pubic Symphysis-Sacrococcygeal Junction Distance: Risk Factors for Hip Dislocation

**William G. Rainer, DO**, Michael J. Taunton, MD, Matthew P. Abdel, MD, Daniel J. Berry, MD, Brett A. Freedman, MD

**Introduction:** Dislocation after total hip arthroplasty (THA) is the most common postoperative complication in contemporary practice. While spinopelvic alignment influences the risk of dislocation, knowledge of readily measured, actionable parameters has been limited. As such, our goal was to determine effect of pelvic tilt, using an easily measured pelvic parameter, on risk of dislocation by evaluating two distinct cohorts: those with and without a history of dislocation.

**Methods:** Using our institutional total joint registry, we identified 8,597 patients (10,082 THAs) who underwent primary THA from 2006 to 2015. Patients who underwent primary THA for acute fracture, tumor, infection, or high-grade dysplasia were excluded. 177 THAs dislocated postoperatively (1.7%). Mean time to dislocation was 15 months. Cases were matched 1:1 (age, sex, BMI, and surgical year) to controls who did not dislocate. Pelvic tilt was calculated using the pubic symphysis to sacrococcygeal junction distance (PSCD) on a single postoperative supine anteroposterior (AP) pelvic radiograph obtained prior to or following dislocation. The association between dislocation and the PSCD was evaluated by logistic regression analysis. Mean follow-up was 3 years.

**Results:** Patients who dislocated had more posteriorly rotated pelvises vs. controls. The mean pelvic tilt in this group was 57° (vs. 60°; p=0.02) and the PSCD was 41 mm (vs. 46 mm; p=0.04). Patients with a PSCD of <0 mm (symphysis above sacrococcygeal junction) had 9-fold odds of dislocation compared to those with a PSCD of >50 (OR 9; p=0.006).

**Conclusions:** Patients who dislocated following primary THA had pelvises that had more mean posterior pelvic rotation. Additionally, those with a PSCD <0 on a supine AP pelvic radiograph had 9-fold increased odds of dislocation. This simple technique could alert a surgeon to those at higher risk for dislocation and avoid the need for supplemental spine radiographs.



# Dislocation Rates Following Direct Anterior Approach Total Hip Regardless of Spinopelvic Deformity

John V. Horberg, MD, **Benjamin R. Coobs, MD**, Aneel Jiwanlal, MD, Christopher J. Betzle, MD, Susan G. Capps, PhD, Joseph T. Moskal, MD, FACS

**Introduction:** The use of the direct anterior approach (DAA) for total hip arthroplasty (THA) has increased in recent years. This is due, in part, to proposed albeit debated benefits including lower risk of dislocation. The purpose of this study is to understand the dislocation rate in a non-selective, consecutive cohort of patients undergoing THA via the DAA including those at high risk for instability due to spinopelvic pathology.

**Methods:** We retrospectively reviewed all patients undergoing THA via the DAA between 2011 and 2017. The primary outcome was dislocation at minimum twoyear follow-up. We then stratified patients by known risk factors for dislocation, including spinopelvic pathology, and performed an in-depth analysis of dislocations.

**Results:** 2,831 hips in 2,205 patients were included. Mean age was 64.9 (Range: 24-96), BMI was 29.2 (Range: 15.1-53.8) and 1,595 (56.3%) were female. There were 11 (0.38%) dislocations within one year of the index operation and 13 (0.45%) total dislocations at terminal follow-up. Five dislocations (38.4% of dislocations; 0.17% overall) required revision. The dislocation rate for surgeons who had completed their learning curve compared to those who had not was 0.15% vs. 1.11%, respectively. There were 666 patients with an established diagnosis spinopelvic pathology or prior surgical instrumentation, of which 2 (0.30%) dislocated and neither required revision.

**Conclusions:** In a non-selective, consecutive cohort of patients undergoing THA via the DAA, the risk of dislocation is low, even amongst patients with lumbosacral stiffness secondary to spinal instrumentation or degenerative changes. Our data suggests that utilizing the DAA in highrisk patients may be protective against dislocation without the need for additional constraint or the use of newer bearing constructs that lack long term outcome studies. The inclusion of seven surgeons in our study further suggests that these results are generalizable.

# Operative Times in Primary Total Hip Arthroplasty Will Remain Stable Up to the Year 2027

Linsen T. Samuel, MD, MBA, Alexander J. Acuña, BS, Jaret M. Karnuta, MS, Ahmed K. Emara, MD, Atul F. Kamath, MD

**Introduction:** Operative time represents a significant portion of intraservice time in total joint arthroplasty. Intraservice time is a primary factor when considering valuation of Current Procedural Terminology (CPT) codes. Recently, the Centers for Medicare and Medicaid (CMS) have announced the decision to review "potentially misvalued" CPT codes, including those for primary total hip arthroplasty (THA). Although recent studies have suggested that THA operative times have remained stable in recent years, there has been an absence of information regarding how operative times are expected to change in the future. Therefore, the purpose of our analysis was to produce two- and ten-year prediction models developed from contemporary operative time data.

**Methods:** Utilizing the American College of Surgeons National Surgical Quality Improvement (ACS-NSQIP) patient database, all primary THA procedures performed between January 1, 2008 and December 31, 2017 were identified. Our final cohort consisted of 85,808 THA patients. Autocorrelation-fit significance was determined using Box-Ljung lack of fit tests. Time series stationarity was evaluated using augmented Dickey-Fuller tests. After adjusting nonstationary time series for seasonality-dependent changes, 2-year and 10-year operative times were predicted using autoregressive integrated moving average (ARIMA) forecasting models.

**Results:** Operative time for ASA Class 2 will remain stable (p=0.8269) and is projected to fall within 1 minute of the previously calculated weighted mean. Similarly, ASA Class 3 projections will remain stable (p=0.2385), falling within 3 minutes of the previously calculated weighted mean.

**Conclusions:** We found that operative time will remain within 3 minutes of the most recently reported mean up to the year 2027. Therefore, our findings do not support lowering physician compensation based on this metric. Future analyses should evaluate if operative times adjust considering the changing patient demographics and alternative reimbursement models.



# Total Hip Arthroplasty for Femoral Neck Fracture: What Are the Contemporary Reasons for Failure?

**Elizabeth B. Gausden, MD, MPH**, William W. Cross, MD, Tad M. Mabry, MD, Mark W. Pagnano, MD, Daniel J. Berry, MD, Matthew P. Abdel, MD

**Introduction:** While total hip arthroplasty (THA) for femoral neck fracture (FNF) provides superior outcomes compared to hemiarthroplasty in active, elderly patients, the historical tradeoff has been a higher risk of dislocation. Given the rise in use of THA to treat FNFs in contemporary practice, it is paramount to understand contemporary reasons for failure. We aimed to describe implant survivorship and reasons for failure after THA for FNFs at a single academic institution.

**Methods:** We identified 218 FNFs (213 patients) treated with THA from 2000-2017 from our institutional total joint registry (over the same period, 2,039 FNFs were treated with hemiarthroplasty). Mean age was 70 years (range: 44-95) and 62% were female. Cemented femoral components were utilized in 39%. Approach was anterolateral in 71%, posterior in 21%, and direct anterior in 8%. Dual-mobility constructs were utilized in 3%. In the remaining patients, femoral head diameter was 28mm in 8%, 32mm in 34%, 36mm in 52%, and 40mm in 2%. We analyzed patient mortality and implant survivorship with Kaplan-Meier survival curves. Mean follow-up was 4 years.

**Results:** The 5-year cumulative incidence of any revision was 10%. 19 hips were revised for the following indications: postoperative periprosthetic femur fracture (6; 3 uncemented stems, 3 cemented), infection (5), aseptic loosening of the femoral component (3; 2 cemented, 1 uncemented), dislocation (3), iliopsoas impingement (1), and liner dissociation (1). The 5-year cumulative incidence of postoperative periprosthetic femur fractures was 6%, including 8 Vancouver AG, 4 B2, and 2 C fractures. The 5-year cumulative incidence of dislocation was 1.5%.

**Conclusions:** The 5-year cumulative incidence of any revision after THA for FNFs was 10%, mostly attributed to periprosthetic fracture and infection. Hip instability (1.5% at 5 years) was not as common after FNF with contemporary patient selection, techniques and implants compared to previous series.

### Computed Tomography Evaluation of Elder Femoral Neck Fractures: Guiding Classification and Treatment

Elizabeth P. Davis, MD, David Rodriguez-Quintana, MD, Timothy Achor, MD

**Introduction:** The Garden classification guides treatment for elder femoral neck fractures. Stable patterns receive percutaneous screw fixation and unstable patterns receive arthroplasty. The purpose of this study is to determine if computed tomography (CT) better identifies posterior cortical roll-off and head angulation and predicts failure of percutaneous fixation of "stable" femoral neck fractures.

**Methods:** A retrospective study of elder femoral neck fractures seen at our institution between January 2017 and August 2019 was performed. Garden classification was done using an AP radiograph of the hip. If the patient had a CT, it was reviewed to determine if it altered initial Garden classification with regards to posterior cortical roll-off, displacement, fracture completeness, and head angulation. Student's t-test was used to compare means and chisquare to compare incidence rates.

**Results:** 249 patients, 168 females and 81 males with mean age of 79, were analyzed. There were 57 and 24 Garden I and II fractures. There were 33 and 134 Garden III and IV fractures. CT was available for analysis in 126 patients. CT changed classification from stable to unstable in 50% of patients. Garden I had a significantly higher incidence of classification change after CT than Garden II, III and IV (p<0.05). Posterior cortical roll-off and head angulation was seen in 57% of Garden I fractures. 21 patients required revision arthroplasty after percutaneous fixation failure. All were stable on radiographs and unstable on CT with posterior cortical roll-off and head angulation. Patients with stable patterns on radiographs and CT did well with percutaneous fixation at 6-months to 1-year follow-up.

**Conclusions:** Radiographs grossly underestimate posterior cortical roll-off, head angulation, and fracture completeness in elder femoral neck fractures. Patients with posterior cortical roll off and increased head angulation that were treated with percutaneous fixation had significantly worse outcomes requiring revision surgery to arthroplasty.



# Symposium VII

### Applying the Hip-Spine Relationship to Clinical Practice

**Faculty:** Jeremy M. Gililland, MD, Ryan M. Nunley, MD, Douglas E. Padgett, MD, Jonathan M. Vigdorchik, MD

This symposium will provide the latest information on why the hip-spine relationship is important to consider in total hip arthroplasty (THA) and how it influences the functional acetabular component position and THA outcomes. This year, we hope to incorporate several new aspects, mainly the femoral side, as well as practical techniques to implement this into practice. Most importantly, audience members will leave with an understanding of the hip-spine relationship and a simple/easy way to incorporate it into their practice.

### Learning Objectives:

- **1.** To understand what x-rays to take, how to take them, and when to take them.
- 2. To understand how to simply interpret that x-ray and when/how to make an intra-operative adjustment no matter if you are an anterior approach, fluoroscopy guided, conventional instruments or navigation/robotic surgeon.

### **Outline:**

Introduction Jonathan M. Vigdorchik, MD

What X-rays Are Important? How to Take Them and How/What to Measure Ryan M. Nunley, MD

Combined Anteversion – The Importance of Femoral Version Douglas E. Padgett, MD

How to Manage These Concepts as an Anterior Approach Surgeon; Appropriate Use of Fluoroscopy? Jeremy M. Gililland, MD

How to Manage These Concepts as a Posterior Approach Surgeon: Specific Case Examples, Audience Response Jonathan M. Vigdorchik, MD

**Discussion** All Faculty

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### Adult Reconstruction Education During the COVID-19 Pandemic: AAHKS Responds

**William G. Hamilton, MD**, Natalie R. Loper, BA, Antonia F. Chen, MD, MBA, Matthew P. Abdel, MD, Bryan D. Springer MD

**Introduction:** The COVID-19 pandemic caused an abrupt disruption in fellowship training, with most in-person teaching ceasing in mid-March 2020. The AAHKS Board of Directors quickly approved and initiated an online lecture series named the Fellows Online COVID-19 AAHKS Learning (FOCAL) Initiative.

**Methods:** Beginning March 31, 2020, an online teaching program was initiated. Adult reconstruction fellows and senior residents with interest in arthroplasty were invited to participate in the free, live, online education sessions. Faculty from well-respected training institutions from around the country volunteered their time to host the initiative, choosing topics to present, ranging from hip (13 lectures) and knee (9), to practice management/miscellaneous (12). All sessions were recorded and posted on the AAHKS website for viewing. Attendee registrations were tracked via the online platform and the maximum number of attendees per session was recorded. A survey was administered to attendees for feedback.

**Results:** 34 one-hour virtual lectures were delivered in real-time by 79 different faculty members from 20 separate institutions. A total of 4,746 registrations for the 34 lectures were received, with 2,768 registrants (58%) attending. The average attendance was 81 viewers per session (Range: 21-143), with attendance peaking mid-April 2020. A gradual decline was observed as the ban on elective surgery was lifted in May 2020. A survey administered to residents and fellows showed that 93/109 (85%) watched (32%), 4-6 (24%), 7-9 (12%), 10-12 (7%), 13 or more (9%). 90% of attendees responded that they wanted the lectures to continue after the pandemic ends.

**Conclusions:** Amid a pandemic with cessation of inperson training, AAHKS delivered a robust virtual training alternative, exposing fellows to a variety of renowned faculty and topics. Attendance and satisfaction with the program were very high. This initiative may lead to future opportunities in virtual fellowship education.

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### Gender Representation in Speaking Roles at the AAHKS Annual Meeting: 2012-2019

Anna R. Cohen-Rosenblum, MD, Jenna A. Bernstein, MD, Cara A. Cipriano MD

**Introduction:** The American Association of Hip and Knee Surgeons (AAHKS) has one of the lowest percentages of women as members among orthopaedic surgery subspecialty societies, having increased from 1.3% to 3.1% since 2012. Our purpose was to report the representation of women in various speaking roles at the AAHKS Annual Meeting over this time period.

**Methods:** We accessed the 2012 through 2019 AAHKS Annual Meeting programs at http://meeting.aahks.org/ archives/ and reviewed all paper presenters, symposium faculty, and session moderators. We recorded instances of women speakers as well as their degree and specialty, noting if a woman speaker was an orthopaedic surgeon (MD/DO in orthopaedic surgery residency or practice). We calculated the percentage of women speakers, women orthopaedic surgeon speakers, women session moderators, and women symposium faculty for the overall period of 2012-2019, and for each Annual Meeting.

**Results:** Between 2012 and 2019, 3.8% (33/877) of all speakers at AAHKS were women. Of these, 11 were women orthopaedic surgeons, or 1.3% of all speakers. 23 (4.8%) out of 477 paper presenters were women, and 16 (3.4%) were women orthopaedic surgeons. The proportion of women speakers per year ranged from 2.7% (2017) to 6.4% (2013), while that of women orthopaedic surgeon speakers ranged from 0.9% (2017 and 2019) to 4.5% (2016). 4 (2.8%) out of 143 session moderators were women, all of whom were orthopaedic surgeons. 2.0% (5/245) of symposium faculty were women, none being women orthopaedic surgeons.

**Conclusions:** While the female AAHKS membership has grown since 2012, the small percentage of women orthopaedic surgeons speaking at AAHKS has not. Importantly, there were no women orthopaedic surgeons included on symposium faculty over this entire period. We appreciate and encourage efforts to improve gender diversity among speakers at AAHKS annual meetings.



# Intraoperative Scrub Nurse Hand-offs Increase Operative Times for Total Hip and Knee Arthroplasty

**Thomas R. Hickernell, MD**, Austin C. Kaidi, MS, Bradley T. Hammoor, MS, William N. Levine, MD, Alexander L. Neuwirth, MD, Jakub Tatka, MD, Jeffrey A. Geller, MD, Herbert J. Cooper, MD

**Introduction:** Surgeons typically remain scrubbed-in for the duration of a surgical case, while scrub nurses and/ or surgical technicians often work shifts, necessitating occasional mid-surgery hand-offs. These hand-offs can create inefficiencies. Currently, no research has been done on the impact of intraoperative hand-offs on orthopaedic procedures' operative times. Since increased operative times are known to increase infection risk and healthcare expenditures, efforts to improve OR efficiency should be optimized wherever possible.

**Methods:** A retrospective chart review was performed at a major, urban, academic medical center for all primary total hip arthroplasties (THA) and total knee arthroplasties (TKA) done between May 2014 and May 2018, identified by CPT code. Operative times, number of scrub nurse handoffs, surgeon information, and patient information were collected. A multivariable linear regression was performed to assess the association between patient and surgeon characteristics, intra-operative hand-offs, and operative times.

**Results:** 1,109 TKA and 1,032 THA patients were identified. Multivariable linear regression demonstrated that increasing the number of intraoperative scrub nurse hand-offs was associated with increased operative times for all patients. For TKA patients, all other variables being held equal, one handoff increased operative times by 3.89 minutes (p=0.02) and two or more hand-offs increased operative times by 15.99 minutes (p<0.001). For THA patients, all other variables being held equal, one handoff increased operative times by 15.99 minutes (p<0.001). For THA patients, all other variables being held equal, one handoff increased operative times by 6.20 minutes (p<0.001) and two or more hand-offs increased operative times by 18.52 minutes (p<0.001).

**Conclusions:** Although direct causation cannot be definitively established, we observed that intraoperative scrub nurse hand-offs were associated with statistically significant increases in operative times for both THA and TKA cases. Optimizing scrub nurse staffing models to decrease intraoperative hand-offs could have practical ramifications on orthopaedic patient care by increasing efficiency, decreasing costs, and potentially decreasing patient complications related to lengthened surgical times, such as infection.



### Generalized Anxiety Disorder: A Modifiable Risk Factor for Pain Catastrophizing in Joint Replacement

Yale A. Fillingham, MD, **Thomas M. Hanson, MD, MS**, Kathleen A. Leinweber, MD, Adriana P. Lucas, MS, David S. Jevsevar, MD, MBA

**Introduction:** Patients with mood disorders undergoing total joint arthroplasty (TJA) are at increased risk for poor functional outcomes, revision, and dissatisfaction. Therapy with serotonin reuptake inhibitors (SSRI/SNRI) is proven treatment for generalized anxiety disorder (GAD). This study seeks to examine the effect of GAD on postoperative pain and evaluate if GAD is a modifiable risk factor for poor postoperative pain control following TJA.

Methods: Between March 2019 and March 2020 at a single-center, 218 TJA patients had preoperative anxiety screening using the Generalized Anxiety Disorder 2-item screening tool (GAD-2; score of ≥3 is the cut-off for GAD in the general population) and 6-week postoperative Pain Catastrophizing Scale (PCS) scores. Patients were organized into 4 cohorts based on preoperative SSRI/SNRI use and GAD-2 scores:

Group 1: No SSRI/SNRI use, GAD-2 score <3 – Control patients

Group 2: SSRI/SNRI use, GAD-2 score <3 – Appropriately treated GAD patients

Group 3: SSRI/SNRI use, GAD-2 score ≥3 – Undertreated GAD patients

Group 4: No SSRI/SNRI use, GAD-2 score  $\geq$ 3 – Untreated GAD patients

The cohorts were subjected to multivariate linear regression analysis and equivalence testing with two-one-sided t-tests.

**Results:** Patients with preoperative GAD-2 scores  $\geq$ 3 had worse postoperative pain as shown by a significantly higher average 6-week postoperative PCS score than patients with GAD-2 scores <3 (9.25 vs. 5.08, respectively; p=0.003). Patients with appropriately treated GAD and the control group had statistically equivalent postoperative pain while patients with undertreated or untreated GAD had worse postoperative pain.

**Conclusions:** Preoperative GAD is a risk factor for poor postoperative pain control following TJA but is a modifiable risk factor when patients are appropriately treated. Screening for preoperative GAD with GAD-2 and referral for treatment is a method to potentially improve patient outcomes and reduce postoperative opioid consumption following TJA.



### Predictors of Failure After Surgical Treatment of FAI: Results of a Multicenter Prospective Cohort

**Jeffrey J. Nepple, MD**, Asheesh Bedi, MD, Ira Zaltz, MD, Chris Larson, MD, Daniel J. Sucato, MD, Paul E. Beaulé, MD, FRCSC, Young Jo Kim, MD, The ANCHOR Study Group, John C. Clohisy, MD

**Introduction:** Treatment of femoroacetabular impingement (FAI) attempts to improve symptoms through repair of intraarticular labrochondral pathology and correction of bony deformity. Nevertheless, a subgroup of patients does not respond favorably to surgery. The purpose of the current study was to determine independent predictors of failure after surgical treatment of femoroacetabular impingement in a large prospective multicenter cohort study.

**Methods:** A prospective cohort study of the surgical treatment of FAI was performed. A total of 760 hips undergoing primary treatment of FAI were enrolled across seven surgeons. Patient characteristics, baseline PROs, imaging findings, intraoperative pathology, and surgical treatments were recorded. A total of 621 hips (81.6%) with minimum one-year follow-up were included (mean 4.3 years). The mHHS was assessed relative to the minimally clinically important difference (MCID, 8 points) and patient acceptable symptom state (PASS, 74 points). Univariate analyses were performed to identify factors significantly associated with failure. Multivariate logistic regression was performed to identify independent predictors of failure.

**Results:** A total of 621 hips undergoing surgery for FAI were followed a mean 4.2 years. This cohort had a mean age of 29.8 years and included 57% females. Multivariate logistic regression identified independent predictors of each failure definition. Failure A (THA) was independently associated with increasing age, acetabular microfracture (both p<0.001), and femoral head chondroplasty (p=0.02). Failure B (THA or revision surgery) was independently associated only with lower preoperative mHHS (p<0.001) (p=0.01). A lower failure C (clinical failure) was independently associated with participation in competitive athletics (p=0.01), BMI (p<0.001), and male gender (p<0.001).

**Conclusions:** This large multicenter cohort demonstrates the outcomes of FAI treatment at a mean of 4.3 years postoperative. Rates of THA and revision surgery were 4.0% and 6.9%. An additional 14.8% of patients demonstrated clinical failure based on patient-reported outcomes.



# Symposium VIII

### Tips and Tricks to Save You During Revision THA: Video-Based Demonstrations

**Faculty:** Matthew P. Abdel, MD, Wayne G. Paprosky, MD, Bryan D. Springer, MD, Robert T. Trousdale, MD

This symposium will provide the latest information on managing patients with failed total hip arthroplasties (THA) who require complex exposures, biologic fixation to manage bone loss, and advanced techniques to treat and mitigate complications such as infection.

### Learning Objectives:

- 1. To understand how to safely expose complex revision THAs with a variety of surgical techniques based upon video demonstrations.
- 2. To understand the principles and surgical techniques behind utilizing modern implants (such as porous metals to address complex acetabular defects, and modular fluted tapered stems to address the majority of femoral defects) most successfully in revision THA.
- **3.** To understand the best techniques when using antibiotic spacers for infection.

### **Outline:**

Introduction Matthew P. Abdel, MD

Extended Trochanteric Osteotomies and Component Removal: It Is an Art! Matthew P. Abdel, MD

Hemispherical Cups, Augments, and Cages: How to Make Them All Work Wayne G. Paprosky, MD

Modular Fluted Tapered Stems: Making Revisions Easy Robert T. Trousdale, MD

Articulating and Non-Articulating Spacers for PJI: What Are the Options in 2020? Bryan D. Springer, MD

**Discussion** All Faculty

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# Periprosthetic Femur Fracture Risk: Influenced by Stem Choice, Not Surgical Approach

Robert A. Sershon, MD, James F. McDonald, III, BS, Henry Ho, MS, William G. Hamilton, MD

**Introduction:** Periprosthetic femur fracture (PFF) remains a common reason for failure following total hip arthroplasty (THA). For over 10 years, our institution has performed both anterior (AA) and posterior (PA) approaches for primary THA with multiple stem designs. The aim of this study is to determine the 90-days relative risk of PFF in regards to approach and stem design.

**Methods:** A retrospective review of our institutional database was performed on all patients undergoing primary THA from 2007-2018 using AA or PA approaches. Five surgeons performing 6,309 THAs (AA=4510; PA=1799) using single-wedge taper (n=2417) or fit-and-fill (n=3892) stems were included. PFF occurring within 90-days of the index procedure were analyzed. Differences in PFF rates, fracture location, stem type, and treatment method were assessed. Comparisons were made using a Cox Regression analysis..

**Results:** The 90-days revision rate for fracture was 0.3%. Clinically significant fractures requiring cerclage cabling, stem change, revision, or ORIF occurred in 1.0% of patients (intraoperative=0.7%; postoperative=0.3%). No increased risk of PFF was found based on approach (p=0.42), sex (p=0.12), or surgeon (p=0.38). Single wedge taper stem designs were 4.8 times more likely to result in PFF than fit-and-fill stems (p<0.01). Collared stems were 4.4 times less likely to result in PFF than non-collared stems (p<0.01). Age over 65 and BMI under 25 were risk factors for PFF (p=0.03).

**Conclusions:** Our single-center experience demonstrates that risk of periprosthetic fracture within one year of surgery is significantly lower with collared stems and fit-and-fill designs. Age over 65 and BMI below 25 nearly double PFF risk.



### **Development of Machine Learning Algorithms for Predicting Complications After Primary THA**

Kyle N. Kunze, MD, Aditya V. Karhade, BS, Evan M. Polce, BS, Alex Sadauskas, MD, Joseph H. Schwab, MD, Brett R. Levine, MD, MS

Introduction: Complications after primary total hip arthroplasty (THA) which result in readmission or reoperation have the potential to impose a significant cost on the healthcare system with the implementation of alternative payment models. The aims of this study were to 1) develop and internally validate supervised machine learning algorithms to predict complications after total hip arthroplasty; and 2) to develop an open-access clinical decision aid capable of providing patient-level risk explanations.

**Methods:** This was a retrospective case-control study of institutional registry data. The primary outcome was allcause complications at two-years after primary THA. Twelve preoperative variables were considered for prediction, including demographics, medical history, opioid use, and preoperative outcome scores. Recursive feature elimination was applied to identify the variables with the greatest predictive value. An 80:20 random sample split was used to stratify patients into training and testing sets. Five supervised machine learning algorithms were developed on the training set using 10-fold cross-validation and internally validated on the independent testing set. All algorithms were assessed by discrimination, calibration, Brier score, and decision curve analysis to quantify performance.

Results: A total of 616 patients were included. The observed complication rate was 16.6%. The stochastic gradient boosting model achieved the best performance in the independent testing set not used for algorithm development, with c-statistic=0.88, calibration intercept=0.1, calibration slope=1.22, and Brier score=0.09. The most important factors for predicting postoperative complications were age, drug allergies, prior hip surgery, smoking, and opioid use. Individual patient-level explanations were provided for the algorithm predictions and the algorithms were incorporated into an open access digital application: https://sorg-apps. shinyapps.io/tha complication.

Conclusions: The stochastic gradient boosting algorithm demonstrated excellent discriminatory capacity for identifying patients at high-risk of experiencing complications following primary THA. The open-access application can be used to determine patient-specific risk of complications based off their medical profile.



# Artificial Intelligence to Identify Arthroplasty Implants from Plain Radiographs of the Hip

**Jaret M. Karnuta, MS**, Heather S. Haeberle, MD, Bryan C. Luu, BS, Alexander Roth, MD, Robert M. Molloy, MD, Nicolas S. Piuzzi, MD, Antonia F. Chen, MD, MBA, Richard Iorio, MD, Viktor E. Krebs, MD, Prem N. Ramkumar, MD, MBA

**Introduction:** The surgical management of complications surrounding patients who have undergone hip arthroplasty necessitates accurate identification of the femoral implant manufacturer and models. Failure to do so risks delays in care, increased morbidity, and further economic burden. Since few arthroplasty experts can confidently classify implants using plain radiographs, automated image processing using deep learning for implant identification may offer an opportunity to improve clinical patient care.

**Methods:** We trained, validated, and externally tested a deep-learning system to classify total hip arthroplasty (THA) and hip resurfacing arthroplasty (HRA) femoral implants as one of 18 different manufacturer models from 1,972 retrospectively collected anterior-posterior (AP) plain radiographs from 4 sites in one quaternary referral health system. From these radiographs, 1,559 were used for training, 207 for validation, and 206 for external testing. Performance was evaluated by calculating the area under the receiver-operating characteristic curve (AUC), sensitivity, specificity, and accuracy, as compared with a reference standard of implant model from operative reports with implant serial numbers.

**Results:** The training and validation data sets from 1,715 patients and 1,766 AP radiographs included 18 different femoral components across four leading implant manufacturers and 10 fellowship-trained arthroplasty surgeons. After 1,000 training epochs by the deep-learning system, the system discriminated 18 implant models with an AUC of 0.999, accuracy of 99.6%, sensitivity of 94.3%, and specificity of 99.8% in the external-testing data set of 206 AP radiographs.

**Conclusions:** A deep-learning system using AP plain radiographs accurately differentiated among 18 hip arthroplasty models from the four industry leading manufacturers.

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### Mepivacaine vs. Bupivacaine Spinal Anesthesia: A Randomized, Double-blind Controlled Trial

**Eric S. Schwenk, MD**, Vincent P. Kasper, MD, Marc C. Torjman, PhD, Matthew S. Austin, MD, Scot A. Brown, MD, William J. Hozack, MD

**Introduction:** Early ambulation after total hip arthroplasty (THA) predicts early discharge. Spinal anesthesia is preferred but can delay ambulation, especially with bupivacaine. Mepivacaine, an intermediate-acting local anesthetic, could enable earlier ambulation than bupivacaine. We hypothesized that patients who received mepivacaine would ambulate earlier than those who received hyperbaric bupivacaine or isobaric bupivacaine for primary THA.

**Methods:** This was a randomized, double-blind controlled trial of patients undergoing primary THA. Patients were randomized 1:1:1 to mepivacaine 52.5 mg, hyperbaric bupivacaine 11.25 mg, or isobaric bupivacaine 12.5 mg for spinal anesthesia. The primary outcome measure was ambulation between 3-3.5 hours. Secondary outcomes included return of motor and sensory function, postoperative pain, opioid consumption, urinary retention, transient neurological symptoms, intraoperative muscle tension, length of stay and 30-day readmissions. A priori power analysis required 44 patients per group. After testing for normality (Shapiro-Wilk test), continuous data were analyzed using analysis of variance (ANOVA) or Kruskal-Wallis, as appropriate, and categorical data were analyzed with chi-square.

**Results:** Of 154 patients, 50 received mepivacaine, 53 received hyperbaric bupivacaine, and 51 received isobaric bupivacaine. Patient characteristics were similar among groups. For ambulation at 3-3.5 hours, 35/50 (70.0%) of patients met this endpoint in the mepivacaine group, followed by 20/53 (37.7%) of hyperbaric bupivacaine and 9/51 (17.6%) of isobaric bupivacaine (p<0.001). Return of motor function occurred earlier with mepivacaine. Pain and opioid consumption were higher for mepivacaine patients in the early postoperative period only. 23/50 (46.0%) of mepivacaine, 13/53 (24.5%) of hyperbaric bupivacaine, and 11/51 (21.5%) of isobaric bupivacaine patients achieved same-day discharge (p=0.014). Length of stay was shortest in mepivacaine patients. There were no differences in complications.

**Conclusions:** Mepivacaine patients ambulated earlier and were more likely to be discharged the same day than both hyperbaric bupivacaine and isobaric bupivacaine patients. Mepivacaine could be beneficial for outpatient THA.



### Incidence and Predictive Risk Factors of Postoperative Urinary Retention After Primary TKA

**Daniel N. Bracey, MD, PhD**, Vishal Hegde, MD, Aviva K. Pollet, BS, Roseann M. Johnson, BS, Jason M. Jennings, MD, Todd M. Miner, MD

**Introduction:** Postoperative urinary retention (POUR) after total knee arthroplasty (TKA) may cause urologic injury and delay patient discharge. It is difficult to predict patients at risk for POUR. This study measures the incidence of POUR and identifies predictive risk factors.

**Methods:** 271 consecutive patients <80 years old undergoing primary unilateral TKA without intraoperative Foley catheterization were prospectively enrolled. Bladder scans were performed in the PACU and every four hours thereafter. POUR was defined as >400cc with inability to spontaneously void and was treated with straight catheterization. Patient demographics, urologic history, operative data, perioperative medications, bladder scanner volumes and IV fluids were investigated. Potentially predictive variables identified by univariate analysis were analyzed by multivariate logistic regression.

Results: Of 271 patients, 55 (20%) developed POUR. Compared to non-catheterized patients, PACU bladder scan volumes were greater in patients who developed POUR (344cc vs. 120cc, p<0.001). POUR patients had lower BMI (27.8 vs. 29.4, p=0.03), longer operative duration (83.9 vs. 76.0 minutes, p=0.002), and lower ASA scores (2.2 vs. 2.4, p=0.01). POUR and non-catheterized patients did not differ in age, gender, or past urologic history. Total IV fluid was equivalent between groups (1134cc vs. 1185cc, p=0.41). POUR patients received less narcotics measured by morphine milligram equivalents (16.1 vs. 23.9, p<0.001). Eleven variables including propofol dosage, spinal type (bupivacaine, ropivacaine) and use of paralytics were not predictive of POUR. Variables potentially predictive of POUR included anesthetic types administered (spinal, general, regional, combination) and perioperative administration of NSAIDs, glycopyrrolate, and muscle relaxants. Multivariate analysis showed that NSAIDs (p=0.04) and glycopyrrolate (p=0.04) were significant predictors of POUR.

**Conclusions:** A significant percentage of patients develop POUR after TKA. Select patient demographics and PACU bladder scanning may identify those at risk. Appropriate pain control and judicious use of perioperative NSAIDs and glycopyrrolate may help minimize the risk of POUR.


# Paper #55

# Acute Kidney Injury After Total Hip and Knee Arthroplasty: What Is the Culprit?

Alisina Shahi, MD, PhD, Alec Kellish, BS, Ali Oliashirazi, MD, Jack W. Shilling, MD

**Introduction:** Acute kidney injury (AKI) is associated with increased complications after total hip and knee arthroplasty (THA, TKA). The purpose of this study was to determine the risk factors of AKI after THA and TKA; and, to evaluate if preoperative antihypertensive drugs can play a role in predisposing patients to AKIs.

**Methods:** A retrospective review of 7,406 primary TKAs and THAs (4,532 hips and 2,874 knees) from 2013 to 2019 was performed. The following preoperative variables were obtained from medical records: medications, chemistry 7 panel, Elixhauser comorbidities, and demographic factors. AKI was defined as an increase in serum creatinine by 26.4 µmol·L–1. Multivariate analysis was performed to identify the risk factors.

**Results:** The overall incidence of postoperative AKI was 6.2% (n=459). Risk factors of postoperative AKI were found to be: chronic kidney disease [odds ratio (OR)=7.09; 95% Confidence interval (CI): 4.8-9.4], diabetes (OR:5.03; 95%CI: 2.8-6.06), multi antihypertensive drugs (3 or more) (OR:4.2; 95%CI: 2.1-6.2), preoperative angiotensin receptor blocker (ARBs) or angiotensin-converting enzyme inhibitor (ACEi) regimen (OR: 3.8; 95%CI: 2.2-5.9), use of perioperative vancomycin (OR:2.7; 95%CI: 1.8-4.6), and body mass index above 40 kg/m2 (OR:1.9; 95%CI: 1.3-3.06).

**Conclusions:** We have identified several modifiable risk factors that can be optimized prior to an elective THA or TKA. The use of certain antihypertensive agents namely ACEi, ARBs and multidrug antihypertensive regimens were found to significantly increase the risk of AKI. We strongly urge the orthopaedic community to consider changing these regimens with preoperative nephrology/medical consultations to decrease the risk of AKIs.



# Paper #56

# Aspirin Is Safe for VTE Prophylaxis for Patients with a History of Gastrointestinal Issues

Matthew J. Grosso, MD, Elie Kozaily, MD, Javad Parvizi, MD, FRCS, Matthew S. Austin, MD

**Introduction:** The safety of acetylsalicylic acid (ASA) in patients with prior history of gastroesophageal reflux or peptic ulcer disease remains unclear. The purpose of this study was to determine the safety of ASA for venous thromboembolism (VTE) prophylaxis following total joint arthroplasty (TJA) in patients with prior history of GI issues.

**Methods:** This was an institutional, retrospective cohort study of 19,044 patients who underwent primary total hip and total knee arthroplasty from 2016 to 2019. We divided the patients into two cohorts based on the presence or absence of a pre-existing gastric condition. Patient demographics, VTE prophylaxis and postoperative complications were collected. The primary outcome measure was Gl bleed. Chi-square tests were utilized to determine differences in rates of dichotomous variables between cohorts, with a p-value <0.05 considered significant. The study had an 80% power to detect a 0.3% difference in Gl bleeding rates between cohorts.

**Results:** In our series of 19,044 patients, 3,090 patients had a preoperative gastric condition and 15,954 did not have a gastric condition. ASA was the most common mode of VTE prophylaxis (89%), followed by coumadin (4.7%), direct oral-anticoagulants (4.2%) and low molecular weight heparin (1.7%). In the cohort of patients given ASA, there was no significant difference in postoperative GI bleeding between those with (2/1781, 0.11%) and without preoperative GI issues (8/7,628, 0.10%, p=1.0). For the overall cohort, preoperative gastric conditions were associated with an increased risk of postoperative GI bleeding (0.32% vs. 0.11%, p=0.031). Although patients with a history of GI bleed had a higher VTE risk score and increased use of low-dose aspirin, there was no difference in VTE rates between cohorts (p=0.210).

**Conclusions:** ASA is safe for VTE prophylaxis after TJA in patients with history of GI issues and is not associated with an increased risk of postoperative GI bleeds.

# Notes

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