Musculoskeletal Infection Society

29th Annual Open Scientific Meeting

MUSCULOSKELETAL
INFECTION SOCIETY

August 2-3, 2019

Grand Hyatt New York

New York, NY

Welcome to New York! On behalf of the Musculoskeletal Infection Society, I also welcome you to the 29th Annual Open Scientific Meeting of the Musculoskeletal Infection Society which is jointly sponsored with the American Academy of Orthopaedic Surgeons (AAOS).

At the end of this continuing medical education activity, a certificate of attendance will be emailed to you. It will serve as documentation of CME credit hours. In order for CME credit to be valid, participants must complete the Evaluation Form included in your Program.

If there is any way I can be of assistance or you have any questions regarding the meeting, please do not hesitate to ask.

Barry Brause, M.D.
President

Please join us!

30th Annual Open Scientific Meeting

of the

Musculoskeletal Infection Society

MUSCULOSKELETAL INFECTION SOCIETY

August 7-8, 2020

Fort Lauderdale, Florida

****

Visit

www.msis–na.org

for updates

Overview

This scientific meeting will address new research, clinical advances, diagnostic methodologies, treatment approaches and protocols being developed to care for patients with infections of the musculoskeletal system.

Objectives

At the conclusion of this educational activity, participants will:

- Understand the evolving role of biomarkers and new techniques in the microbiologic diagnosis of periprosthetic infections;

- Understand the evolving variety of local antibiotic delivery systems for use in treating musculoskeletal infections;

- Understand basic science technology as it relates to clinically important issues in biofilm formation and disruption;
-
- Understand the place of Debridement, Antibiotics and Implant Retention ("DAIR") in treatment of prosthetic joint infections and

- Have an enhanced understanding of the relationship between opioid use disorder and musculoskeletal infection.

Intended Audience

This course is designed for member and nonmember physicians including orthopaedic surgeons, infectious disease specialists and other health care providers who manage the care of patients with musculoskeletal infections.

Continuing Education Credit

This activity has been planned and implemented in accordance with the accreditation requirements and policies of the Accreditation Council for Continuing Medical Education (ACCME) through the joint providership of the American Academy of Orthopaedic Surgeons and the Musculoskeletal Infection Society. The American Academy of Orthopaedic Surgeons is accredited by the ACCME to provide continuing medical education for physicians.

The American Academy of Orthopaedic Surgeons designates this live activity for a maximum of ***13.5 AMA PRA Category 1 Credits™***. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Course Director and Musculoskeletal Infection Society President

Barry D. Brause, M.D.

2018–2019 Executive Board

Carlos Higuera-Rueda, M.D.
First Vice President

Angela Hewlett, M.D.
Second Vice President

Aaron J. Tande, M.D.
Secretary/Treasurer

Alex C. McLaren, M.D.
Member At Large

Antonia F. Chen, M.D., MBA
Past President

Sandra B. Nelson, M.D.
Second Past President

Planning Committee

Maja Babic, M.D.

Laura Certain, M.D.

Christopher Gauland, DPM

Carlos Higuera-Rueda, M.D.

Brian A. Klatt, M.D.

Alex C. McLaren, M.D.

Andy O. Miller, M.D.

Sandra Nelson, M.D.

Thorsten Seyler, M.D.

Marcy Wilkinson, Administrative Coordinator

The MSIS appreciates its Supporters

Diamond
Symposium Sponsors

This year the Musculoskeletal Infection Society (MSIS) decided to offer a novel form of corporate sponsorship for our symposium program.

Instead of the sponsor developing the symposium program, the sponsor was invited to suggest an area of interest and the MSIS would accept or not accept the idea. However, the MSIS was entirely responsible for the content of the symposium and the selection of speakers without any input from the sponsors. In return, all of the sponsors were credited with supporting three different symposia as a "bundle" and their tremendous support is recognized by their placard being placed at the front of the auditorium during the three "bundled", content uncontrolled, symposia. We are very fortunate to have two sponsors who supported this level of educational endeavor for this initial year of its development. They are our first Diamond sponsors.

****

Heraeus

MicroGen DX

The MSIS appreciates its Supporters

The MSIS thoroughly thanks our exhibitors for their generous and ongoing support of our society. Their assistance allows the society to expand the scope of our annual meeting.

Please visit the exhibitors in the Museum space next to the lecture hall

Platinum Exhibitors

Exactech, Inc

Joint Purification Systems

OsteoRemedies

Gold Exhibitors

Allergan

Austin Medical Ventures

Biocomposites

Biofire

BONESUPPORT Inc.

Convatec Inc.

Coram

Heraeus Medical

KCI an Acelity Company

Stryker

Zimmer Biomet, Inc

Agenda

Friday, August 2, 2019

7:15 a.m.	Registration Opens – Manhattan Ballroom Foyer
7:15-7:45 a.m.	Continental Breakfast –Museum Space / Manhattan Foyer *Seating in Manhattan Ballroom* **Visit Exhibitors and e-Posters- Museum Space**
7:46-7:59 a.m.	Welcome, Disclosures Presentation of the George C. Cierny, III, M.D. Memorial Award Barry D. Brause, M.D.
Session I	**EPIDEMIOLOGY AND PREVENTION** Moderator: Maja Babic, PhD; Brian A. Klatt, M.D.
8:00-8:06 a.m.	Hospital Volume and Post-Operative Infections in Total Knee Arthroplasty *Hiba K Anis*; Bilal M Mahmood; Alison K Klika; Wael K Barsoum; Robert M Molloy; Carlos A Higuera
8:07-8:13 a.m.	Is Treatment of Periprosthetic Joint Infection Improving Over Time? *Mohammed Abdelaal*; Karan Goswami; Chi Xu; Timothy L Tan; Michael Yayac; Qiaojie Wang; Javad Parvizi
8:14-8:20 a.m.	Opioid Use Disorder Increases the Risk of Infection after Primary Total Hip Arthroplasty Nipun Sodhi; Hiba Anis; Rushabh Vakharia; *Eric Grossman*; Carlos A Higuera; Martin Roche; Michael Mont
8:21-8:27 a.m.	Comparing the Treatment of Knee Periprosthetic Joint Infections between Substance Use Disorder Patients and Non-Users in a Nationally-Representative Sample 2010-2014 Eric L Smith; Evan Dugdale; David Tybor; Amir Shahien; *Kenneth McAlpine*
8:28-8:36 a.m.	Discussion
8:37-8:43 a.m.	Greater Risk for Mental Health Conditions after Prosthetic Joint Infections in Total Knee Arthroplasty Hiba Anis; *Jared Warren*; Alison Klika; Siran Koroukian; Guangjin Zhou; Carlos A Higuera; Wael Barsoum; Nicolas Piuzzi

8:44-8:50 a.m.	Risk Factors for Infection after Primary Total Knee Arthroplasty in Octogenarians and Nonagenarians Nipun Sodhi; Hiba Anis; Rushabh Vakharia; Bilal Mahmood*; Eric Grossman*; Martin Roche; Michael Mont
8:51-8:57 a.m.	The Economics of Antibiotic Cement in Total Knee Arthroplasty: Added Cost with No Reduction in Infection Rates P. Maxwell Courtney; *Michael Yayac*; Alexander Rondon; Timothy Tan; Hannah Levy; Javad Parvizi
8:58-9:04 a.m.	Tranexamic Acid Reduces Periprosthetic Joint Infection after Primary Total Joint Arthroplasty Yazdi Hamid Reza; Mitchell R Klement; Mohammed Hammad; Daisuke Inoue; Chi Xu; *Karan Goswami*; Javad Parvizi
9:05-9:11 a.m.	Preoperative decolonisation and surgical site infections in orthopaedic surgery: a prospective randomised controlled trial (DECO-SSI trial) *Felix Rohrer*, Hubert Noetzli; Lorenz Risch; Thomas Bodmer; Philippe Cottagnoud; Tanja Hermann; Andreas Limacher; Niklaus Fankhauser; Karoline Wagner; Jan Bruegger
9:12-9:22 a.m.	Discussion
SYMPOSIUM #1 9:23-10:13 a.m.	**Post-operative Spine Infections with Collections (para-spinal, epidural and subdural)** Moderator: Sandra Nelson, M.D. Hollis Potter, M.D. Chair, Department of Radiology and Imaging Hospital for Special Surgery New York, NY Joseph Schwab, M.D. Spine Surgeon Massachusetts General Hospital Harvard Medical School Boston, MA
10:14-10:34 a.m.	Refreshment Break - Museum Space / Manhattan Foyer **Visit Exhibitors and ePosters –Museum Space**
Session II	**BASIC SCIENCE** Moderator: Laura Certain, M.D. Martin McNally, FRCS, FRCS(Ortho), MBChB, MD.

10:35-10:41 a.m.	Synovial fluid induced Staphylococcus aureus aggregate development and its impact on surface attachment and biofilm formation *Matthew J Pestrak*; Devendra H Dusane; Doug Guzior; Paul Stoodley
10:42-10:48 a.m.	Antibiotic-loaded calcium sulfate beads provide extended killing of biofilms beyond limits of the spacer: an in vitro study. *Paul Stoodley*; Casey W Peters; Craig Delury; Sean S Aiken; Phillip Laycock; Ed McPherson; Anne Sullivan; Jeffrey F Granger; Devendra H Dusane
10:49-10:55 a.m.	Shotgun Metatranscriptomics for PJI diagnosis: A Novel Prospective Investigation *Karan Goswami*; Alexander J Shope; Timothy L Tan; Justin Wright; James J Purtill; Javad Parvizi; Regina Lamendella
10:56-11:02 a.m.	Killing of persister cells and biofilms of Pseudomonas aeruginosa by spatial distribution of antibiotic-loaded calcium sulfate beads. *Devendra H Dusane*; Jack R Brooks; Devin Sindeldecker; Casey Peters; Craig Delury; Sean S Aiken; Phillip Laycock; Anne Sullivan; Jeffrey F Granger; Paul Stoodley
11:03-11:11 a.m.	Discussion
11:12-11:18 a.m.	Simulated Large Joint Fluid Model for Evaluating Intra-Articular Local Antibiotic Delivery Systems *Edward J. McPherson*; Andrew J. Wassef; Joel D. Bumgardner; Jessica A. Jennings; Scott P. Noel; V. Priya Murali; Michael Harris; Madison Brown; Omar Yunis; Matthew V Dipane
11:19-11:25 a.m.	The Antimicrobial Effects of Synovial Fluid *Samy S Gabriel*; Reuben Judd; Michael R Bubb
11:26-11:32 a.m.	Using laser capture microdissection to determine the bone concentration of antibiotics in mice: a pilot study *Laura Certain*; Brendan Prideaux; Claire Carter; Veronique Dartois
11:33-11:41 a.m.	Discussion
Session III	**DIAGNOSTICS** Moderator: Andy O. Miller, M.D.; Stephen L. Kates, M.D.
11:42-11:48 a.m.	Metagenomic DNA Sequencing for Pathogen Identification in Orthopedic Nonunion Gerard Chang; Timothy L Tan; Karan Goswami; John Strony; Keenan Sobol; *Brianna Fram*; Javad Parvizi; James C Krieg
11:49-11:55 a.m.	The Quality of a Synovial Fluid Aspirate is Critical to Result Interpretation Carl Deirmengian; *Gregory Kazarian*; Scott Feeley; Keith Kardos

11:56-12:02 a.m. Neutrophil-to-Lymphocyte ratio (NLR) is a Strong Predictor of Treatment Failure and Postoperative 90-Day Mortality in Septic Hip and Knee Arthritis
Pierre-Emmanuel Schwab; Nathan Varady; Antonia F Chen

12:03-12:09 p.m. A Potential New Indicator for the Diagnosis of Fracture-Related Infections: Platelet Count to Mean Platelet Volume Ratio
Taylor Paziuk; Gerard Chang; Brianna Fram; John Strony; James Krieg

12:10-12:16 p.m. Prospective, Multicenter, Adjudicator-Blinded Clinical Trial of the Alpha-Defensin (AD) Lateral Flow Test for Periprosthetic Infection (PJI)
Carl Deirmengian; Sujith Kallur; John Madigan; Janet Conway; Carlos A Higuera; Robin Patel

12:17-12:27 p.m. Discussion

12:30-12:50 p.m. Lunch– Manhattan Ballroom
Please get your lunch and return to your seat
For the best Biofilm Symposium
Basic Science with a clinical focus

SYMPOSIUM # 2 Biofilm
12:50-1:45 p.m. Basic Science Findings Guide Clinical Outcomes Data
Is acute vs chronic a biofilm question?
Local vs systemic antimicrobials, can either work against mature biofilm?
Moderator: Alex C. McLaren, M.D.

Edward Schwarz, PhD
Burton Professor of Orthopaedics
Director of the Center for Musculoskeletal Research
University of Rochester Medical Center
Rochester, NY

Steven Kates, M.D.
Professor and Chair
The John Cardea Chair of Orthopaedics
Virginia Commonwealth University
Richmond, VA

Kordo Saeed, MB ChB MSc FRCPath
Consultant Microbiologist, Hampshire Hospitals NHS Foundation Trust
Honorary Senior Lecturer, University of Southampton Medical School
Basingstoke, UK

*This symposium is supported by **Heraeus** and **MicroGenDx** as an educational endeavor, but the content and the selection of speakers are entirely controlled by the MSIS*

Session IV	**PJI DIAGNOSTICS AND MANAGEMENT** Moderators**:** Angela L. Hewlett, M.D.; Carlos A. Higuera-Rueda, M.D.
1:46-1:52 p.m.	A low percentage of patients meet inclusion criteria for single-stage exchange arthroplasty *Malcolm E. Dombrowski*; Alan Wilson; Michael J. O'Malley; Kenneth Urish; Brian R. Hamlin; Lawrence S. Crossett; Brian A. Klatt
1:53-1:59 p.m.	Femoral Impaction Bone Grafting in Staged Revision for Infected Hip Arthroplasty. *Mukai Chimutengwende-Gordon*; Stuart A Callary; Jerome A Davidson; Kerry Costi; Sue M Pannach; Roumen Stamenkov; Donald W Howie; Lucian B Solomon
2:00-2:06 p.m.	Rheumatic Disease Patients Have More Culture Negative Prosthetic Joint Infections- Are There Clinical Differences? Milan Kapadia; Andy O Miller; Allina A Nocon; Peter Sculco; Susan Goodman; *Michael Henry*
2:07-2:13 p.m.	Total Joint Arthroplasty after Septic Arthritis: When can this be Safely Performed? *Timothy L Tan*; Chi Xu; Elie Ghanem; Carlos Higuera; Jaiben George; Karan Goswami; Ji-Ying Chen; Javad Parvizi
2:14-2:22 p.m.	Discussion
2:23-2:29 p.m.	Automated Cell Counters May Yield Falsely Elevated Synovial fluid WBC Counts in TKA Carl Deirmengian; Scott Feeley; Stephen Sizer; *Gregory Kazarian*
2:30-2:36 p.m.	Diagnostic Performance of the Synovasure Microbial ID Test *Carl Deirmengian*; Scott Feeley; Tony Joaquim
2:37-2:43 p.m.	Organism Prevalence in Prosthetic Joint Infection (PJI) Before and After the Implementation of Routine Implant Sonicate Culture *Lee M Sasala*; Alan Wilson; Elena Nikonova; Michael J O'Malley; Brian A Klatt
2:44-2:50 p.m.	Differences in Pathogens Between Hip and Knee Prosthetic Joint Infections Michael Henry; Milan Kapadia; Joseph Nguyen; Barry Brause; *Andy O Miller*
2:51-2:59 p.m.	Discussion
3:00-3:20 p.m.	Refreshment Break - Museum Space / Manhattan Foyer **Visit Exhibitors and e-Posters – Museum Space**

SYMPOSIUM # 3 **Pre-operative PJI Risk Calculators**
3:21-4:16 p.m. **The importance of modifying the modifiable**
Moderator: Alberto V. Carli, M.D.

Antonia F. Chen, M.D., MBA
Orthopaedic Surgeon
Director of Research in Arthroplasty, Brigham and Women's Hospital
Boston, MA

Carlos A. Higuera-Rueda, M.D.
Center Director Orthopaedics and Rheumatology Chairman
Levitetz Department of Orthopaedic Surgery
Cleveland Clinic Florida
Weston, FL

Aaron J. Tande, M.D.
Assistant Professor of Medicine
Division of Infectious Diseases, Mayo Clinic
Rochester, MN

*This symposium is supported by **Heraeus** and **MicroGenDx** as an educational endeavor, but the content and the selection of speakers are entirely controlled by the MSIS*

Session V **PJI OUTCOMES**
Moderator: Parham Sendi, M.D.; Antonia F. Chen, M.D., MBA

4:17-4:23 p.m. Periprosthetic joint infections diagnosed by MSIS and sonication cultures demonstrate greater than 50% treatment failure rate in patients with a history of two-stage exchange arthroplasty
Alan E Wilson; Kwesi St. Louis; Michael J O'Malley; Kenneth L Urish; Lawrence S Crossett; Brian A Klatt

4:24-4:30 p.m. Host Grade and Long Term Reinfection Rate in Prosthetic Joint Infection
Lee Sasala; Alan Wilson; Elena Nikonova; Michael O'Malley; Brian Klatt

4:31-4:37 p.m. Evolution of the 2 Stage to a 1 Stage in the Treatment of Infected Total Joints Arthroplasties: Results of the First 500 cases
Gerhard E Maale; John J Eager; Anirurth Srinivasaraghavan

4:38-4:44 p.m. Serial Aspirations & Intra-Articular Antibiotic Injections for Non-Operative Management of Chronic PJI: Introducing the Concept of Biofilm Training
Edward J. McPherson; Jasmine A. Castillejos; Madhav Chowdhry; Matthew V Dipane

4:45-4:53 p.m. Discussion

4:54-5:00 p.m.	Treatment Outcomes and Attrition in Gram Negative Periprosthetic Joint Infection *Irene Kalbian*; Karan Goswami; Nathan John; Carol Foltz; Timothy L Tan; Javad Parvizi; William V Arnold
5:01-5:07 p.m.	Safety and Tolerability of Rifampin in Staphylococcal Orthopedic Infections *Andy O Miller*; Milan Kapadia; Alberto Carli; Michael Henry
5:08-5:14 p.m.	The Value of Serological Screening Prior to Conversion Total Hip Arthroplasty *Kyle H Cic*hos; Matthew C Christie; Alex R Heatherly; Gerald McGwin; Johnathan H Quade; Elie Ghanem
5:15-5:21 p.m.	Reporting Outcomes of Treatment for Periprosthetic Joint Infection of the Knee and Hip Together with a Minimum 1-year Follow-up is Reliable William T Li; *Timothy L Tan*; Chi Xu; Karan Goswami; Javad Parvizi
5:22-5:30 p.m.	Discussion
5:40 -7:00 p.m.	**President's Reception- Gallery on Lex** Wine & Beer with very light Hors d'oeuvres *SUGGESTION: Make dinner reservations early*
6:00-6:30 p.m.	Oral Presentations of Selected e-Posters
6:30 p.m.	Remarks: Barry D. Brause, M.D, President

Saturday, August 3, 2019

6:45-7:30 a.m.	MSIS Business Meeting (MSIS Members only) Regency Room, Grand Hyatt Hotel (2nd floor)
6:45-7:30 a.m.	Continental Breakfast – Museum Space / Manhattan Foyer *Seating in the Manhattan Ballroom* **Visit Exhibitors and e-Posters –Museum Space**
7:30-8:00 a.m.	**Special Presentation:** **Journal of Bone and Joint Infections (JBJI)** **Journal of the EBJIS & the MSIS** Best Papers of 2018-2019 Parham Sendi, M.D. Associate Professor, University of Bern Lead Physician University Hospital Basel Basel, Switzerland Elie Berbari, M.D. Professor and Chair of the Infectious Diseases Division Mayo Clinic College of Medicine Rochester, MN *REMINDER: EBJIS Meeting is in Antwerp, Belgium, September 12-14, 2019*

Symposium #4
8:01-8:56 a.m.

Debridement, Antibiotics and Implant Retention (DAIR) Case presentations with panel discussions, in memory of Carl L. Nelson, M.D.
Co-branded with the American Association of Hip and Knee Surgeons
Moderator: Javad Parvizi, M.D.

Brian A. Klatt, M.D.
Orthopaedic Surgeon
Assistant Professor
Department of Orthopaedic Surgery
University of Pittsburgh
Pittsburgh, PA

Thorsten Seyler, M.D., PhD
Orthopaedic Surgeon
Assistant Professor in Orthopaedic Surgery
Duke University School of Medicine
Durham, NC

Angela L. Hewlett, M.D.
Associate Professor
Department of Internal Medicine
University of Nebraska
Medical Director
Nebraska Biocontainment Unit
Associate Medical Director
Infection Control and Epidemiology
Omaha, NE

Michael Henry, M.D.
Assistant Attending Physician
Infectious Diseases and Internal Medicine
Hospital for Special Surgery
Assistant Professor
Cornell Medical School
New York, NY

Session VI **BASIC SCIENCE**
Moderator**:** Aaron J. Tande, M.D.; Prof. Paul Stoodley, PhD.

8:57-9:03 a.m. Transfusion of Older Blood Increases Bacterial Burden in a Validated Mouse Model of Spine Implant Infection
Peter P Hsiue; Chad R Ishmael; Sam Uweh; Clark J Chen; Kellyn R Hori; Howard Y Park; Zachary DC Burke; Eldad A Hod; Nicholas M Bernthal; *Benjamin Kelley*

9:04-9:10 a.m. Translational Challenges of Fluorescence Image-Guided Surgical Debridement in a Mouse Model of Spine Implant Infection
Peter P Hsiue; Chad R Ishmael; Kellyn R Hori; Clark J Chen; Cristina Villalpando; Howard Y Park; Steve D Zoller; Kevin P Francis; Nicholas M Bernthal; *Danielle Greig*

9:11-9:17 a.m. Fatty acid dispersal signals affect monocyte activation and nitric oxide release
Zoe Harrison; Daniel Baker; J Amber Jennings

9:18-9:24 a.m. Injectable mannitol chitosan blended paste prevents osteomyelitis in rabbit model
Leslie R Pace; Logan R Boles; Karen Beenken; Mark Smeltzer; J Amber Jennings

9:25-9:33 a.m. Discussion

Symposium # 5 **Molecular Diagnostics for Musculoskeletal Infection**
9:34-10:24a.m **Next Generation Sequencing**
MODERATOR: Thomas W. Bauer, M.D., PhD.

Andy O. Miller, M.D.
Infectious Diseases Consultant, Hospital for Special Surgery
Associate Professor of Clinical Medicine,
Weill-Cornell University Medical Center
New York, NY

Laura Donlin, PhD
Co-Director Derfner Foundation Precision Medicine Laboratory
Assistant Scientist, Hospital for Special Surgery Research Institute
Assistant Professor, Weill-Cornell University Medical Center
New York, NY

Karan Goswami, M.D.
PhD Candidate, Rothman Institute
Research Fellow, Department of Orthopaedic Surgery
Philadelphia, PA

*This symposium is supported by **Heraeus** and **MicroGenDx** as an educational endeavor, but the content and the selection of speakers are entirely controlled by the MSIS*

10:25-10:45 a.m. Refreshment Break - Museum Space / Manhattan Foyer
Visit Exhibitors and e-Posters – Museum Space

Session VII **CLINICAL STUDIES**
Moderator**:** Elie Berbari, M.D.; Arvind Nana, M.D.

10:46-10:52 a.m. Mycobacterium chimera (MC) Spondylodiscitis—A Medical and Surgical Collaboration
Bethany Lehman; Anita R. Modi; Maja Babic; Christopher Karakasis; R. Douglas Orr; Faisal Bakaeen; Steven M. Gordon

10:53-10:59 a.m. Development of a machine learning algorithm for prediction of failure of non-operative management in spinal epidural abscess
Akash A Shah; Aditya V Karhade; Christopher M Bono; Mitchel B Harris; Sandra B Nelson; Joseph H Schwab

11:00-11:06 a.m. Introducing a Novel Test for the Diagnosis of Native Vertebral Osteomyelitis
Talha Riaz; Matthew T Howard; Aaron J Tande; Paul M Huddleston; Elie F Berbari

11:07-11:13 a.m. Factors Associated with In-Hospital Mortality in Necrotizing Fasciitis
Joseph Featherall; Joshua Lawrenz; Jaymeson Gordon; Jaret Karnuta; Deepak Ramanathan; Claus Simpfendorfer; Lukas Nystrom;
Nathan Mesko; Maja Babic

11:14-11:22 a.m. Discussion

11:23-11:29 a.m. Patient Institutional Transfer During the Inter-stage Period of Two-Stage Periprosthetic Knee Infection Treatment Leads to Inferior Results
Simon Garceau; Yaniv Warschawski; Omar Dahduli; Ibrahim Alshaygy; Jesse Wolfstadt; David Backstein

11:30-11:36 a.m. The Fate of Positive Intraoperative Cultures Following Conversion Total Hip Arthroplasty
Kyle H Cichos; Maxwell Detweiler; Javad Parvizi; Gerald McGwin; Johnathan H Quade; Elie Ghanem

11:37-11:43 a.m. Investigating the Role of Serum Inflammatory Markers in Predicting Success of Two-Stage Prosthetic Hip Infection Revision
Simon Garceau; Ethan B Sanders; Alan Gross; Oleg Safir; Paul Kuzyk

11:44-11:50 a.m. Sonication cultures obtained during presumed aseptic revision hip and knee arthroplasty are not predictive of future periprosthetic joint infection
Adam S Olsen; Alan E Wilson; Rebecca I Minorini; *Michael J O'Malley*; Kenneth L Urish; Brian R Hamlin; Lawrence S Crossett; Brian A Klatt

11:51-11:57 a.m.	The presence of a draining sinus is not a risk factor for two-stage exchange arthroplasty treatment failure *Alan E Wilson*; Richard A Wawrose; Elena S Nikonova; Michael J O'Malley; Kenneth L Urish; Lawrence S Crossett; Brian A Klatt
11:58--12:06 p.m.	Discussion
12:07-12:35 p.m.	**Introduction of Incoming President: Carlos Higuera-Rueda, M.D.** *Barry D. Brause, M.D.* **Presentation of Awards** Jon T. Mader Award; Jeanette Wilkins Award; e-Poster Award **Closing Remarks**; *Barry D. Brause, M.D.* Adjourn

Session I

Epidemiology And Prevention

Moderators: Maja Babic, M.D., Brian Klatt, M.D.

Corresponding Author Hiba K Anis
E-Mail Address hiba.anis@gmail.com
Institution Cleveland Clinic
Department Orthopaedic Surgery
Address 9500 Euclid Ave/A41
City, State Cleveland
Zip / Postal Code OH
All Authors Hiba K Anis; Bilal M Mahmood; Alison K Klika; Wael K Barsoum; Robert M Molloy; Carlos A Higuera

Title Hospital Volume and Post-Operative Infections in Total Knee Arthroplasty

Background / Rationale With the increase in accessibility to higher volume hospitals, outcome comparisons between different volume hospitals are of interest to patients and providers alike. There is controversy in current literature with some database studies suggesting high volume centers are associated with higher infection risks. However, such studies are less amenable to granular analyses which adequately adjust for patient comorbidities and therefore institutional studies with contemporary volume thresholds are warranted.

Study Question The purpose of this study was to evaluate the associations of hospital volume with 1) prosthetic joint infections (PJIs) and 2) surgical site infections (SSIs).

Methods A review of 12,295 primary TKAs at a large integrated health system from 2014 to 2017 was conducted. Thirteen hospitals were classified as low, medium, or high volume hospitals (<100, 100-500, or >500 TKAs per year, respectively). Thresholds were guided by percentiles and recent literature on volume-outcome relationships. Medical records were reviewed for diagnoses of SSI (skin/superficial wound infections) and PJI (deep joint infections requiring surgery) over a mean 2-year review period. Multivariate regression analyses adjusting for patient (age, gender, body mass index, comorbidities) and clinical characteristics (operative time, bilateral procedure, antibiotic cement use, and surgeon volume) were performed.

Results The overall PJI rate was 0.7% (n=80) and the overall SSI rate was 2.6% (n=318). After accounting for potential confounders, the risk of PJI at high volume hospitals was similar to the risk at low (odds ratio [OR], 1.197; 95% confidence interval [CI] 0.812-1.766; p=0.364) and at medium (OR 1.391; 95% CI 0.800-2.420; p=0.243) volume hospitals (Table 1). Moreover, the risk of SSI at high volume hospitals was found to be similar to the risk at low (OR 1.188; 95% CI 0.965-1.461; p=0.104) and at medium (OR 0.860; 95% CI 0.657-1.127; p=0.275) volume hospitals (Table 1).

Discussion Infection outcomes are quality metrics that are frequently used to evaluate and compare hospitals including those of varying volumes. After accounting for a range of clinical and patient-related factors, PJI and SSI risks were similar between high volume hospitals and low or medium volume hospitals.

Conclusion Using contemporary volume thresholds, this study found that infection risk after TKA at high volume hospitals is comparable to low and medium volume hospitals.

Table 1. Multivariate analysis of prosthetic joint infections (PJI) and surgical site infections (SSI) at high volume hospitals compared to low and medium volume hospitals

		95% confidence intervals		
Factor	**Odds ratio**	**Lower**	**Upper**	**p-value**
High volume hospitals vs. low volume hospitals				
PJI	1.197	0.812	1.766	*0.364*
SSI	1.188	0.965	1.461	*0.104*
High volume hospitals vs. medium volume hospitals				
PJI	1.391	0.800	2.420	*0.243*
SSI	0.860	0.657	1.127	*0.275*

Corresponding Author	Karan Goswami
E-Mail Address	research@rothmanortho.com
Institution	Rothman Orthopaedic Institute
Department	
Address	125 S 9th St. Ste 1000
City, State	Philadelphia, PA
Zip / Postal Code	19107
All Authors	Karan Goswami; Chi Xu; Timothy L Tan; Michael Yayac; Qiaojie Wang; Javad Parvizi

Title Is Treatment of Periprosthetic Joint Infection Improving Over Time?

Background / Rationale It is unknown whether the outcomes of treatment for periprosthetic joint infection (PJI) are improving with time.

Study Question The purpose of this study was to evaluate trends in PJI treatment outcomes following two-stage exchange arthroplasty and irrigation and debridement (I&D) over the last seventeen years.

Methods We reviewed 550 two-stage exchanges and 194 I&Ds between 2000 and 2016 at our institution. Treatment success was defined according to the Delphi consensus criteria and Kaplan-Meier survivorship curves were generated. A multivariate Cox proportional hazards regression model was generated to determine time trends in the outcome of PJI treatment with the year of surgery included as both a continuous covariate (per 1-year increase) and a categorical covariate (2000-2010 or 2011-2016).

Results The survivorship of I&D (p=0.57), two-stage revision (p=0.22) and the total combined cohort (p=0.79) was comparable between 2000-2010 and 2011-2016. Multivariate Cox regression analysis showed that the year of surgery was not associated with treatment failure following an I&D (Hazard Ratio [HR]1.05; p=0.178) or two-stage exchange arthroplasty (HR 0.98; p=0.373), and neither did it increase the risk of non-reimplantation (HR 1.03; p=0.210). When year of surgery was considered as a categorical variable, there remained no significant difference in treatment failure following an I&D (HR 1.03; p=0.897) or two-stage exchange arthroplasty (HR, 0.79; p=0.310) between the 2000-2010 cohort and 2011-2016 cohort.

Discussion Despite the increasing clinical focus, research advances and growing literature relating to PJI, we were unable to detect any substantial improvement in the treatment success rates of PJI over the 17 years examined in our study.

Conclusion Novel treatments and techniques are certainly needed as current and prior techniques remain far from optimal.

Corresponding Author	Michael Mont
E-Mail Address	mmont@northwell.edu
Institution	Lenox Hill Hospital
Department	
Address	100 E 77th St
City, State	New York, NY
Zip / Postal Code	10075
All Authors	Nipun Sodhi; Hiba Anis; Rushabh Vakharia; Eric Grossman; Carlos Higuera; Martin Roche; Michael Mont

Title Opioid Use Disorder Increases the Risk of Infection after Primary Total Hip Arthroplasty

Background / Rationale Recent studies have shown that patients with an opioid use disorder (OUD) have impaired immunity. However, there is a paucity of literature on the impact of OUD on infection risk after primary total hip arthroplasty (THA).

Study Question Therefore, the purpose of this study was to determine whether patients with OUD undergoing primary THA are at a higher risk of developing: 1) surgical site infections (SSI) and 2) peri-prosthetic joint infections (PJI) compared to matched control patients

Methods ICD-9 codes were used to identify all primary THAs performed between 2005 and 2014 in an administrative claims database. Booelan command operations were used to form the study group of patients with a 90-day history of OUD prior to THA. Study group patients were matched 1:1 to controls according to age, gender, and Elixhauser Comorbidity Index (ECI) scores which yielded 7,592 patients in total. Primary outcomes analyzed were SSI and PJI at 90 days and at 2 years post-operatively which were identified with ICD-9 codes. Logistic regression analysis was performed and A p-value less than 0.05 was considered statistically significant.

Results SSI rates were higher in patients with OUD compared to matched control patients without OUD at 90 days and at 2 years (3.72 vs. 2.05% and 10.25 vs. 6.10%, respectively). OUD was associated with a 3.7 times increased SSI risk at 90 days (OR 3.72, 95% CI 1.51 to 2.25, p<0.001) and 1.8 times increased SSI risk at 2 years (OR 1.75, 95% CI 1.55 to 1.98, p<0.001). Similarly, PJI rates at 90 days and 2 years post-operatively were higher in patients with OUD compared to matched control patients without OUD (3.42 vs. 1.11% and 6.15 vs. 3.78%, respectively). OUD patients were 3.1 times more likely to develop a PJI at 90 days (OR 3.13, 95% CI 2.44 to 4.00, p<0.001) and 1.7 times more likely to develop PJI at 2 years (OR 1.66, 95% CI 1.43 to 1.93, p<0.001).

Discussion After accounting for age, gender, and comorbidity burden, these results revealed that patients with OUD were at a significantly increased risk of SSI and PJI in the 90-day and 2-year post-operative period. Future studies should compare the risk of developing these complications between different opioids.

Conclusion Opioid abuse is associated with an increased infection risk after primary THA. Patient education and pre-operative optimization are crucial to help mitigate infection risk and improve outcomes.

Corresponding Author	Eric L Smith
E-Mail Address	eric.smith@bmc.org
Institution	Boston Medical Center
Department	Orthopaedic Surgery
Address	725 Albany Street 4th floor
City, State	Boston
Zip / Postal Code	02118
All Authors	Eric L Smith; Evan Dugdale; David Tybor; Amir Shahien; Kenneth McAlpine

Title Comparing the Treatment of Knee Periprosthetic Joint Infections between Substance Use Disorder Patients and Non-Users in a Nationally-Representative Sample 2010-2014

Background / Rationale People who inject drugs (PWID) have been shown to receive inferior medical care compared to non-users due to a variety of factors. In treating knee periprosthetic joint infections (PJI), noncompliance in PWID could bias orthopaedic surgeons to provide a simpler, though less effective, treatment if the surgeon feels the patient would be unable to adhere to the more rigorous postoperative course required of a more complex procedure.

Study Question The purpose of our study was to evaluate if orthopaedic surgeons show bias in their decision making in PWID using the model of treatment in PJI after TKA.

Methods We used the Nationwide Inpatient Sample (NIS) to gather hospital admissions data from 2010-2014. We identified patients receiving treatment for knee PJI and isolated two outcome groups – patients receiving a two-stage revision and patients receiving an open debridement and polyethylene liner exchange (ODPE). We then stratified patients into two treatment groups: patients with ICD-9 codes suggestive of injectable substance use disorder (SUD), identifying them as PWID, and non-users. We compared the rates at which PWID and non-users received a two-stage revision procedure vs. ODPE.

Results NIS records representing 55,326 patients were included in our study. 20,103 patients underwent ODPE and 35,223 underwent two-stage revision. Of the patients undergoing ODPE, 205 (1.02%) were identified as patients likely to have an injectable SUD compared to 480 (1.36%) of the patients undergoing two-stage revision.

Discussion There was no significant difference in the odds of receiving a two-stage revision procedure between the two groups (OR=1.34, 95% CI: 0.93, 1.92). This finding was unchanged after adjustment for the following potential confounding variables: age, sex, race, median household income of patient's zip code, number of diagnoses, number of chronic illnesses, number of procedures, length of stay, total charges, year of admission, month of admission, and whether or not admission was on a weekend (OR=1.13, 95% CI: 0.73, 1.74).

Conclusion We found no evidence of orthopaedic surgeon bias in performing the standard of care for treatment of PJI in TKA when caring for patients who inject drugs.

Table 3: Tabulation of Substance Use Disorder Patients and Non-Users By Treatment Type for Periprosthetic Knee Infection, HCUP-NIS

Treatment	Non-Users	ISUDP
ODPE	19,898	205
Two-Stage Revision	34,743	480

Corresponding Author Nicolas Piuzzi
E-Mail Address piuzzin@ccf.org
Institution Cleveland Clinic
Department
Address 9500 Euclid Avenue
City, State Cleveland, OH
Zip / Postal Code 44195
All Authors Hiba Anis; Jared Warren; Alison Klika; Siran Koroukian; Guangjin Zhou; Carlos Higuera; Wael Barsoum; Nicolas Piuzzi

Title Greater Risk for Mental Health Conditions after Prosthetic Joint Infections in Total Knee Arthroplasty

Background / Rationale Prosthetic joint infections (PJIs) after total knee arthroplasty (TKA) confer substantial burdens on a patient's quality of life. Although there is an abundance of literature on physical and functional outcomes after infection, there is a paucity of literature on the effect of PJIs on mental health.

Study Question The purpose of this study was to compare the incidence of mental health conditions among patients undergoing 1) primary TKA, 2) septic revision TKA, and 3) aseptic revision TKA.

Methods The Healthcare Cost and Utilization Project State Inpatient Databases were queried for all TKAs from 2007 to 2012 which yielded 351,635 patients. Patients were separated into cohorts based on procedure: primary, septic revision, and aseptic revision. Diagnoses of any mental health condition as well as the following specific conditions were compared between the three cohorts: schizophrenia/delusion, bipolar disorder, depression/mood disorder, personality disorder, anxiety/somatic/dissociative disorder, eating disorders, ADHD/conduct/impulse control, alcohol abuse, and drug abuse. Univariate analysis was performed to assess differences and trends in mental health conditions among the three cohorts.

Results There was a significantly higher incidence of mental health conditions overall among patients in the septic revision cohort (22.6%) compared to the primary (17.9%, p<0.001) and aseptic revision (20.3%, p<0.001) cohorts. Specifically, septic revision TKA patients had a higher incidence of schizophrenia (p=0.034), bipolar disorder (p<0.001), depression (p<0.001), alcohol abuse (p<0.001), and drug abuse (p<0.001) compared to primary TKA patients. Additionally, there was a significantly higher incidence of depression (14.9% vs. 13.4%, p=0.004), alcohol abuse (1.5% vs. 0.7%, p<0.001), and drug abuse (1.7% vs. 0.9%, p<0.001) among septic revision patients compared to aseptic revision patients.

Discussion Mental health conditions were higher among septic revision patients and the incidences of alcohol and drug abuse in particular were approximately twice as high compared to primary and aseptic TKA patients. Future studies should investigate the incidence of self-harm and suicide in arthroplasty patients and evaluate strategies for mental health support in the peri-operative period.

Conclusion Patients undergoing revision for infection after TKAs had significantly higher rates of several mental health conditions.

Mental health condition	Primary TKA (%) N=325,924	Septic revision TKA (%) N=5,431	Aseptic revision TKA (%) N=20,280	p-value primary vs. septic	p-value septic vs. aseptic	p-value primary vs. aseptic
Schizophrenia/Delusion	1,521 (0.5)	36 (0.7)	116 (0.6)	***0.034***	*0.499*	***0.030***
Bipolar	3,280 (1.0)	84 (1.5)	253 (1.2)	***<0.001***	*0.098*	***0.007***
Depression/Mood	36,799 (11.3)	809 (14.9)	2,711 (13.4)	***<0.001***	***0.004***	***<0.001***
Personality	85 (0.0)	*	*	*0.632*	*1.000*	*0.467*
Anxiety/Somatic/Dissociative	28,511 (8.7)	501 (9.2)	2,038 (10.0)	*0.180*	*0.075*	***<0.001***
Eating disorders	*	*	*	*0.699*	*1.000*	*0.574*
ADHD/Conduct/Impulse control	507 (0.2)	*	*	*0.376*	*0.898*	*0.334*
Alcohol abuse	2,714 (0.8)	83 (1.5)	147 (0.7)	***<0.001***	***<0.001***	*0.112*
Drug abuse	2,533 (0.8)	95 (1.7)	185 (0.9)	***<0.001***	***<0.001***	***0.030***
All mental health conditions combined	58,419 (17.9)	1,229 (22.6)	4,121 (20.3)	***<0.001***	***<0.001***	***<0.001***

TKA=total knee arthroplasty; ADHD=attention deficit hyperactivity disorder

* n<11, masked

Corresponding Author Michael Mont
E-Mail Address mmont@northwell.edu
Institution Lenox Hill Hospital
Department
Address 130 E 77th St
City, State New York, NY
Zip / Postal Code 10075
All Authors Nipun Sodhi; Hiba Anis; Rushabh Vakharia; Bilal Mahmood; Eric Grossman; Martin Roche; Michael Mont

Title Risk Factors for Infection after Primary Total Knee Arthroplasty in Octogenarians and Nonagenarians

Background / Rationale With increasing life expectancy and the success of total knee arthroplasty (TKA), orthopaedic surgeons are more likely to operate on patients older than 80 years old. It is therefore important to understand the risk factors for infection in this population.

Study Question The purpose of this study was to investigate risk factors for: 1) surgical site infections (SSIs) and 2) prosthetic joint infections (PJIs) in primary TKA patients aged 80 years and older.

Methods An administrative claims database was queried for all primary TKA patients aged 80 years or older from 2005 to 2014 using International Classification of Disease (ICD-9) code 81.54 and Current Procedural Terminology (CPT) code 27447. This yielded 275,717 patients. Multivariate logistic regression models were constructed to evaluate the effect of risk factors on 90-day SSI and 2-year PJI incidence. Several risk factors that comprise the Charlson comorbidity index and Elixhauser comorbidity index were selected to construct the models (Table 1). A Bonferroni-adjusted correction was performed and a p-value <0.002 was considered statistically significant.

Results An increased risk of 90-day SSIs associated with male gender (odds ratio [OR] 1.28, p<0.0001), increased body mass index (BMI, p<0.0001), and pre-existing diagnoses of: coagulopathies (OR 1.24, p<0.0001), depression (OR 1.28, p<0.0001), electrolyte imbalances (OR 1.39, p<0.0001), iron deficiency anemia (OR 1.42, p<0.0001), and peripheral vascular disease (OR 1.21, p<0.0001). A higher risk of 2-year PJI was also associated with male gender (OR 1.67, p<0.0001), BMI (p<0.0001) and the following conditions: heart failure (OR 1.19, p<0.0001), depression (OR 1.33 p<0.0001), diabetes (OR 1.13, p<0.0001), electrolyte imbalance (OR 1.67, p<0.0001), iron deficiency anemia (OR 1.81, p<0.0001), renal failure (OR 1.22, p=0.0003), and rheumatoid arthritis (OR 1.19, p<0.0001).

Discussion Octogenarians and nonagenarians form an increasing proportion of the TKA patient population. These findings show that in this population, men with high BMIs are at a higher risk for SSIs and PJIs. Iron deficiency anemia, electrolyte imbalances, and diabetes are also risk factors for infection among octogenarians.

Conclusion These findings should help guide pre-operative optimization and patient counseling in order to mitigate infection risk in octogenarians and nonagenarians undergoing TKA.

Table 1. Multivariate regression models evaluating risk factors for 90-day surgical site infection incidence (SSI) and prosthetic joint infection (PJI) incidence following primary total knee arthroplasty.

Variable	Odds ratio	95% Confidence interval	*p*-value
90-day SSI incidence			
Male	1.38	1.25 – 1.522	*<0.0001*
Alcohol Abuse	1.11	0.84 – 1.43	*0.430*
BMI < 19kg/m^2	1.35	0.90 – 1.95	*0.117*
BMI 19 – 24kg/m^2	0.81	0.58 – 1.10	*0.208*
BMI 25 – 29kg/m^2	1.58	1.29 – 1.92	*<0.0001*
BMI 30 – 39kg/m^2	1.44	1.24 – 1.67	*<0.0001*
BMI 40 – 70kg/m^2	2.32	1.82 – 2.92	*<0.0001*
Cannabis abuse	1.69	0.09 – 7.81	*0.601*
CHF	1.07	0.97 – 1.18	*0.128*
Coagulopathies	1.24	1.14 – 1.41	*<0.0001*
Depression	1.28	1.16 – 1.42	*<0.0001*
Diabetes mellitus	1.12	1.02 – 1.22	*0.015*
Electrolyte/fluid imbalance	1.39	1.25 – 1.55	*<0.0001*
Hypertension	1.14	0.92 – 1.42	*0.224*
Hypothyroidism	1.04	0.95 – 1.14	*0.349*
Iron deficiency anemia	1.42	1.28 – 1.58	*<0.0001*
Opioid use disorder	1.52	0.91 – 2.36	*0.050*
Peptic ulcer disease	1.09	0.95 – 1.24	*0.194*
Peripheral vascular disease	1.21	1.11 – 1.33	*<0.0001*
Renal failure	1.06	0.91 – 1.23	*0.417*
Rheumatoid arthritis	1.14	1.02 – 1.28	*0.018*
Sleep apnea	1.03	0.90 – 1.17	*0.595*
2-year PJI incidence			
Male	1.67	1.55 – 1.79	*<0.0001*
Alcohol abuse	1.03	0.83 – 1.25	*0.769*
BMI < 19kg/m^2	1.21	0.88 – 1.61	*0.200*
BMI 19 – 24kg/m^2	1.51	1.25 – 1.81	*<0.0001*
BMI 25 – 29kg/m^2	1.28	1.09 – 1.51	*0.002*
BMI 30 – 39kg/m^2	1.43	1.27 – 1.61	*<0.0001*
BMI 40 – 70kg/m^2	1.77	1.44 – 2.16	*<0.0001*
Cannabis abuse	0.99	0.05 – 4.57	*0.996*
CHF	1.19	1.10 – 1.28	*<0.0001*
Coagulopathies	1.28	1.18 – 1.39	*<0.0001*
Depression	1.33	1.23 – 1.43	*<0.0001*
Diabetes mellitus	1.13	1.05 – 1.22	*0.0004*
Electrolyte/fluid imbalance	1.67	1.53 – 1.81	*<0.0001*
Hypertension	1.09	0.92 – 1.30	*0.318*
Hypothyroidism	1.03	0.96 – 1.11	*0.312*
Iron deficiency anemia	1.81	1.66 – 1.97	*<0.0001*
Opioid use disorder	1.22	0.79 – 1.78	*0.322*
Peptic ulcer disease	1.03	0.92 – 1.14	*0.535*
Peripheral vascular disease	1.05	0.97 – 1.13	*0.176*
Renal failure	1.22	1.09 – 1.36	*0.0003*
Rheumatoid arthritis	1.19	1.09 – 1.30	*<0.0001*
Sleep apnea	1.04	0.94 – 1.14	*0.396*

BMI=body mass index; CHF=congestive heart failure

Corresponding Author	P. Maxwell Courtney
E-Mail Address	p.maxwell.courtney@gmail.com
Institution	Rothman Institute
Department	
Address	925 Chestnut St, 5th floor
City, State	Philadelphia
Zip / Postal Code	PA
All Authors	P. Maxwell Courtney; Michael Yayac; Alexander Rondon; Timothy Tan; Hannah Levy; Javad Parvizi

Title	The Economics of Antibiotic Cement in Total Knee Arthroplasty: Added Cost with No Reduction in Infection Rates

Background / Rationale	In order to reduce the substantial clinical and financial burden of periprosthetic joint infection (PJI), some surgeons advocate for the use of antibiotic loaded bone cement (ALBC) in primary TKA, although its effectiveness continues to be debated in the literature.
Study Question	The purpose of this study was to determine whether the routine use of ALBC is cost-effective in reducing PJI following primary TKA.
Methods	We retrospectively reviewed a consecutive series of patients undergoing cemented primary TKA at two hospitals within our institution from 2015-2017. We compared demographics, comorbidities, costs, and PJI rates between patients receiving ALBC and plain cement. We performed a multivariate regression analysis to determine the independent effect of ALBC on PJI rate. We calculated readmission costs for PJI and reduction in PJI needed to justify the added cost of ALBC.
Results	**:**Of 2511 patients, 1077 underwent TKA with ALBC (43%), with no difference in PJI rates (0.56% vs. 0.14%, p=0.0662) or complications (1.2% vs. 1.6%, p=0.3968), but higher cement costs ($416 vs. $117, p<0.0001) and overall procedure costs ($6,445 vs. $5.968, p<0.0001). ALBC had no effect on infection rate (p=0.0894). Patients readmitted with PJI had higher overall 90-day-episode-of-care claims costs ($49,341 vs. $19,032, p<0.001). To justify additional costs, ALBC would need to prevent infection in one out of every 101 patients.
Discussion	ALBC resulted in significant increase in total inpatient facility costs compared to plain cement in primary TKA. Further study is needed to determine whether select use of ALBC would be justified in high-risk patients.
Conclusion	Routine use of ALBC in primary TKA is not cost effective, adding $299 without a reduction in PJI rate.

Univariate analysis of variables and periprosthetic joint infection

Variable	Odds Ratio	Confidence Interval	Significance
Age over 70	3.863	0.921 - 16.206	0.0647
Male Gender	0.468	0.094 - 2.323	0.3528
BMI over 35	6.239	1.486 - 26.190	**0.0124**
Antibiotic Cement	4.008	0.807 - 19.899	0.0894
Anxiety	1.320	0.162 - 10.784	0.7955
Depression	1.357	0.166 - 11.087	0.7757
Hypertension	2.468	0.588 - 10.355	0.2169
Hyperlipidemia	0.662	0.133 - 3.290	0.6145
Chronic Kidney Disease	17.328	2.020 - 148.60	**0.0093**
Pulmonary Disease	9.138	1.092 - 76.452	**0.0412**
Osteoporosis	1.239	0.152 - 10.114	0.8417
Scoliosis	2.607	0.318 - 21.380	0.3721
Obstructive Sleep Apnea	2.846	0.571 - 14.185	0.2020
Staph Infection	7.282	0.875 - 60.579	0.0662
Thyroid Disorder	2.196	0.441 - 10.934	0.3369

Forward stepwise, multivariate logistic regression analysis for independent risk factors for infection following TKA

Variable	Odds Ratio	Confidence Interval	Significance
Age over 70	6.019	1.346 - 26.915	**0.0188**
BMI over 35	8.567	1.915 - 38.332	**0.0050**
Chronic Kidney Disease	16.122	1.690 - 153.920	**0.0157**
Pulmonary Disease	9.670	1.078 - 86.742	**0.0427**

Corresponding Author	Yazdi Hamid Reza
E-Mail Address	research@rothmanortho.com
Institution	Rothman Orthopaedic Institute
Department	
Address	125 S 9th St. Ste 1000
City, State	Philadelphia, PA
Zip / Postal Code	19107
All Authors	Yazdi Hamid Reza; Mitchell R Klement; Mohammed Hammad; Daisuke Inoue; Chi Xu; Karan Goswami; Javad Parvizi

Title Tranexamic Acid Reduces Periprosthetic Joint Infection after Primary Total Joint Arthroplasty

Background / Rationale Previous studies have demonstrated preoperative anemia to be a strong risk factor for periprosthetic joint infection (PJI) in total joint arthroplasty (TJA). Allogeneic blood transfusion can also increase the risk of PJI after primary and revision TJA. Tranexamic acid (TXA) is known to reduce blood loss and the need for allogeneic blood transfusion after TJA.

Study Question Does administration of intravenous TXA result in a reduction in PJI after TJA?

Methods A prospectively maintained institutional database was utilized to identify 6,340 patients undergoing primary TJA between January1st, 2013 to June 31st , 2017 with a minimum of 1-year follow-up. Patients were divided into two groups based on whether they received intravenous TXA prior to TJA or not.
Patients who developed PJI following primary arthroplasty were identified. All PJI patients met the 2018 International Concensus meeting(ICM) definition for PJI. A multivariate regression analysis was performed to identify variables independently associated with PJI after primary TJA.

Results Of the patients included in the study 3,683(58.1%) patients received TXA and 2,657(41.9%) were not administered any TXA. The overall incidence of preoperative anemia was 16%, postoperative blood transfusion was 1.8%, and PJI rate was 2.4%.

Discussion Bivariate analysis showed that patients who received TXA were significantly at lower odds of infection (odds ratio (OR): 0.47, 95%CI: 0.34- 0.66, p=0.000). After adjusting for all confounding variables, multivariate regression analysis showed that, TXA was an independent protective factor against PJI (OR: 0.68, 95%CI: 0.46- 0.99, p=0.04).

Conclusion TXA can help reducing the rate of PJI after primary TJA. This protective effect is likely interlinked to reduction in blood loss, lower need for allogeneic blood transfusion and issues related to immunomodulation associated with transfusion.

Corresponding Author Felix Rohrer
E-Mail Address flex.rohrer@gmail.com
Institution Sonnenhofspital
Department Department of Orthopeadic Surgery,
Address Buchserstrasse 30
City, State Bern, Switzerland
Zip / Postal Code 3006
All Authors Felix Rohrer; Hubert Noetzli; Lorenz Risch; Thomas Bodmer; Philippe Cottagnoud; Tanja Hermann; Andreas Limacher; Niklaus Fankhauser; Karoline Wagner; Jan Brugger

Title Preoperative decolonisation and surgical site infections in orthopaedic surgery: a prospective randomised controlled trial (DECO-SSI trial)

Background / Rationale Surgical site infections (SSI) present a growing health care challenge in orthopaedic surgery. Preoperative decolonisation could decrease SSI incidence in orthopaedic surgery, though evidence-based consensus is still lacking. The aim of the DECO-SSI trial was to determine the impact of preoperative decolonisation on SSI rates after orthopaedic surgery in *S. aureus* carriers and non– *S. aureus* carriers.

Study Question

Methods In this prospective randomised single-blinded trial we recruited patients undergoing all forms of elective orthopaedic surgery in one tertiary care centre in Switzerland. We used culture methodology to screen patients for nasal *Staphylococcus aureus* carriage and allocated them into either an *S. aureus* carrier or a non- carrier group. Each group was blindly randomised intocontrol and intervention arms using central randomisation implemented in the electronic data entry system. Intervention consisted of chlorhexidine showers for both groups and additional mupirocin nasal ointment for carriers. Occurrence of SSI and total costs were documented for all arms.

Results Between November 2014 and September 2017, 1,318 patients were recruited. The *S. aureus* carrier rate was 35% (465 patients) with only one case (0·08%) of Methicillin resistant *S. aureus* (MRSA) carriage. SSI rates were 0·43% (one of 232 patients) in decolonised and 0·43% (one of 233 patients) in the control *S. aureus* carriers. In the non-carrier group, SSI rates were 0·23% (one of 426 patients) in decolonised and 0·23% (one of 427 patients) in control patients. The SSI caused by *S. aureus* was due to the initial colonising germ which was identified by next generation sequencing. Regarding relevance to clinical practice, decolonisation would only be cost effective if SSI was prevented in at least six out of 1,000 patients.

Discussion DECO-SSI is the first trial to study the efficacy of decolonisation in *S. aureus* carriers and non-carriers. Due to the lack of benefits found, decolonisation cannot be recommended for SSI prevention in orthopaedic surgery.

Symposium 1

Post-operative Spine Infections with Collections

(para-spinal, epidural and subdural)

Moderator: Sandra B Nelson, M.D.

Hollis Potter, M.D.
Chair Department. of Radiology and Imaging
Hospital for Special Surgery
New York, NY

Joseph Schwab, M.D.
Spine Surgeon
Massachusetts General Hospital
Harvard Medical School
Boston, MA

Session II

Basic Science

Moderators: Laura Certain, M.D.; Martin McNally FRCS, FRCS(Ortho), MBChB, MD.

Corresponding Author	Paul Stoodley
E-Mail Address	matthew.pestrak@osumc.edu
Institution	The Ohio State University
Department	Microbial Infection and Immunity
Address	760 Biomedical Research Tower 460 W. 12th Ave.
City, State	Columbus, OH
Zip / Postal Code	43210
All Authors	Matthew J Pestrak; Devendra H Dusane; Doug Guzior

Title Synovial fluid induced Staphylococcus aureus aggregate development and its impact on surface attachment and biofilm formation

Background / Rationale Staphylococcus aureus is one of the most common causes of PJI, and can be very difficult to control with antibiotics due to antibiotic resistant strains and its ability to form biofilms. Biofilms associated with the surface of indwelling medical devices have been observed on retrieved implants; however, the initiation, development and localization of biofilms in PJI remains unclear. Prior studies have shown that synovial fluid (SF) promotes the development of aggregates with biofilm-like properties, including antibiotic tolerance. We hypothesize that these aggregates play an important role in initiating biofilm development in PJIs.

Study Question What are the kinetics of SF promoted aggregate formation and does this process impact surface attachment and biofilm formation?

Methods We utilized flow cytometry and microscopy to quantify the aggregation index and size of various clinical S. aureus strains following exposure to SF or purified SF components. To determine how SF affects surface attachment, we utilized polystyrene flow cells and microscopy to measure bacterial attachment over time under various shear stress conditions.

Results We determined that fibronectin, fibrinogen, and serum albumin promotes bacterial aggregation, while the effects of eDNA and hyaluronic acid were minimal. We also found that SF exposure significantly impeded bacterial surface attachment to a plastic surface. Furthermore, we determined that fibrinogen and serum albumin inhibited S. aureus surface attachment.

Discussion This study provides important insight on the initiation of infection and the early stages of biofilm development. The primary protein components of SF contribute significantly to S. aureus aggregation, and it is possible that targeting these factors with therapeutics will aid in disrupting biofilm formation and antimicrobial resistance. Additionally, we propose that SF benefits the host by reducing attachment and subsequent biofilm formation during PJI. However, this protective function for the host may be offset by the formation of protected bacterial aggregates that could lodge in surface features of implants and host tissue.

Conclusion We conclude that components of SF has a crucial role in promoting bacterial aggregation and preventing surface attachment during PJI

Corresponding Author Paul Stoodley
E-Mail Address Paul.Stoodley@osumc.edu
Institution The Ohio State University
Department Microbial Infection & Immunity
Address 716 Biomedical Research Tower,
460 West 12th Avenue,
City, State Columbus, OHIO
Zip / Postal Code 43210
All Authors Paul Stoodley; Casey W Peters; Craig Delury; Sean S Aiken; Phillip Laycock; Ed McPherson; Anne Sullivan; Jeffrey F Granger; Devendra H Dusane

Title Antibiotic-loaded calcium sulfate beads provide extended killing of biofilms beyond limits of the spacer: an in vitro study.

Background / Rationale Antibiotic-loaded spacers and absorbable beads are used in the management of periprosthetic joint infection to provide prolonged high local concentrations of antibiotics required to better kill bacterial biofilms. In quiescent areas of the joint space, diffusion will control the spread of antibiotics; therefore, the distribution of beads may be important to ensure adequate antibiotic coverage.

Study Question Do antibiotic-loaded absorbable calcium sulfate beads (ALCSB*) provide a greater zone of coverage and killing of biofilms than antibiotic-loaded PMMA spacers alone?

Methods Biofilms of bioluminescent strains of Staphylococcus aureus and Pseudomonas aeruginosa were formed on stainless steel, hydroxyapatite, titanium and polyethylene coupons for 3 days. Diffusion experiments were performed in large glass plates as (i) control PMMA spacer with no antibiotics, (ii) a spacer with vancomycin and tobramycin (2000 mg of each per 40 g pack) and (iii) an antibiotic loaded spacer plus ALCSB containing vancomycin and tobramycin (1000mg and 240 mg/ 10cc respectively). The spacer was placed in the center of the glass plate and the coupons placed radiating from the spacer. The ALCSB were spread evenly and the whole plate was overlaid with agar. The plates were incubated and killing of biofilms was analyzed using luminescence and white light images.

Results Growth and spread of biofilms from the coupons was observed for the control unloaded spacer. The loaded spacer showed a localized zone of inhibition radiating a few mm from the spacer. The addition of ALCSB demonstrated a much greater zone of clearance, killing biofilm on the coupons and preventing spread from the coupons.

Discussion In quiescent areas where the spread of antibiotics is dominated by diffusion, the distribution from an antibiotic-loaded spacer alone might be limited. The addition of ALCSB beads in addition to a loaded spacer can increase the area of coverage. A joint space is a highly complicated milieu and biofilm can be easily spread during surgical procedures.

Conclusion To achieve the antibiotic concentration and exposure times required to kill or reduce biofilm bacteria, placing other reservoirs such as ALCSBs is necessary to cover as much exposed joint space as possible. Further work is required to confirm this confirm this clinically.
*Stimulan Rapid Cure (Biocomposites Ltd)

Corresponding Author Karan Goswami
E-Mail Address research@rothmanortho.com
Institution Rothman Orthopaedic Institute
Department
Address 125 S 9th St. Ste 1000
City, State Philadelphia, PA
Zip / Postal Code 19107
All Authors Karan Goswami; Alexander J Shope; Timothy L Tan; Justin Wright; James J Purtill; Javad Parvizi; Regina Lamendella

Title Shotgun Metatranscriptomics for PJI diagnosis: A Novel Prospective Investigation

Background / Rationale While metagenomic (microbial DNA) sequencing technologies can detect the presence of microbes in a clinical sample, it is unknown whether this signal represents dead or live organisms. Metatranscriptomics (sequencing of RNA) offers the potential to detect transcriptionally "active" organisms within a microbial community, and also map expressed genes to functional pathways of interest (e.g antibiotic resistance).

Study Question We used this approach to evaluate the utility of metatrancriptomics to diagnose PJI and predict antibiotic resistance.

Methods In this prospective study, samples were collected from 20 patients undergoing revision TJA (10 aseptic and 10 infected) and 10 primary TJA. Synovial fluid and peripheral blood samples were obtained from patients at the time of surgery, as well as negative field controls (skin swabs, air swabs, sterile water). All samples were shipped on ice to the laboratory for metatranscriptomic analysis. Following microbial RNA extraction and host analyte subtraction, metatranscriptomic sequencing was performed. Bioinformatic analyses (including quality filtration and human sequence subtraction) were implemented prior to mapping against curated microbial sequence databases - to generate taxonomic expression profiles. Principle Coordinates Analysis (PCoA) and Partial Least Squares-Discriminant Analysis were utilized to ordinate metatranscriptomic profiles, using the 2018 definition of PJI as the gold standard.

Results After RNA metatranscriptomic analysis, blinded PCoA modeling revealed accurate and distinct clustering of samples into 3 separate cohorts (infected, aseptic and primary joints) – purely based on their active transcriptomic profile, both in synovial fluid and peripheral blood (synovial anosim p=0.001, peripheral blood anosim p=0.034). Differential metatranscriptomic signatures for infected vs. noninfected cohorts enabled us to train machine learning algorithms to 84.9% predictive accuracy for infection. A variety of antibiotic resistance genes were also expressed, with high concordance to conventional antibiotic sensitivity data.

Discussion Our findings highlight the potential of metatranscriptomics for infection diagnosis.

Conclusion To our knowledge, this is the first report of RNA sequencing in the orthopaedic literature. Further work using larger patient cohorts will better inform deep learning approaches to improve accuracy, predictive power, and clinical utility of this technolog

Corresponding Author	Paul Stoodley
E-Mail Address	Paul.Stoodley@osumc.edu
Institution	The Ohio State University
Department	Microbial Infection & Immunity
Address	716 Biomedical Research Tower, 460 West 12th Avenue,
City, State	Columbus, OHIO
Zip / Postal Code	43210
All Authors	Devendra H Dusane; Jack R Brooks; Devin Sindeldecker; Casey Peters; Craig Delury; Sean S Aiken; Phillip Laycock; Anne Sullivan; Jeffrey F Granger

Title Killing of persister cells and biofilms of Pseudomonas aeruginosa by spatial distribution of antibiotic-loaded calcium sulfate beads.

Background / Rationale Pseudomonas aeruginosa (PA) is a common Gram-negative rod found in periprosthetic joint infection (PJI). Antibiotic-loaded calcium sulfate beads (ALCSB*) are used in the management of PJI. PA have developed diverse strategies to evade antibiotics by forming resistant, tolerant and persister phenotypes in biofilms.

Study Question Are the number and spatial distribution of ALCSB important for the complete eradication of biofilms including persister cells?

Methods We used a bioluminescent strain of PA to grow 24-hour agar lawn biofilms. ALCSB were loaded with vancomycin and tobramycin (1000mg and 240 mg/10cc respectively). ALCSB were arranged as (i) a single bead in the center, (ii) 16 beads placed as four clusters of four, (iiii) in a ring, (iv) as a group in the center, or (v) 19 beads placed evenly across the plate. Luminescence and images were taken daily for 7 days. Replica plating onto fresh plates was performed to assess growth of persisters.

Results Zones of antimicrobial activity spread from the beads and increased over time. However, the growth of antibiotic tolerant cells was observed after 3 days as colonies began to grow out from the dead lawn, highlighting three distinct zones, 1) a cleared zone adjacent to the bead, 2) a tolerant zone and 3) the background lawn. All ALCSB arrangements eventually killed the biofilms; however, the rate of clearing per bead was greater when the beads were distributed evenly over the plate rather than in clusters. Replica plating showed that in the cleared zone there was no evidence of persisters or other antibiotic tolerant phenotypes.

Discussion Persister cells are implicated in the recalcitrance of biofilm infections to antibiotics. In vitro studies suggest that systemic dosages are not adequate to kill persisters which can proliferate after the antibiotic concentration drops below inhibitory levels. Here we find that antibiotics released from ALCSB can kill biofilms and persisters adjacent to the bead. To ensure adequate coverage, it is important to consider the spread of beads so that these zones overlap.

Conclusion Both the distribution and number of ALCSB are important to ensure adequate coverage of antibiotics in order to eradicate in vitro biofilms and persisters cells from a given area.

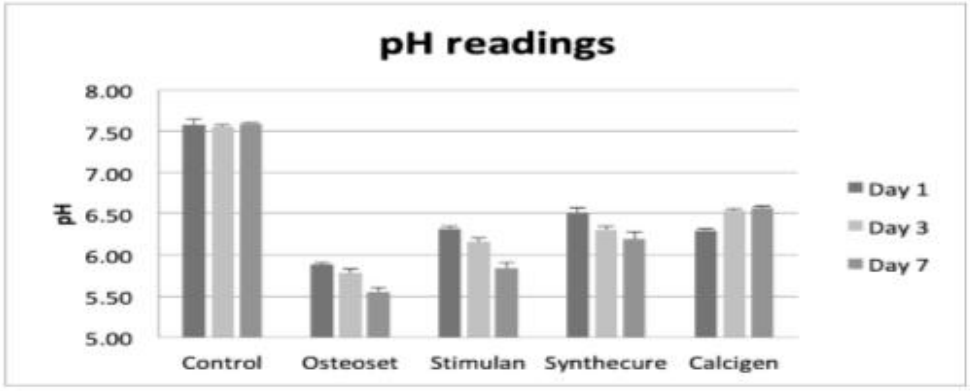
*Stimulan Rapid Cure (Biocomposites Ltd)

Corresponding Author	Matthew V. Dipane
E-Mail Address	MDipane@mednet.ucla.edu
Institution	UCLA
Department	Department of Orthopaedic Surgery
Address	1250 16th St.
City, State	Santa Monica
Zip / Postal Code	90404
All Authors	Edward J. McPherson; Andrew J. Wassef; Joel D. Bumgardner; Jessica A. Jennings; Scott P. Noel; V. Priya Murali; Michael Harris; Madison Brown; Omar Yunis

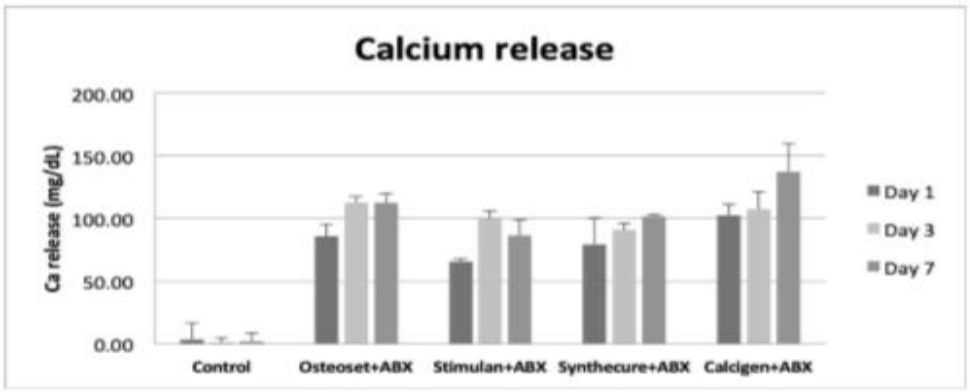
Title	Simulated Large Joint Fluid Model for Evaluating Intra-Articular Local Antibiotic Delivery Systems

Background / Rationale	Calcium sulfate is frequently used in PJI treatment. Following cancer treatment trends, next generation PJI treatment will focus on local delivery of antibiotics/other agents. There is no current standardized model to evaluate delivery of such agents from CaSO4 or other materials. We introduce a large joint fluid model, demonstrating its application in initial tests with antibiotic-loaded CaSO4.
Study Question	In a large joint fluid model, is there supra-therapeutic elution of antibiotics from CaSO4 beads? What changes in pH or Ca levels result as beads undergo dissolution in a closed large joint space?
Methods	Beads of 4 different commercially available calcium sulfate materials were aseptically prepared in both non-loaded (n=3) & antibiotic-loaded (n=4) form. Loading doses of 1g vancomycin and 1.2g tobramycin per 10cc kit were selected per surgeon-directed practice. The model used a 1g bead:2ml of 25% bovine serum in PBS solution ratio with complete exchange at 1, 3 & 7 days. A pH electrode determined pH and a Cresolphthalein assay quanitified Ca release. Antibiotic release was determined using high-pressure liquid chromatography and activity was confirmed by zone of inhibition against P. aeruginosa and E. faecalis for tobra and vanco, respectively.
Results	Serum pH levels dropped significantly (p<0.05) to 6.5 or below for all groups, remaining at similar levels for 7 days. Ca release increased from 65.2-103 on day 1 to 87-137 mg/dL by day 7, with differences between sources and antibiotic loading status. Elution patterns demonstrated burst release of both antibiotics, with lower elution concentrations of vanco than tobra. All concentrations remained >1.0 mg/ml (100x MIC) for vanco over 7 days, while tobra concentrations were >1.8 mg/ml (110x MIC). Zones of inhibition confirmed antibiotic concentration and activity.
Discussion	Reported pH levels for CaSO4 vary, but are consistently acidic in physiologically relevant media. Joint fluid Ca levels from CaSO4 are high and likely explain the 13-15% incidence of hypercalcemia in the literature. Antibiotic was eluted at high active levels at which biofilm eradication may result. The model provided consistent use, highlighting differences between commercially available products, possibly related to product purification.
Conclusion	We propose the simulated large joint model as a standardized method for intra-articular elution studies for locally-delivered antibiotic agents.

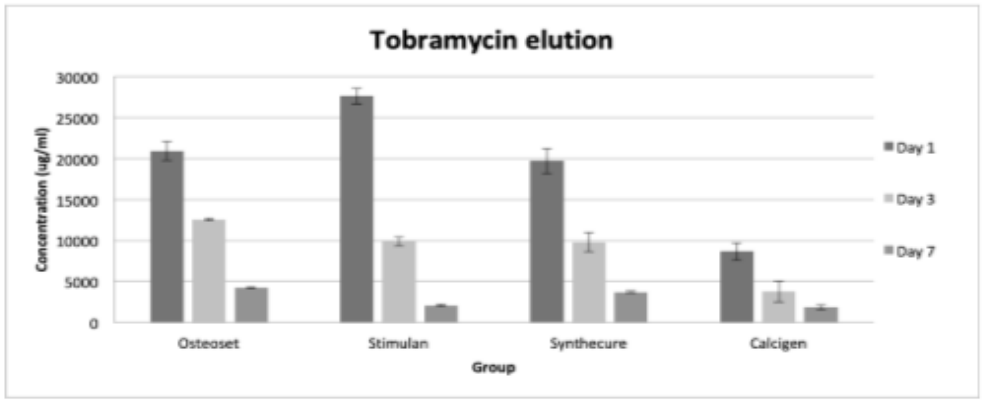
A



B



C



D

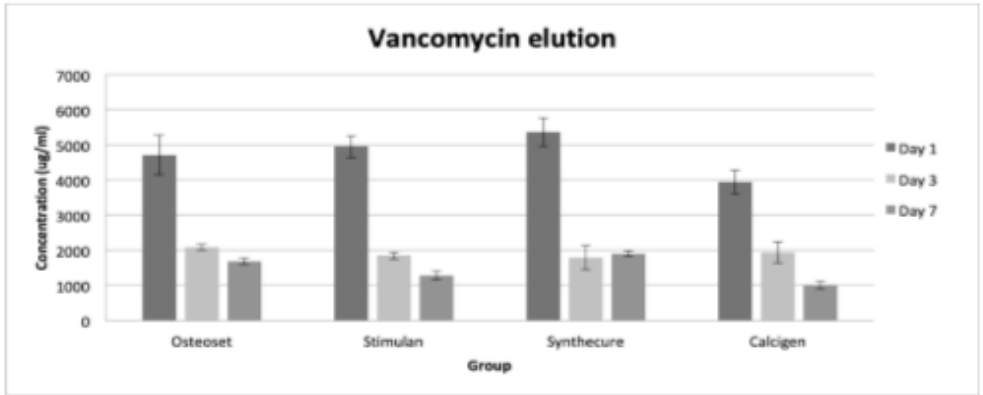


Figure 1. Graphical representation of a) pH, b) Ca concentration, c) tobramycin elution, and d) vancomycin elution for days 1, 3 and 7.

Corresponding Author	Samy S Gabriel
E-Mail Address	samy.gabriel@ufl.edu
Institution	University of Florida
Department	
Address	825 SW 11th Street Apt 201
City, State	Gainesville, FL
Zip / Postal Code	32601
All Authors	Samy S Gabriel; Reuben Judd; Michael R Bubb

Title The Antimicrobial Effects of Synovial Fluid

Background / Rationale While external factors are thought to play a large role in post-operative infections, there is a possibility that inherent patient susceptibilities are also implicated. There are a few reports of the antimicrobial properties of synovial fluid, however the exact mechanism of this property has not been identified.

Study Question Does synovial fluid demonstrate consistent antimicrobial effects and are antimicrobial peptides responsible for this effect?

Methods After IRB approval, synovial fluid was collected from patients who underwent knee aspiration. This fluid was ultra-centrifuged and cell free supernatant was plated with bacterial suspension and broth in 96 well plates. Growth was measured by optical density and compared to controls. Growth curves were created to evaluate rate of growth. This test was repeated using different doses of synovial fluid to assess the strength of the antibacterial effect. Synovial fluid supernatant was then separated by size exclusion and ion exchange chromatography and the process was repeated to assess the activity. Mass spectrometry was then performed on the fraction that maintained activity.

Results All four collected samples of cell free synovial fluid showed decreased optical density (mean=0.117) at 5 hours of growth compared to that of controls (mean= .413, $p>0.0001$). Subsequent fractionation led to two peaks of UV absorption, with only one fraction maintaining anti-microbial activity (mean optical density =0.291 vs control mean=0.411, $p=0.007$). Doses of 60, 40, 20, and 10 uL of synovial fluid showed significant antibacterial effects with slight increases of bacterial proliferation with decreases in synovial fluid dose.

Discussion The strong antimicrobial effects that were observed are encouraging in continuing to purify endogenous bactericidal peptides. A single peptide could be useful as a marker for pre-operative risk in total joint arthroplasty patients. This study is unique in that it identifies anti-microbial activity of a gross sample and then attempts to characterize the underlying peptide that is responsible.

Conclusion Cell free synovial fluid displays a dose dependent bactericidal effect. After purification, this effect was limited to a single fraction. Based on UV absorption, it is likely that a small peptide present in this fraction is responsible. Mass spectrometry

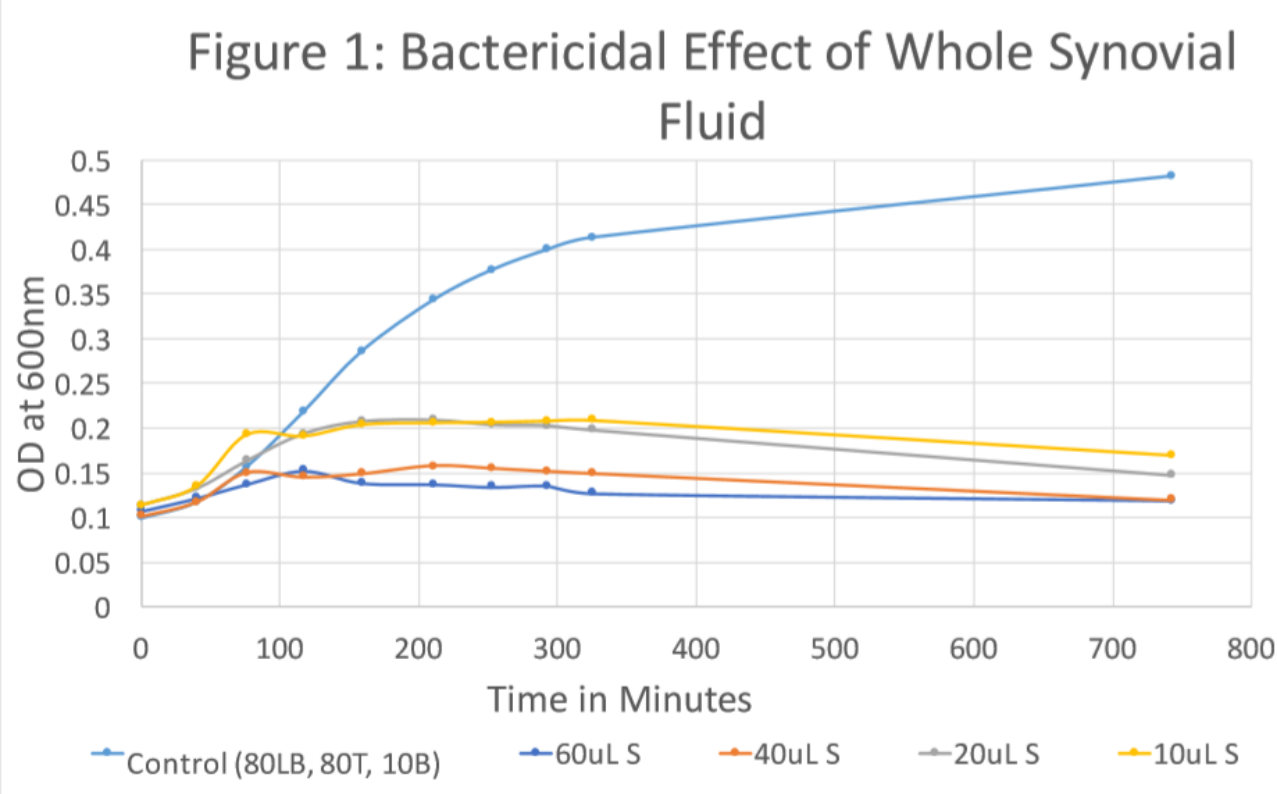


Figure 1: Bactericidal Effect of Whole Synovial Fluid
OD at 600nm
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
100
200
300
400
500
600
700
800
Time in Minutes
Control (80LB, 80T, 10B)
60uL S
40uL S
20uL S
10uL S

Corresponding Author Laura Certain
E-Mail Address laura.certain@hsc.utah.edu
Institution University of Utah
Department
Address 30 N 1900 E
4B319
City, State Salt Lake City
Zip / Postal Code 84132
All Authors Laura Certain; Brendan Prideaux; Claire Carter; Veronique Dartois

Title Using laser capture microdissection to determine the bone concentration of antibiotics in mice: a pilot study

Background / Rationale In order for antibiotics to treat an infection effectively, they must reach the site of the infection at adequate concentrations to kill the bacteria. In orthopedic infections, the ability of a given antibiotic to penetrate bone – especially infected or necrotic bone – is often called into question. Even if an antibiotic achieves adequate concentrations in healthy bone, the changes in tissue architecture at the site of infection may mean that the antibiotic still does not reach the infecting bacteria at bactericidal concentrations. That is, an antibiotic may penetrate the bone adequately but not penetrate a micro-abscess or sequestrum. The technique of laser capture microdissection has been used successfully to determine the penetration of various antibiotics into tuberculous granulomas in the lung. We propose to use the same technique to study the penetration of antibiotics into sites of musculoskeletal infection.

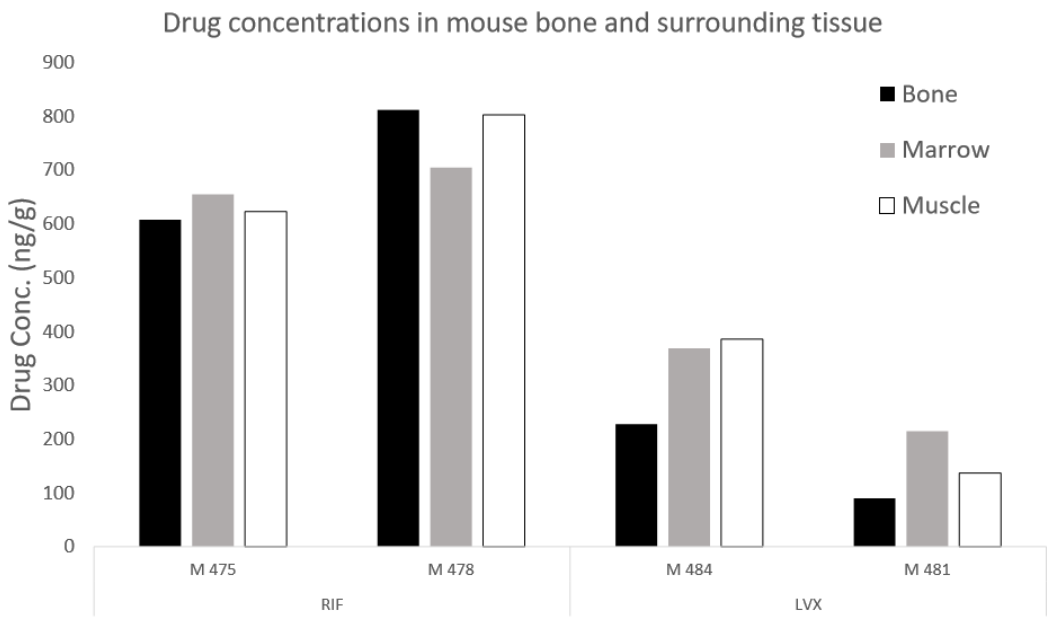
Study Question Can laser capture microdissection combined with liquid chromatography mass spectrometry (LCM-LC/MS) determine the concentration of antibiotics in mouse bone and surrounding tissue?

Methods Mice were treated with either levofloxacin (500 g/L of drinking water) or with rifampin (25 mg/kg subcutaneously x 1 dose five hours prior to sacrifice). After sacrifice, their legs were harvested and frozen. The legs were then embedded in gelatin and sectioned onto slides (thickness = 25 um). Areas of bone, muscle, and marrow (totaling 3 mm^2 in area per tissue type) were dissected using a laser and the amount of drug within each piece quantified using liquid chromatography mass spectrometry (LC-MS).

Results Two mice that had received levofloxacin and two that had received rifampin were processed as described above. The bone concentration of rifampin was comparable to the concentration in muscle and marrow in both mice, while the bone concentration of levofloxacin was lower than marrow or muscle in both mice.

Discussion This pilot study demonstrates the feasibility of using LCM-LC/MS to determine the concentration of a given antibiotic within a specific area of tissue, including bone.

Conclusion LCM-LC/MS is a promising technique for determining the penetration of antibiotics into specific areas of tissue, including bone, with spatial resolution on the scale of millimeters.


Drug concentrations in mouse bone and surrounding tissue
Drug Conc. (ng/g)
900
800
700
600
500
400
300
200
100
0
Bone
Marrow
Muscle
M 475
M 478
M 484
M 481
RIF
LVX

Session III

Diagnostics

Moderators: Andy O Miller, M.D.; Stephen Kates, M.D.

Corresponding Author Gerard Chang

E-Mail Address research@rothmanortho.com
Institution Rothman Orthopaedic Institute
Department
Address 125 S 9th St. Ste 1000
City, State Philadelphia, PA
Zip / Postal Code 19107
All Authors Gerard Chang; Timothy L Tan; Karan Goswami; John Strony; Keenan Sobol; Brianna Fram; Javad Parvizi; James C Krieg

Title Metagenomic DNA Sequencing for Pathogen Identification in Orthopedic Nonunion

Background / Rationale While it is known that fracture nonunions may occur due to septic or aseptic reasons, the true extent to which the presence of microbes preclude fracture healing remains unknown. With the increasing availability of next-generation sequencing(NGS), rapid and high throughput detection of all microbial DNA present within a clinical sample is now possible. It has therefore been proposed that a significant percentage of nonunions actually harbor microbes that escape detection by conventional culture. To date, no study has examined the NGS profile of fracture nonunions or explored its clinical relevance.

Study Question What is the role of NGS in the diagnosis of nonunion compared to culture, and its association with treatment outcomes in terms of fracture union.

Methods Samples were prospectively collected from 20 consecutive patients undergoing open surgical intervention for long bone nonunions(7 femurs, 9 tibias, 4 humeri). Nonunion was defined as a failure to progress towards union within an anticipated timeframe. 3 tissue samples(superficial membrane; proximal and distal fracture) and 3 intraoperative swabs were obtained and sent for NGS. Tissue specimens from concordant sites were sent to the institutional lab for culture. Patients were followed up for a minimum of 6-months(range 6–11) for radiological evidence of union. Concordance and bivariate statistics were used to compare NGS, culture and union rates. Principal coordinates analysis of NGS species diversity was also conducted.

Results 14 nonunions were culture-negative(14/20; 70.0%) and 6 were culture-positive(6/6; 100.0%). Among the positive cultures, complete concordance between NGS and culture results was noticed in 6 cases(100% dominant species similarity). Among the 14 culture-negative cases, NGS identified a microbe in 6 cases(42.9%). NGS detected multiple organisms in most positive samples(mean 2.9 microbes) but one organism was typically dominant. Positive NGS signal in culture-negative cases was inversely associated with fracture union at interim follow-up(50% vs 75%); however this trend did not reach statistical significance(p=0.12).

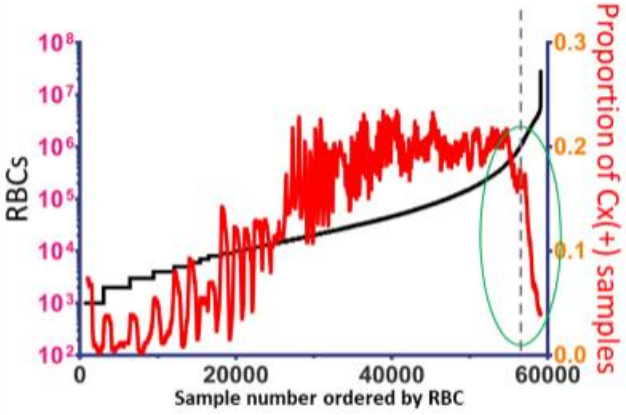
Discussion NGS may be useful for identification of the causative organism(s) in culture-negative nonunion.

Conclusion Some cases of nonunion may have additional organisms that escape detection when culture is used. Further multicenter work is required to determine the clinical implications of organisms detected on metagenomic sequencing.

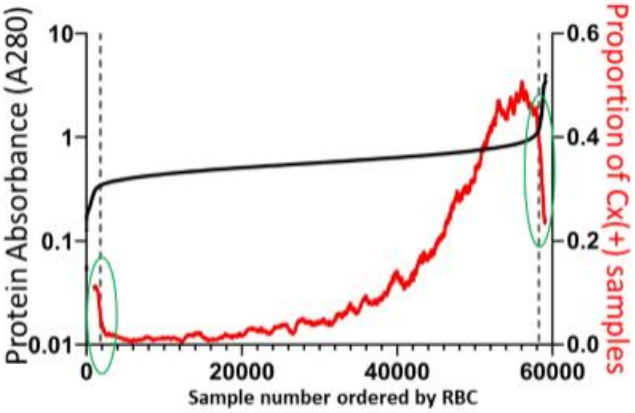
Corresponding Author	Carl Deirmengian
E-Mail Address	deirmenc@gmail.com
Institution	Rothman Institute
Department	
Address	26 Springton Pointe Dr
City, State	Newtown Square
Zip / Postal Code	19073
All Authors	Carl Deirmengian; Scott Feeley; Keith Kardos

Title	The Quality of a Synovial Fluid Aspirate is Critical to Result Interpretation

Background / Rationale	The publications about laboratory tests for PJI have exploded, yet there has been almost no research focusing on the impact of synovial fluid (SF) aspirate quality on the diagnostic test. Building on a previous study, we further define a poor-quality SF aspirate and demonstrate how diagnostic tests are adversely impacted.
Study Question	At what extremes of protein absorbance (A280), which detects saline lavage and contrast, are aberrant diagnostic results observed? At what extremes of RBC concentration are aberrant diagnostic results observed? What percentage of knee, hip, and shoulder S
Methods	59,094 SF samples from knee, hip and shoulder arthroplasties were submitted to one laboratory for PJI testing, each having an RBCs, A280 and a culture result. Extreme values of RBCs and A280 were assessed for impact on the SF CRP, alpha-defensin (AD), neutrophil elastase (NE), white blood cells (WBCs), and culture. Graphical and descriptive statistics are utilized to demonstrate where SF testing results begin to fail. The T-test was utilized to demonstrate significant differences between adequate vs. poor-quality SF samples.
Results	All diagnostic tests, including the SF CRP, AD, NE, WBC and Culture demonstrate clearly aberrant results in the following poor-quality SF conditions: 1) RBCs > 1,000,000 or 2) Protein absorbance < 0.342 or > 1.19 (see sample figure). The false negative rates of each test relative to a culture-positive gold standard increased substantially among poor-quality SF samples compared to adequate samples (SF CRP, 34.9 vs. 12.2%; AD, 33.2 vs 6.8%; NE, 19.8 vs 5.0%; and WBC, 31.8 vs. 7.0%) all with p<0.0001. Depending on the biomarker and joint analyzed, the false negative test rate attributable to poor-quality SF ranged from 6% to 60%. The overall rate of poor-quality SF was observed was 8.6%, with 6.6% of knee, 21.8% of hip, and 21.1% of shoulder aspirates involved (p<0.0001 for knee vs hip or shoulder).
Discussion	This study demonstrates that poor-quality synovial fluid aspirates resulting from joint lavage and bloody aspiration are highly prevalent (8.6%) and yield failure of all test's diagnostic performance, disproportionately impacting hip and shoulder aspirates.
Conclusion	When a SF aspirate is attained by joint lavage or contains >1,000,000 RBCs, the performance of SF tests are not reliable, demonstrating high false-negative rates.



Culture rates (red) vary predictably vs. RBCs (black) until the RBC count >1,000,000. At this point culture rates unexpectedly drop off (green).



Culture rates (red) vary predictably vs. A280 (black) until the A280 is >1.19 or < 0.342. At these points point culture rates unexpectedly change (green).

Corresponding Author Antonia Faustina Chen
E-Mail Address afchen@bwh.harvard.edu
Institution Brigham and Women's Hospital
Department Orthopaedic Surgery
Address 75, Francis Street
City, State Boston, MA
Zip / Postal Code 02115
All Authors Pierre-Emmanuel Schwab; Nathan Varady

Title Neutrophil-to-Lymphocyte ratio (NLR) is a Strong Predictor of Treatment Failure and Postoperative 90-Day Mortality in Septic Hip and Knee Arthritis

Background / Rationale Traditionally, serum white blood count (WBC), C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) have been utilized as markers to evaluate septic arthritis (SA). Recently, neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) have been identified as prognostic factors for treatment failure, mortality and morbidity in various clinical settings. To date, these markers have not been utilized for evaluating outcomes after hip and knee SA.

Study Question To determine the ability of admission NLR and PLR to predict treatment failure and postoperative 90-day mortality in hip and knee SA.

Methods A retrospective study was performed to identify 235 patients with native hip and knee septic arthritis from 2000-2018. Patient demographics, comorbidities and social factors were obtained, and NLR and PLR were calculated based on complete blood count values on admission. Receiver operating curves were analyzed, and optimal thresholds for NLR and PLR were determined with Youden's test. Univariate and multivariate analyses determined if these ratios were independent predictors of treatment failure (readmission or reoperation) and 90-day mortality after surgery. These ratios were compared to serum WBC count, CRP, and ESR.

Results Optimal thresholds for NLR was 9.49 (sens=60%, spec=84%) and PLR was 303 (sens=54%, spec=77%). With univariate analysis, NLR>9.49 was associated with failure (odds ratio [OR]=7.64, 95%CI=4.10-14.21) and 90-day mortality (OR=9.83, 95%CI=2.74-35.25). PLR>303 was associated with increased failure (OR=3.85, 95%CI=2.12-7.00). In multivariate analysis controlling for patient demographics, comorbidities and social factors, elevated NLR remained an independent predictor of failure (OR=7.04, 95%CI=3.78-13.14) and 90-day mortality (OR=5.98, 95%CI=1.60-22.32), whereas PLR remained a predictor of failure (OR=3.58, 95%CI=1.95-6.58). NLR was a better predictor of failure and 90-day mortality compared to serum WBC, CRP, and ESR.

Discussion This study demonstrates that NLR and PLR can estimate the severity of hip and knee SA. NLR performs better than serum WBC, CRP and ESR to predict treatment failure and 90-day mortality, whereas PLR is a good predictor of failure.

Conclusion NLR and PLR are reliable novel biomarkers that may be utilized when evaluating SA patients.

Corresponding Author	Taylor Paziuk
E-Mail Address	paziuk14@gmail.com
Institution	Rothman Orthopaedic Institute at Thomas Jefferson University
Department	Orthopaedic Surgery
Address	The Rothman Orthopaedic Institute 925 Chestnut, 5th Floor Philadelphia, PA 19107
City, State	Philadelphia, PA
Zip / Postal Code	19107
All Authors	Taylor Paziuk; Gerard Chang; Brianna Fram; John Strony; James Krieg

Title A Potential New Indicator for the Diagnosis of Fracture-Related Infections: Platelet Count to Mean Platelet Volume Ratio

Background / Rationale Diagnosing fracture related infection preoperatively is difficult. Although traditional serum biomarkers are used, they are often misleading and therefore often add a monetary burden to a diagnostic evaluation without providing any additional clinical information. Platelets are a known acute phase reactant who parameters are assessed in all patients undergoing surgery via standard preoperative complete blood count.

Study Question Are platelet indices, specifically that of platelet count (PC) and mean platelet volume (MPV), useful in the diagnosis of fracture-related infections (FRI) relative to other serum biomarkers.

Methods A retrospective review of all fracture nonunion revision surgeries performed at our single institution between 2013 and 2018. All patients undergoing revision surgery for a nonunion were included. Nonunion was defined as an arrest in the biologic fracture repair process, as seen on imaging, for three consecutive months with a minimum of six months between the index procedure and diagnosis. Positive intraoperative cultures defined the FRI cohort. Preoperative ESR, CRP, and platelet indices were assessed for each patient using ROC curve analysis.

Results Sensitivity, specificity, and Area Under the Curve (AUC) of the ROC curve analysis of the PC to MPV ratio were 100%, 55.56%, and 0.814, respectively. The ratio by itself outperformed ESR and CRP individually and in combination with each other. Finally, the diagnostic performance of ESR, CRP, and the ratio together had an AUC of 0.879 on ROC curve analysis.

Discussion Platelets have a clear association with FRI. The PC to MPV ratio outperformed traditional biomarkers like ESR and CRP in the assessment of PJI. All patients get a preoperative CBC, so platelet indices add no temporal or monetary burden in the assessment of patients with potential FRI.

Conclusion The PC to MPV ratio can serve as a cost-effective and reliable screening test for FRI. Utilizing ESR, CRP, and the PC to MPV ratio in conjunction with one another optimizes the diagnostic performance of a preoperative FRI assessment.

Corresponding Author Carl Deirmengian
E-Mail Address deirmenc@gmail.com
Institution Rothman Institute
Department
Address 26 Springton Pointe Dr
City, State Newtown Square
Zip / Postal Code 19073
All Authors Carl Deirmengian; Sujith Kallur; John Madigan; Janet Conway; Carlos Higuera; Robin Patel

Title Prospective, Multicenter, Adjudicator-Blinded Clinical Trial of the Alpha-Defensin (AD) Lateral Flow Test for Periprosthetic Infection (PJI)

Background / Rationale There are numerous publications demonstrating that the AD laboratory-based (ELISA) test for PJI (performed at CD Diagnostics) exhibits excellent diagnostic performance. However, the literature assessing the AD lateral-flow test is mixed, comprised of smaller retrospective studies with few PJIs.

Study Question The purpose of this study was to assess the diagnostic performance of the AD lateral flow test for PJI. A secondary purpose was to compare the lateral flow and laboratory-based AD tests.

Methods A prospective, multicenter, adjudicator blinded clinical trial (NCT02868736) was designed as required by the FDA for consideration of a de novo diagnostic device. The trial design included 2 arms: a prospective cohort of patients prior to anticipated revision hip or knee arthroplasty (N=305) and a laboratory-derived fresh synovial fluid sample cohort of subjects meeting MSIS criteria (MSIS+) for PJI (N=65). The 2013 MSIS criteria were utilized as the gold standard for subject classification, with each subject independently adjudicated by a panel of three expert adult arthroplasty surgeons blinded to study results. Adjudication of combined cohorts yielded 122 MSIS(+) and 248 MSIS(-) patients. The lateral-flow and laboratory-based AD tests were performed on every sample.

Results The AD lateral-flow test for PJI demonstrated a sensitivity of 94.3% (95%CI: 88.5-97.7%) and specificity of 94.8% (95%CI: 91.2-97.2%) in the combined cohorts. There was no statistically significant impact of prior antibiotic or other medication treatment or underlying systemic inflammatory diagnoses. There was also no statistically significant difference in the AD lateral-flow performance comparing PJIs that were culture (+) vs. culture (-). The sensitivity and specificity of the AD lateral flow test (94.3 and 94.8%) did not demonstrate a statistically significant difference from the AD laboratory-based test (92.7 and 97.6%; both p>0.05).

Discussion The diagnostic performance and rapid nature of the AD lateral-flow test makes it appealing in situations where a rapid test result for PJI is necessary.

Conclusion This study demonstrates that the AD lateral-flow test for PJI has a sensitivity of 94.3%, and specificity of 94.8%, and exhibits a diagnostic performance similar to the laboratory-based test for AD.

Symposium #2

Biofilm

Basic Science Findings Guide Clinical Outcomes Data

Is acute vs chronic a biofilm question?

Local vs Systemic antimicrobials, can either work against mature biofilm?

Moderator: Alex C. McLaren, M.D.

Edward Schwarz, PhD
Burton Professor of Orthopaedics
Director of the Center for Musculoskeletal Research
University of Rochester Medical Center, Rochester, NY

Steven Kates, M.D.
Professor and Chair, The John Cardea Chair of Orthopaedics
Virginia Commonwealth University, Richmond, VA

Kordo Saeed, MB, ChB, MSc, FRCPath
Consultant Microbiologist
Hampshire Hospitals, NHS Foundation Trust
Honorary Senior Lecturer
University of South Hampton Royal Hampshire County Hospital Basingstoke, UK

This symposium is supported by Heraeus and MicroGenDx as an educational endeavor, but the content and the selection of speakers are entirely controlled by the MSIS

Session IV

PJI Diagnosis and Management

Moderators: Angela L. Hewlett, M.D.; Carlos A. Higuera-Rueda, M.D.

Corresponding Author	Malcolm E. Dombrowski
E-Mail Address	dombrowskime@upmc.edu
Institution	University of Pittsburgh Medical Center
Department	Department of Orthopedic surgery
Address	Kaufmann Medical Building, Suite 1010 3471 Fifth Ave
City, State	Pittsburgh, Pennsylvania
Zip / Postal Code	15213
All Authors	Malcolm E. Dombrowski; Alan Wilson; Michael J. O'Malley; Kenneth Urish; Brian R. Hamlin; Lawrence S. Crossett; Brian A. Klatt

Title A low percentage of patients meet inclusion criteria for single-stage exchange arthroplasty

Background / Rationale Periprosthetic joint infection (PJI) is the leading cause of arthroplasty failure, and two-stage exchange arthroplasty is the 'gold standard' treatment for chronic PJI. Single-stage exchange arthroplasty is gaining popularity as a treatment for chronic PJI, and some have suggested that this should be done for all chronic infection patients. However, to be considered for a single-stage exchange you must meet a narrow set of inclusion criteria. Our impression was that a low number of our patients meet these criteria

Study Question What percentage of chronic PJI treated at our institution meet the inclusion criteria for single-stage exchange arthroplasty? What is the reinfection rate after 2-stage exchange in those meeting inclusion criteria for single-stage exchange compared to tho

Methods This is a retrospective review of all patients with chronic PJI that underwent two-stage exchange from 2012-2016 at a single US quaternary referral center with at least 2 years follow-up. Patients were excluded from single-stage exchange based on ICM criteria. Specifically: unknown organism pre-operatively, immunocompromised host, presence of sinus tract, and virulent/resistant pathogen. Re-infection rate was compared using an unpaired student t-test.

Results 91 patients were identified from 2012-2016 with chronic PJI that underwent 2-stage exchange. Of which, 83.5% (n=76) would be contraindicated from single-stage exchange. Of those patients that met the inclusion criteria (16.4%) for single-stage exchange there was a 20% (3/15) reinfection rate after 2-stage exchange compared to 31.6% (n =24) re-infection rate in those contraindicated from single-stage exchange (p = 0.375) (Figure 1).

Discussion The most significant finding of this study is that of all chronic PJI presenting at our institution over a four-year period only 16.4% would be considered for single-stage exchange under the current published inclusion criteria. Even so, the difference in reinfection rate was not statistically significant between those meeting inclusion criteria for single-stage exchange compared to those who do not.

Conclusion Most patients treated at our large referral center do not meet the inclusion criteria for single-stage exchange. The literature on single-stage exchange does not include the same patients who are treated with two-stage. Offering single-stage exchange to all patients is not a logical step based on existing data.

Corresponding Author Mukai Chimutengwende-Gordon
E-Mail Address mukai.cg@mac.com
Institution Royal Adelaide Hospital, Adelaide, Australia
Department Department of Orthopaedics and Trauma
Address Royal Adelaide Hospital, Port Road, Adelaide, SA 5000, Australia
City, State South Adelaide
Zip / Postal Code 5000
All Authors Mukai Chimutengwende-Gordon; Stuart A Callary; Jerome A Davidson; Kerry Costi; Sue M Pannach; Roumen Stamenkov; Donald W howie; Lucian B Solomon

Title Femoral Impaction Bone Grafting in Staged Revision for Infected Hip Arthroplasty.

Background / Rationale Femoral impaction bone grafting (IBG) may be used to restore bone stock in revision total hip arthroplasty (THA) and allow the use of a shorter, than otherwise, length stem, especially in cases with significant femoral defects. This is most beneficial in younger patients who are likely to require further revisions. However, concerns persist regarding the use of bone graft following prosthetic joint infection as well as significant stem subsidence.

Study Question This study aimed to assess the rate of infection eradication, femoral stem subsidence and clinical outcomes with the use of IBG for staged revision THA for infection.

Methods A prospective cohort of 29 patients who underwent staged revision THA for infection was investigated. Patients underwent implantation of an interval prosthesis at the first stage and femoral impaction bone grafting at the time of implantation of the definitive cemented prosthesis. Femoral stem subsidence was measured with radiostereometric analysis. Clinical outcomes were assessed with the Harris Hip, Harris Pain, and Société Internationale de Chirurgie Orthopédique et de Traumatologie Activity (SICOT) Scores. The minimum clinical follow-up was two years (2 – 10 years).

Results The original infection was eradicated in 28 patients (96.5%). One patient required a repeat staged revision THA due to re-infection with the same organism. Twenty-three patients required an extended trochanteric osteotomy (ETO) at the first stage procedure to remove the original prosthesis. Twenty-six patients (89.6%) were managed with either a standard or mid-length femoral stem including 22 of the patients who underwent an ETO. At two-year follow-up, the median subsidence was -1.70 mm at the stem-bone interface (-0.31 to -4.98mm). The median Harris Hip Score improved from 51 pre-operatively to 80 at two years (p=0.000), the Harris Pain Score from 20 to 44 (p=0.000) and the SICOT Score from 2.5 to 3 (p=0.003).

Discussion Femoral IBG during the final reconstruction of the femur after staged revision THA for infection avoids the use of a long-stemmed prosthesis in the majority of cases, including cases where an ETO is performed. This technique is associated with minimal subsidence and good clinical outcomes without re-infection in the majority of cases.

Conclusion This study supports the use of femoral IBG during the final reconstruction of the femur after staged revision THA for infection.

Corresponding Author	Milan Kapadia
E-Mail Address	kapadiam@hss.edu
Institution	Hospital for Special Surgery
Department	
Address	535 E 70th Street
City, State	New York, New York
Zip / Postal Code	10021
All Authors	Milan Kapadia; Andy O Miller; Allina A Nocon; Peter Sculco; Susan Goodman

Title Rheumatic Disease Patients Have More Culture Negative Prosthetic Joint Infections- Are There Clinical Differences?

Background / Rationale Rheumatic disease (RD) patients are at increased risk for prosthetic joint infections (PJI), however, diagnosis is challenging because active RD may mimic joint infection. We aimed to assess the incidence of culture negative (CN) PJI in a population of RD and osteoarthritic (OA) PJI using an institutional PJI registry. Baseline clinical differences between CN-RD and culture positive (CP)-RD as well as the relationship of culture negativity to survivorship of the prosthesis were also evaluated.

Study Question Is culture negativity more common in PJI patients with rheumatic disease? How do these culture negative patients with rheumatic disease differ from other patient groups?

Methods A retrospective cohort of hip and knee PJIs, from 2008 to 2016, were identified by ICD codes, and confirmed by chart review. RD cases were identified by ICD code and use of RD-specific medications. CN cases were defined as PJIs with no evidence of microbial growth in intraoperative cultures. Demographics, medications, microbiology, histopathology, surgical therapy and outcome were abstracted. Baseline characteristics were evaluated using Fisher's exact and Chi-Square tests. Kaplan-Meier estimates were used to calculate survivorship.

Results 807 PJI cases were identified including 36 RD (33 rheumatoid arthritis and 3 systemic lupus erythematosus) and 771 OA. A higher proportion of RD PJI were CN (N=10, 27%) vs. OA PJI (N=109, 14%, p=0.02). Fewer CN-RD cases met PJI histopathology criteria compared to CN-OA, (p=0.08). On average, RD-CN were younger than OA-CN (59 vs 69, p=.01), but no different than RD-CP cases. One year survivorship of CN-OA and CN-RD were 87% and 66%, respectively and 47% for CP-RD. Comparing CN-RD vs. CP-RD, no difference was observed in age, smoking, diabetes, or Charlson comorbidities, but a trend towards higher prevalence of prior PJI in the CN-RD group. Clinically, no differences were found in surgical treatment (p=0.92) or use of biologics and DMARDs (p=0.12) between CN and CP RD patients.

Discussion RD PJIs are more likely to be culture negative than OA PJIs.

Conclusion Prior PJI, histopathology and better outcomes suggest biologic differences that should be explored further.

Corresponding Author	Timothy L Tan
E-Mail Address	research@rothmanortho.com
Institution	Rothman Orthopaedic Institute
Department	
Address	125 S 9th St. Ste 1000
City, State	Philadelphia, PA
Zip / Postal Code	19107
All Authors	Timothy L Tan; Chi Xu; Elie Ghanem; Carlos Higuera; Jaiben George; Karan Goswami; Ji-Ying Chen; Javad Parvizi

Title Total Joint Arthroplasty after Septic Arthritis: When can this be Safely Performed?

Background / Rationale Patients undergoing total joint arthroplasty following septic arthritis demonstrate a substantially higher risk of developing PJI. However, there is minimal literature to guide surgeons on the ideal candidates and timing of arthroplasty in this specific population.

Study Question The purpose of this study to perform a multi-center study to determine risk factors for failure including prior surgery, time from treatment of septic arthritis, and the role of serological markers prior to arthroplasty on the development of PJI.

Methods A retrospective study of 172 TJAs following prior septic arthritis was performed at four institutions. Culture results, prior treatment, time from initial infection, and other relevant variables were extracted from the medical record. The primary outcome was development of PJI defined by Musculoskeletal Infection Society criteria. Bivariate and multivariate analyses were performed to identify risk factors for failure. Kaplan Meier survivorship curves were generated for prior treatment and spline curves were generated to assess the influence of time from native septic arthritis on developing PJI.

Results The PJI rate was 10.5% (18/172) in patients who underwent TJA after native septic arthritis. Predisposing risk factors for developing PJI included diabetes (HR 3.94) and resistant organisms (HR 3.70) in the bivariate analysis. There was no optimal time (p=0.117) from native septic arthritis treatment to arthroplasty; however, it appears that more than 1 year is safe. Although ESR was higher in patients that subsequently failed, ESR and CRP did not prove useful as the Youden's index demonstrated that cutoff values were in the normal range.

Discussion The influence of several factors, including time from PJI treatment, on the development of PJI after TJA for septic arthritis were identified.

Conclusion We hope that surgeons can be cognizant of the influence of these factors when determining when and whom should receive arthroplasty following septic arthritis.

Corresponding Author Carl Deirmengian
E-Mail Address deirmenc@gmail.com
Institution Rothman Institute
Department
Address 26 Springton Pointe Dr
City, State Newtown Square
Zip / Postal Code 19073
All Authors Carl Deirmengian; Scott Feeley; Stephen Sizer; Gregory Kazarian

Title Automated Cell Counters May Yield Falsely Elevated Synovial fluid WBC Counts in TKA

Background / Rationale It has been well known that automated cell counters may falsely elevate the synovial fluid (SF) white blood cell count in the setting of THA corrosion. The accuracy of automated cell counters and their correspondence to manual cell counting has not been well studied in the setting of SF aspirates of the knee.

Study Question Do automated counts produce false positive results in the knee? What is the correlation between automated and manual WBC counts in the knee?

Methods We retrospectively identified 40,407 SF aspirations from knees from 2015-2018, including 38,165 TKAs and 2,242 native knees. All synovial fluid samples were sent to one laboratory for the purpose of a diagnostic evaluation, and had an automated SF WBCs, PMN%, culture, alpha defensin, neutrophil elastase, and SF CRP. All automated WBC counts > 3000 cells/ul were reflexed to also attain a manual count (819 native knees and 6892 TKAs). The correlation between automated and manual WBC counts was analyzed.

Results 687 (10%) of TKA samples with >3000 WBCs on automated count were found to have a count < 3000 WBCs on manual count. This was greater than the 4.4% false positive automated WBC elevation rate found among native knees (p<0.0001). Additionally, the Pearson correlation between automated and manual SF WBC counts was lower for TKAs (r=0.90; 95%CI:0.89-0.90) than for native knees (r=0.97; 95%CI: 0.97-0.98). Among the 687 falsely-elevated automated TKA WBC counts, 279 (40.6%) were elevated to a degree that was 50% or greater than that of the manual count result.
SF samples that had a positive automated count but a negative manual count had a lower CRP (6.3 vs 27.4), alpha-defensin(0.61 vs 2.5), neutrophil elastase (1.4 vs 5.2), PMN% (58.5 vs 85.6), and Culture(+) rate (5.4% vs 52%) than samples with both a positive automated and manual count (all with p<0.0001).

Discussion We demonstrate that the presence of a knee replacement, but not a native knee, is associated with high false-positive automated cell counts. The correlation between automated and manual cell counts was greater in native knees compared to TKAs. The low inflammatory marker levels and culture rates among samples with a corrected manual count corroborates the accuracy of manual counts.

Conclusion The observation of false-positive automated cell counts is not only an issue for hip corrosion samples, but also observed in 10% of TKA samples.

Corresponding Author Carl Deirmengian
E-Mail Address deirmenc@gmail.com
Institution Rothman Institute
Department
Address 26 Springton Pointe Dr
City, State Newtown Square
Zip / Postal Code 19073
All Authors Carl Deirmengian; Scott Feeley; Tony Joaquim; Dan Keeter

Title Diagnostic Performance of the Synovasure Microbial ID Test

Background / Rationale We previously reported the results of a pilot study demonstrating the ability of a microbial immunoassay to identify organisms in synovial fluid; the Microbial ID Test.

Study Question What is the diagnostic performance of the Microbial ID assays? Are they really detecting microbial antigens in synovial fluid? Can these assays detect microbes in culture-negative infection without resulting in a high apparent false-positive rate?

Methods 20,644 synovial fluid samples from knee (17,962), hip (2,374) and shoulder (310) were sent to one laboratory for Microbial ID testing to evaluate for PJI. Each sample was given an inflammatory score based on the levels of fluid CRP, alpha-defensin, leukocyte esterase, WBC count, and the PMN%. Correlations of measured organism antigen level in the Microbial ID tests were made in comparison to the eventual "time to culture" and to the inflammatory score. Additionally, the performance of the assay in the setting of culture-negative inflammation was analyzed.

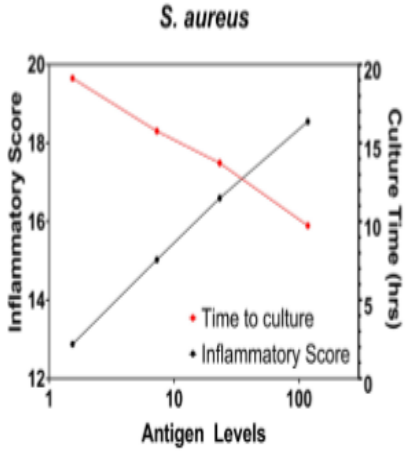
Results The Microbial ID Test sensitivity, relative to a culture-positive gold-standard, was 91% (95%CI: 89.7-92.5) for the Staphylococcal panel, 98% (95%CI: 93.2-99.8) for the Enterococcal panel, and 82% (95%CI:72.8-88.9) for the Candidal panel.

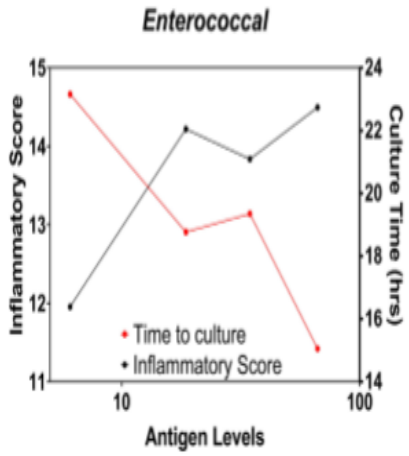
The detection of increasing organism antigen by the microbial ID assay correlated directly with decreasing eventual "time to culture" for all organisms. Additionally, the detection of increasing organism antigen levels correlated directly with increasing inflammatory scores (see figure).

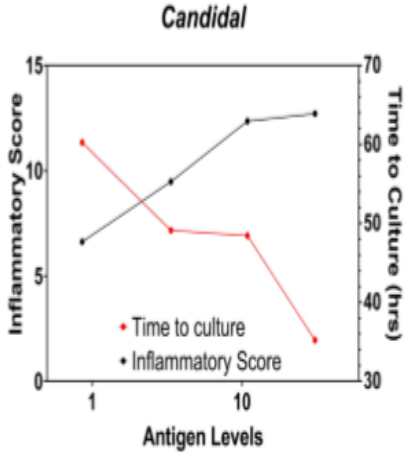
The Microbial ID Test detected no organism among 14,474 of 14,670 culture-negative samples with a low inflammatory score (<2) yielding a specificity of 98% (95%CI: 98.5-98.8). Despite this very low false-positive rate, the test detected organism in 54% of culture-negative, high inflammatory (5) samples.

Discussion The Microbial ID Test, based on immunoassay technology, has high sensitivity and specificity. The Microbial ID Test detects an organism in 54% of culture-negative infections, without unexpectedly high microbiome or false-positive detection rates. The correlation of antigen levels with decreased "time to culture" and increased inflammatory scores demonstrates that the assay detects organisms in synovial fluid.

Conclusion The synovial fluid microbial ID assays detect organisms, has an excellent diagnostic performance, and can help identify the organism in culture-negative scenarios.


S. aureus
Inflammatory Score
Culture Time (hrs)
Time to culture
Inflammatory Score
Antigen Levels


Enterococcal
Inflammatory Score
Culture Time (hrs)
Time to culture
Inflammatory Score
Antigen Levels


Candidal
Inflammatory Score
Time to Culture (hrs)
Time to culture
Inflammatory Score
Antigen Levels

Corresponding Author	Brian A Klatt
E-Mail Address	klattba@upmc.edu
Institution	University Of Pittsburgh Medical
Department	Department of Orthopaedic Surgery
Address	Shadyside Medical Building (Joint Reconstruction Center) 5200 Centre Ave. Suite 415
City, State	Pittsburgh, PA
Zip / Postal Code	15232
All Authors	Lee M Sasala; Alan Wilson; Elena Nikonova; Michael J O'Malley; Brian A Klatt

Title

Organism Prevalence in Prosthetic Joint Infection (PJI) Before and After the Implementation of Routine Implant Sonicate Culture

Background / Rationale

Implant sonicate culture is the most sensitive culture technique for PJI and should more easily detect organisms that form biofilm. With more sensitive culture technique we postulated that we would have less culture negative infections and would detect a larger number of organisms that form biofilm. We anticipated increased rates of Staph Aureus detection.

Study Question

Has the implementation of the routine use of sonication:

1. Decreased the rate of culture negative PJI?
2. Altered the prevalence of bacteria in our patient population?
3. Increased the frequency of polymicrobial infections?

Methods

We performed a retrospective chart review of all PJI cases at our institution over a six year period before and after the routine use implant sonication. Patients without sufficient data points for analysis were excluded. In the post-sonication group, infection was defined using MSIS criteria. In the pre-sonication group, infection was defined based on operative reports and culture data.

Results

The number of culture negative PJI cases decreased from 27% to 6.3% after the implementation of sonication. The most common organisms were coagulase negative Staphylococcus, MSSA and MRSA. There was a significant decrease in the frequency of both MSSA and MRSA PJIs in the post-sonication group. There was no change in the frequency of CoNS infections. (Table 1)

The pre-sonication prevalence of polymicrobial PJI was 13% compared to 8% in the post-sonication group. The most common organisms in polymicrobial infections prior to sonication were CoNS, MSSA and Diptheroids. In the post-sonication group, CoNS and MSSA were again the most prevalent followed by E. faecalis and S. agalactiae

Discussion

Our data again demonstrate the high sensitivity of implant sonicate culture. The only significant change in prevalence was a decrease in MSSA and MRSA PJIs. This finding was the opposite of what was anticipated. It is possible that there has been a change in the prevalence of organisms in our community during this study. Furthermore, we have a nasal decolonization protocol and treatment program, and this might impact the overall rate at our facility. The reason for the decrease in polymicrobial PJI after the use of sonication is not clear.

Conclusion

Culture negative PJI decreased with sonication use. MSSA, MRSA, and Polymicrobial PJI prevalence decreased over the study period.

Table 1: Relative Prevalence of Organisms

	Monomicrobial	**Pre-2012 (%)**	**Post-2012 / Sonication(%)**	**Polymicrobial**	**Pre-2012 (%)**	**Post-2012/ Sonication (%)**
	N=	148	138	*N*=	22	12
1	CoNS	25.0	29.7	CoNS	54.5	41.7
2	MSSA	**29.1***	**17.4* (p=0.020)**	MSSA	22.7	33.3
3	MRSA	**23.0***	**13.0* (p=0.029)**	*E. faecalis*	13.6	25.0
4	Viridans	3.4	6.5	GBS (*S. agalactiae*)	0.0	25.0
5	GBS	4.1	5.1	Diphtheroids	27.3	8.3
6	*E. faecalis*	3.4	4.3	*E. cloacae*	9.1	8.3
7	Diphtheroids	2.0	2.2	MRSA	13.6	8.3
8	Propionibacterium spp.	1.4	1.4	E. *coli*	4.5	16.7
9	*Pseudomonas aeruginosa*	1.4	3.6	*Serratia marcescens*	4.5	16.7
10	*E. coli*	1.4	2.9	*P. aeruginosa*	9.1	16.7

Corresponding Author	Milan Kapadia
E-Mail Address	kapadiam@hss.edu
Institution	Hospital for Special Surgery
Department	
Address	535 E 70th Street
City, State	New York, New York
Zip / Postal Code	10021
All Authors	Michael Henry; Milan Kapadia; Joseph Nguyen; Barry Brause; Andy O Miller

Title	Differences in Pathogens Between Hip and Knee Prosthetic Joint Infections

Background / Rationale	There is contradicting evidence characterizing the difference in pathogens that cause hip and knee prosthetic joint infection (PJI). A possible difference in microbiology may inform choice in antibiotic prophylaxis, and empiric treatment as well as infection etiology. We sought to analyze a large cohort of PJIs to see if there was a significant difference in pathogen between joints.
Study Question	Is there a difference in pathogen type between hip and knee prosthetic joint infections?
Methods	A retrospective cohort of hip and knee PJIs, from 2008 to 2016, were identified by ICD code and surgical codes. The PJI pathogen was identified from synovial or intra-articular tissue cultures. The Student's t-test was used to compare continuous variables. Chi-square tests were used to compare the categorical variables to joint.
Results	807 PJI cases were identified including 444 knees and 363 hips. There were no significant differences between hip and knee PJIs in age, sex, history of PJI, rheumatoid arthritis, Charlson comorbidity index and laterality. There was a higher frequency of diabetes in knee PJIs (25.3%) compared to hip PJIs (15.7%), p<.001. No significant difference was found in the prevalence of fungal, staphylococcal (including Staphylococcus aureus), streptococcal, or enterococcal pathogens between hip and knee PJIs.
Discussion	n/a
Conclusion	In this single center cohort, hip and knees PJIs are infected with similar pathogens. Multiple site studies are needed to characterize the microbiology of PJIs at a larger scale.

Symposium #3

Pre-Operative PJI Risk Calculators

Moderator: Alberto V. Carli, M.D.

Antonia F. Chen, M.D., MBA
Orthopaedic Surgeon
Director of Research in Arthroplasty, Brigham and Women's Hospital
Boston, MA

Carlos A. Higuera-Rueda, M.D.
Center Director Orthopaedics and Rheumatology Chairman
Levitetz Department of Orthopaedic Surgery
Cleveland Clinic Florida
Weston, FL

Aaron J. Tande, M.D.
Assistant Professor of Medicine
Division of Infectious Diseases, Mayo Clinic
Rochester, MN

*This symposium is supported by **Heraeus** and **MicroGenDx** as an educational endeavor, but the content and the selection of speakers are entirely controlled by the MSIS*

Session V

PJI Outcomes

Moderators: Parham Sendi, M.D.; Antonia F. Chen, M.D., MBA

Corresponding Author	Brian A Klatt
E-Mail Address	klattba@upmc.edu
Institution	University of Pittsburgh Medical Center
Department	Orthopaedic Surgery
Address	University of Pittsburgh Department of Orthopaedic Surgery 3471 Fifth Avenue
City, State	Pittsburgh, PA
Zip / Postal Code	15213
All Authors	Alan E Wilson; Kwesi St. Louis; Michael J O'Malley; Kenneth L Urish; Lawrence S Crossett; Brian A Klatt

Title	Periprosthetic joint infections diagnosed by MSIS and sonication cultures demonstrate greater than 50% treatment failure rate in patients with a history of two-stage exchange arthroplasty
Background / Rationale	Sonication of explanted total joint components has been demonstrated to improve culture sensitivity in patients with periprosthetic joint infection (PJI) to greater than 90%. It is thought that improved culture yields will lead to more targeted antimicrobial therapy that increases cure rates while minimizing harmful side effects and emergence of resistant organisms.
Study Question	What is the rate of treatment failure for PJI diagnosed with MSIS consensus criteria and sonication fluid culture treated with two-stage exchange arthroplasty?
Methods	We performed a single institution, multi-center retrospective chart review of 173 patients who met MSIS consensus criteria for PJI of both total knee and total hip arthroplasty between September 2012 and May 2016. All patients had a minimum of 2 years follow-up or treatment failure prior to this time. Treatment failure was defined as reinfection or failure to complete two-stage exchange secondary to persistent infection or other host factors. 118 patients underwent explant of infected components with intent to complete two-stage exchange arthroplasty (Figure 1). Sonication cultures were positive (? 5 colony forming units) in 94.0% of infections.
Results	The overall rate of treatment failure was 34.0% (34 of 100). Reinfection occurred in 18.5% (15/81) of patients who successfully completed two-stage exchange. 19 of 100 patients were never replanted and were treated with chronic antibiotic suppression (10), fusion (5) or amputation (4). 20 patients had previously been treated with two-stage exchange arthroplasty for PJI. Overall rate of failure for this subset was 55.0% (11/20); 4 of 20 were ultimately reinfected and 7 of 20 were never replanted. The relative risk of treatment failure given a history of prior two-stage exchange arthroplasty for PJI was 1.91 (95% CI [1.13 to 3.24], p = 0.016).
Discussion	Despite improved diagnostic accuracy with sonication culture, overall treatment failure in this cohort is roughly one third of patients. A large subset of patients in this study had a history of prior infection, which portended a much higher likelihood of treatment failure.
Conclusion	The risk of treatment failure is nearly twice as high for patients with PJI who have previously failed two-stage exchange arthroplasty.

Corresponding Author Brian A Klatt
E-Mail Address klattba@upmc.edu
Institution University of Pittsburgh Medical Center
Department Department of Orthopaedic Surgery
Address Shadyside Medical Building (Joint Reconstruction Center)
5200 Centre Ave.
Suite 415
City, State Pittsburgh, PA
Zip / Postal Code 15232
All Authors Lee Sasala; Alan Wilson; Elena Nikonova; Michael O'Malley; Brian Klatt

Title Host Grade and Long Term Reinfection Rate in Prosthetic Joint Infection

Background / Rationale Patients who experience a PJI are likely to be poor hosts. Furthermore, host grade has been associated with increased the risk of PJI recurrence.

Study Question (1) Does host status effect the reinfection rate after revision for prosthetic joint injection?

Methods We performed a retrospective chart review of all patients who underwent revision surgery for PJI at our institution. Patients who died or were lost to follow up were excluded from analysis. Host status was graded using the MSIS host grading system. Recurrence of infection was defined as repeat operation other than for aseptic reasons.

Results There were 54 grade A hosts, 131 B hosts, and 85 C hosts. Overall, 25.9% of all patients had a recurrence of infection within 2 years, 40.2% at 5 years, and 58.6% at 10 years. At 2 years, 28.2 % of Type B and 29.4% of Type C hosts were reinfected versus 14.8% of the type A hosts. At 10 years, 6.7% of group A hosts had a recurrence, versus 24.3% in type C hosts. (Table 1) 11.3% of patients who were initially culture negative became reinfected in the first 2 years compared with 31.9% of patients who were culture positive.

Discussion Our observed overall increased reinfection rate in the first 2 years agrees with prior published results. In the first 2 years, host grades B and C had higher reinfection rates. At 2-5 years, all host grades had similar recurrence rates. This data indicate that for grade B and C hosts, there was a higher overall reinfection rate at all time points compared to A hosts. Interestingly, only 11.3% of patients who were culture negative infections became infected in the first 2 years. This could raise the question of the accuracy of the original PJI diagnosis.

Conclusion Higher host grade seems to correlate with higher reinfection rate after revision for PJI.

Table 1: Reinfection rates by host status

		Reinfected, 2-years, no. (%)	Reinfected, 5-years, no. (%)	Reinfected, 10-years, no. (%)
		N = 270	*N = 217*	*N =70*
Host Status	A	8 /54(14.8%)	7/46 (15.2%)	1/15(6.7%)
	B	37/131 (28.2%)	15/113 (13.3%)	9/40 (24.3%)
	C	25/85 (29.4%)	9/58 (15.5%)	3 /18(16.7%)
	Total:	***70 (25.9%)***	***31 (14.3%)***	***13 (18.6%)***

Corresponding Author Gerhard E Maale
E-Mail Address gerhardmaale53@gmail.com
Institution DFW Sarcoma Group/ Medical City Plano
Department Orthopedic Oncology
Address 4708 Alliance Blvd.
Suite 710
City, State Plano, Texas
Zip / Postal Code 75093
All Authors Gerhard E Maale; John J Eager; Anirurth Srinivasaraghavan

Title Evolution of the 2 Stage to a 1 Stage in the Treatment of Infected Total Joints Arthroplasties: Results of the First 500 cases

Background / Rationale The 2 stage treatment of infected total joint arthroplasties (PJI) was published in 1996. This involves debridement with placement of an antibiotic cement spacer and then an exchange total joint at a later time interval. The type of debridement is critical. The one stage is now staring to be more accepted, but requires more radical debridement with excision of all biofilm related tissue and hardware, antibiotic cement, a stabilized prosthesis that are constrained and the use of biodegradable local antibiotic carriers.

Study Question What are the McPherson stages of PJI, risk factors for one stage, demographics on patients, recurrence rate, complications, requirements of re-operation, flaps performed, # of previous surgeries prior to referral, and amputation rate, and organism recover

Methods All the patients treated with a one stage were reviewed with at least 2 years of follow-up. They were analyzed for organism recovery, demographics, prior surgeries historically prior to referral, stage of host by McPherson's classification and Cierny's. Recurrence and complications. Debridement was performed radically with removal of any implant and reactive tissues in an oncology type of procedure.

Results There were 35 Shoulders, 12 elbows , 4 scapular thru forearm replacements. The rest were divided 2-1 Hips to knee. There was 15 total hip-knee and one pelvis -knee replacement. The average surgeries prior to referral was 5-7 cases, with a range 1 -19. Organism retrieval was <10% . 95% were Stage III-C-3 using McPherson's classification. The salvage rate was 90%, lower in the compromised C host for which 35% required amputation. Dislocation is the most common cause of re-operation and then recurrence of PJI in hips knee and shoulders. Organism recovery was under 10%. Free flaps were necessary in 20% of knees, 8% in hip and 45% of upper extremities.

Discussion The results show one stage can be done with similar results to 2 stage with quicker functional recovery.

Conclusion The one stage treatment for PJI has better results in our hands than the 2 stage. Careful consideration needs to be given for physiologic host, as some borderline C's would best be served with amputation. Locked rotating hinge knees arthroplasties are recommended in people with large soft tissue resection for infection. Constrained devices are necessary for any PJI after radical debridement.

Corresponding Author	Matthew V. Dipane
E-Mail Address	MDipane@mednet.ucla.edu
Institution	UCLA
Department	Department of Orthopaedic Surgery
Address	1250 16th St.
City, State	Santa Monica
Zip / Postal Code	90404
All Authors	Edward J. McPherson; Jasmine A. Castillejos; Madhav Chowdhry

Title	Serial Aspirations & Intra-Articular Antibiotic Injections for Non-Operative Management of Chronic PJI: Introducing the Concept of Biofilm Training

Background / Rationale	We outline a treatment protocol for subjects with chronic PJI who elected not to have surgery. We developed a method of serial "fluid-depleting" aspirations with intra-articular gentamycin injections to affect the population of the biofilm community. Our longest follow-up is 10 years.
Study Question	Can a chronic PJI biofilm be controlled or modified non-operatively?
Methods	A group of 25 subjects diagnosed with a chronic PJI were treated with an active suppression protocol, in lieu of surgery. The protocol entailed frequent aspirations and intra-articular gentamycin injections to quell the PJI inflammatory response. Based on a subject's response, he/she was identified as 1 of 3 classifications: 1) Ongoing Treatment – Biofilm Trained (OTBT), 2) Ongoing Treatment – Biofilm Untrained (OTBU), and 3) Treatment Failure (TF). OTBT subjects showed no clinical signs of infection. Serum biomarkers (CRP, ESR) remained consistently normal and subjects were not on oral suppressive antibiotics. Aspiration analysis and cultures remained negative. Maintenance treatment consisted of an aspiration/injection every 12-16 weeks. OTBU subjects showed improved symptoms, lowered serum biomarkers, and lowered WBC counts, but still demonstrated objective signs of infection. TF subjects showed unchanged/worsening clinical symptoms.
Results	Of the 25 subjects, 8 were THA's and 17 were TKA's. Of these cases, 21 (84%) were endoprosthetic replacements. 8 subjects (32%) were classified as OTBT, 6 (24%) as OTBU, and 11 (44%) as TF. All TF subjects were treated with a two-stage exchange protocol.
Discussion	This study is the first describing the potential of modifying bacterial biofilm in a chronic PJI. OTBT subjects demonstrated dramatic changes and led normal lives, minimally disrupted by an aspiration and injection every 3-4 months. We are now evaluating different agents to modify biofilm, including those designed to disrupt the biofilm surface and transform the biofilm to a benevolent state.
Conclusion	While modest, our success rate is promising in terms of controlling biofilm with non-operative means. If able to achieve such a state in a consistent fashion, the impact on the patient and healthcare communities would be enormous.

Corresponding Author Irene Kalbian
E-Mail Address ixk021@jefferson.edu
Institution Rothman Orthopaedic Institute
Department
Address 125 S 9th St. Ste 1000
City, State Philadelphia, PA
Zip / Postal Code 19107
All Authors Irene Kalbian; Karan Goswami; Nathan John; Carol Foltz; Timothy L Tan; Javad Parvizi; William V Arnold

Title Treatment Outcomes and Attrition in Gram Negative Periprosthetic Joint Infection

Background / Rationale While the prevailing belief is that PJI caused by Gram negative (GN) organisms confers a poorer prognosis than Gram positive (GP) cases, the current literature is sparse and inconsistent. The purpose of this study was to compare the treatment outcomes for GN PJI versus GP PJI and Gram mixed (GM) PJI, as well as to describe the profile of GN organisms causing PJI.

Study Question How do the treatment outcomes compare between patients treated for GN PJI and patients treated for GP or GM PJI?

Methods A retrospective review of 1,189 PJI cases between 2007 and 2017 was performed using our institutional PJI database. All PJI cases met Musculoskeletal Infection Society (MSIS) criteria. Cases were excluded if they were culture negative or lacked a minimum of one-year follow-up. Treatment failure defined by Delphi consensus criteria was compared between PJI caused by GN organisms (n=45), GP organisms (n=663), and Gram mixed (GM) (n=28) cases. Cox multivariate regression was used to predict time to failure.

Results GM status, but not GN, had significantly higher rates of treatment failure compared to GP PJI (67.9% vs. 32.2% failure; HR=2.243, p=.004) in the multivariate analysis. In a sub-analysis of only the two-stage exchange procedures, both GN and GM cases were significantly less likely to reach reimplantation than GP cases (HR=.344, p<.0001; HR=.404, p=.013). Gram negative organisms associated with lower rates of reimplantation included E. coli, Pseudomonas, Proteus mirabilis and Klebsiella in bivariate analysis (p's<.05).

Discussion While there was no observed difference in the overall Delphi failure rates between GN (31.1% failure) and GP (33.2%) PJI cases, there was significant attrition in the GN cohort, and these patients were significantly less likely to reach reimplantation. We hypothesize this is largely a result of the GN patients being older and more comorbid hosts. This data adds to the current body of literature, which may currently underestimate the overall failure rates of GN PJI treated via two-stage exchange and fail to identify pre-reimplantation morbidity. Further research is needed to investigate the utility of alternate procedures to the two-stage exchange in older or immunocompromised patients.

Conclusion Our findings corroborate the prevailing notion that GN PJI is associated with poorer overall outcomes versus GP PJI.

Corresponding Author Milan Kapadia
E-Mail Address kapadiam@hss.edu
Institution Hospital for Special Surgery
Department
Address 535 E 70th Street
City, State New York, New York
Zip / Postal Code 10021
All Authors Andy O Miller; Milan Kapadia; Alberto Carli; Michael Henry

Title Safety and Tolerability of Rifampin in Staphylococcal Orthopedic Infections

Background / Rationale Rifampin is part of optimal combination antimicrobial therapy for staphylococcal foreign-body infections, including periprosthetic joint infections (PJI) in cases of retained prostheses. However, rifampin can have important drug interactions, can cause hepatotoxicity and other organ toxicity, and can induce treatment-limiting side effects. Although rifampin safety and tolerability is well-described in tuberculosis patients, its use in orthopedic infections is poorly described. We therefore analyzed the safety and tolerability of rifampin in patients with staphylococcal hip and knee PJIs treated with implant retention.

Study Question What is the safety and tolerability of rifampin when used to treat staphylococcal PJI with implant retention?

Methods A retrospective institutional PJI database was queried to identify all staphylococcal PJI cases treated with implant retention, from 2008 to 2016. Patient demographics, comorbidities, and antibiotic treatment course were collected. The Chi-square or Fisher's exact test was used for comparisons between rifampin-tolerant (RT) and -intolerant (RI) subgroups.

Results 80 patients were included, of which 75 (94%) began rifampin. Of the 75 who received rifampin, 23% (17/75) were RI. The median duration of rifampin for RT was 3.0 months (range 1 – 60) and .75 months for RI (range .1 – 3). Reasons for RI included allergies (N=6), GI toxicity (N=5), increased liver function tests (N=2), leukopenia (N=2), acute kidney injury (N=1), exacerbated epilepsy (possibly due to low phenytoin; N=1), and vasculitis (N=1). Patient age, sex, and Charlson comorbidity index did not predict rifampin intolerance. In 5/80 (6%) patients who never received rifampin, reasons included liver disease, drug interactions, and rifampin resistance. Overall, 27% (22/80) could not be adequately treated with rifampin.

Discussion In this study cohort of PJI patients, contraindications to rifampin initiation were infrequent, but discontinuation due to intolerance, allergy, or toxicity occurred in nearly a quarter of patients.

Conclusion Drug-drug interactions can preclude rifampin use, or may cause important medication switches in critical areas such as anticoagulation, epilepsy treatment, and HIV care. Research into the anti-staphylococcal efficacy and safety of alternative rifamycins (such as rifabutin and rifapentine) in patients with staphylococcal hardware infections is warranted.

Corresponding Author Elie S Ghanem

E-Mail Address eghanem@uabmc.edu
Institution University of Alabama at Birmingham
Department Orthopaedic Surgery
Address Suite 207
1313 13th St S
City, State Birmingham, AL
Zip / Postal Code 35205
All Authors Kyle H Cichos; Matthew C Christie; Alex R Heatherly; Gerald McGwin; Johnathan H Quade

Title The Value of Serological Screening Prior to Conversion Total Hip Arthroplasty

Background / Rationale Studies indicate that conversion THA for failed internal fixation of the hip results in increased infection rates compared to primary THA.

Study Question This study sought (1) to assess the value of serological testing prior to conversion THA in predicting infection, (2) to identify optimal serological values for routine screening prior to conversion THA, and (3) to assess the role of serological testing i

Methods All patients at a single tertiary referral center undergoing conversion THA after hip or acetabular fracture procedure from 2013-2018 were retrospectively reviewed. Inclusion criteria were patients who previously underwent hemiarthroplasty or open reduction and internal fixation (ORIF) of acetabular, intertrochanteric, and subtrochanteric fractures, that ultimately progressed to conversion THA due to post-traumatic arthritis and had serologies (ESR and CRP) prior to conversion. Infection was defined as positive intraoperative cultures not deemed contaminant in collaboration with infectious disease consult and/or development of PJI within 1-year.

Results Six (7%) of 87 patients had positive intraoperative cultures, while 9 total (10%) developed PJI within 1-year. The overall infection rate was 12/87 (14%). The mean ESR (37.2 vs 24.4 mm/h; p=0.2062) and CRP (22.4 vs 9.0 mg/L; p=0.0026) in the infected cohort were elevated compared to the non-infected group. CRP (AUC=0.77, 95% CI 0.58-0.97) demonstrated a better capacity to differentiate infected from non-infected patients than ESR (AUC=0.62, 95% CI 0.41-0.82). An optimal screening cut-off value for CRP of 12 mg/L revealed a 75% sensitivity, 84% specificity, 43% PPV, and 95% NPV (p<0.0001) in the entire cohort. The acetabular ORIF group, specifically, had positive cultures in 4/48 (8%) patients, while 6 (13%) developed PJI in 1-year. The overall infection rate in this cohort was 7/48 (15%). A CRP cutoff value of 12 mg/L demonstrated slightly improved sensitivity (86%) and NPV (97%) in the acetabular ORIF group.

Discussion Patients without preoperative clinical signs of acute infection undergoing conversion total hip arthroplasty from prior internal fixation of hip/acetabular fractures are at high risk for developing PJI.

Conclusion All patients undergoing conversion THA should have ESR and CRP measured preoperatively; those patients with elevated CRP should undergo additional workup, including aspiration.

Table 1: Sensitivity and specificity analysis for predicting infection in the overall conversion THA cohort

Serological value*	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	p value
ESR≥30	54.5	74.3	24	91.7	0.0743
ESR≥45	27.2	87.8	25	89	0.1834
CRP≥10	75	75	33.3	94.8	0.0012
CRP≥20	66.7	90.4	53.3	94.3	<0.0001
ESR≥30 and CRP≥10	72.7	61.1	22.2	93.6	0.0501
ESR≥45 and CRP≥20	63.6	84.7	38.9	93.9	0.0015
CRP≥12	75	83.6	42.9	95.3	<0.0001
CRP≥24	50	93.2	54.6	91.9	0.0007
ESR≥18	81.8	41.9	17.3	93.9	0.1896
ESR≥19	72.7	43.2	16	91.4	0.5131

ESR, erythrocyte sedimentation rate; CRP, C-reactive protein; PPV, positive predictive value; NPV, negative predictive value

*ESR values in mm/hr, CRP values in mg/L

Corresponding Author	William T Li
E-Mail Address	research@rothmanortho.com
Institution	Rothman Orthopaedic Institute
Department	
Address	125 S 9th St. Ste 1000
City, State	Philadelphia, PA
Zip / Postal Code	1910
All Authors	William T Li; Timothy L Tan; Chi Xu; Karan Goswami; Javad Parvizi

Title	Reporting Outcomes of Treatment for Periprosthetic Joint Infection of the Knee and Hip Together with a Minimum 1-year Follow-up is Reliable

Background / Rationale	Although there is an increasing trend toward requiring that hip and knee arthroplasty outcomes should be reported separately, it remains unknown whether joint-specific reporting is necessary for PJI as sample sizes are already low given its relatively rare occurrence.
Study Question	The aim of this study is to compare treatment outcomes between knee and hip PJI. Furthermore, we aim to establish the necessary follow-up time for an accurate reporting of PJI treatment
Methods	A retrospective study of 792 cases of hip and knee PJI treated with I&D or two-stage exchange arthroplasty from 2000-2017 was performed. Treatment failure was defined based on a Delphi method based criteria. Kaplan-Meier survivorship curves were generated and a log-rank test was used to evaluate differences in survivorship. A multivariate Cox proportional hazards regression and a sensitivity analysis using propensity matching were performed. A two-piecewise linear regression model was used to examine the threshold effect of time after treatment on survival rates.
Results	There were no significant differences between hip and knee PJIs in overall survivorship, or when stratified by I&D or two-stage exchange arthroplasty. There was also no difference by joint in the multivariate or sensitivity analysis. Survival rates had the most dramatic rates of decrease in the initial months following treatment of PJI but began to plateau after 1.09 years.
Discussion	This study reveals no difference in treatment outcomes between knee and hip PJI.
Conclusion	There was no difference in treatment outcomes between knee and hip PJI. Given the difficulty with obtaining follow-up, we suggest that one-year follow-up is sufficient for an accurate reporting of treatment failure.

Special Presentation

Journal of Bone and Joint Infections (JBJI)

Journal of the EBJIS and the MSIS

Best Papers of 2018-2019

Parham Sendi, M.D.
Associate Professor, University of Bern
Lead Physician University Hospital Basel
Basel, Switzerland

Elie Berbari, M.D.
Professor and Chair of the Infectious Diseases Division
Mayo Clinic College of Medicine
Rochester, MN

REMINDER: EBJIS Meeting is in Antwerp, Belgium, September 12-14, 2019

Symposium #4

Debridement, Antibiotics and Implant Retention

(DAIR) Case presentations with Panel discussion

In Memory of Carl L Nelson, M.D.

Co-branded with the American Association of Hip and Knee Surgeons

Moderator: Javad Parvizi, M.D.

Brian A. Klatt, M.D.
Orthopaedic Surgeon
Assistant Professor
Department of Orthopaedic Surgery
University of Pittsburgh
Pittsburgh, PA

Thorsten Seyler, M.D., PhD
Orthopaedic Surgeon
Assistant Professor in Orthopaedic Surgery
Duke University School of Medicine
Durham, NC

Angela L. Hewlett, M.D.
Associate Professor
Department of Internal Medicine
University of Nebraska
Medical Director
Nebraska Biocontainment Unit
Associate Medical Director
Infection Control and Epidemiology
Omaha, NE

Michael Henry, M.D.
Assistant Attending Physician
Infectious Diseases and Internal Medicine
Hospital for Special Surgery
Assistant Professor
Weill-Cornell Medical Center
New York, NY

MUSCULOSKELETAL INFECTION SOCIETY

AAHKS
AMERICAN ASSOCIATION OF HIP AND KNEE SURGEONS

Session VI

Basic Science

Moderators: Aaron Tande, M.D.; Prof. Paul Stoodley, PhD

Corresponding Author	Peter P Hsiue
E-Mail Address	phsiue@mednet.ucla.edu
Institution	David Geffen School of Medicine at UCLA
Department	Orthopaedic Surgery
Address	10833 Le Conte Avenue, 76-143 CHS
City, State	Los Angeles, CA
Zip / Postal Code	90095
All Authors	Peter P Hsiue; Chad R Ishmael; Sam Uweh; Clark J Chen; Kellyn R Hori; Howard Y Park; Zachary DC Burke; Eldad A Hod; Nicholas M Bernthal

Title Transfusion of Older Blood Increases Bacterial Burden in a Validated Mouse Model of Spine Implant Infection

Background / Rationale Current Food and Drug Administration regulations allow for blood to be stored for up to 42 days with an average storage time of 18 days prior to transfusion (US Department of Health and Human Services, 2011). Recent studies have suggested that transfusion with older blood may influence postoperative infection risk.

Study Question We aim to answer the following: does storage duration of blood affect bacterial burden in a clinically relevant mouse model of spine implant infection?

Methods To model a spine implant infection in C57BL/6 mice, a stainless-steel wire was surgically placed in the L4 spinous process and inoculated with Xen36, a bioluminescent strain of Staphylococcus aureus. Mice were transfused immediately postoperatively and on postoperative day (POD) 1 with 200 microliters of either old syngeneic blood (2 weeks storage), fresh syngeneic blood (1 day storage), or no blood (saline). Of note, mouse blood storage duration of 2 weeks and 1 day corresponds approximately to human blood storage of 42 days and 7 days, respectively. In vivo bioluminescent imaging (BLI) was used to quantify bacterial burden postoperatively.

Results All Xen36 infected mice demonstrated increased BLI compared to sterile controls. On POD3, mice transfused with old and fresh blood had higher average BLI compared to mice who received no blood. On POD7 and POD10, mice transfused with old blood demonstrated higher average BLI than both fresh and no blood groups.

Discussion Iron is an essential enzyme co-factor for all living organisms. Prolonged storage duration of blood has been shown to increase free iron content. Therefore, transfusion of old blood may introduce excess free iron, which has been shown to inhibit host immune function and provide pathogens with easier access to a vital nutrient. Our findings not only support this theory, but also demonstrate for the first time that blood storage duration affects bacterial burden in a mouse model of spine implant infection.

Conclusion In our observational study, we show that mice transfused with old blood had increased bacterial burden as measured by BLI compared to mice transfused with fresh blood or no blood. These findings suggest that storage duration of blood may influence postoperative infection risk and warrant further investigation.

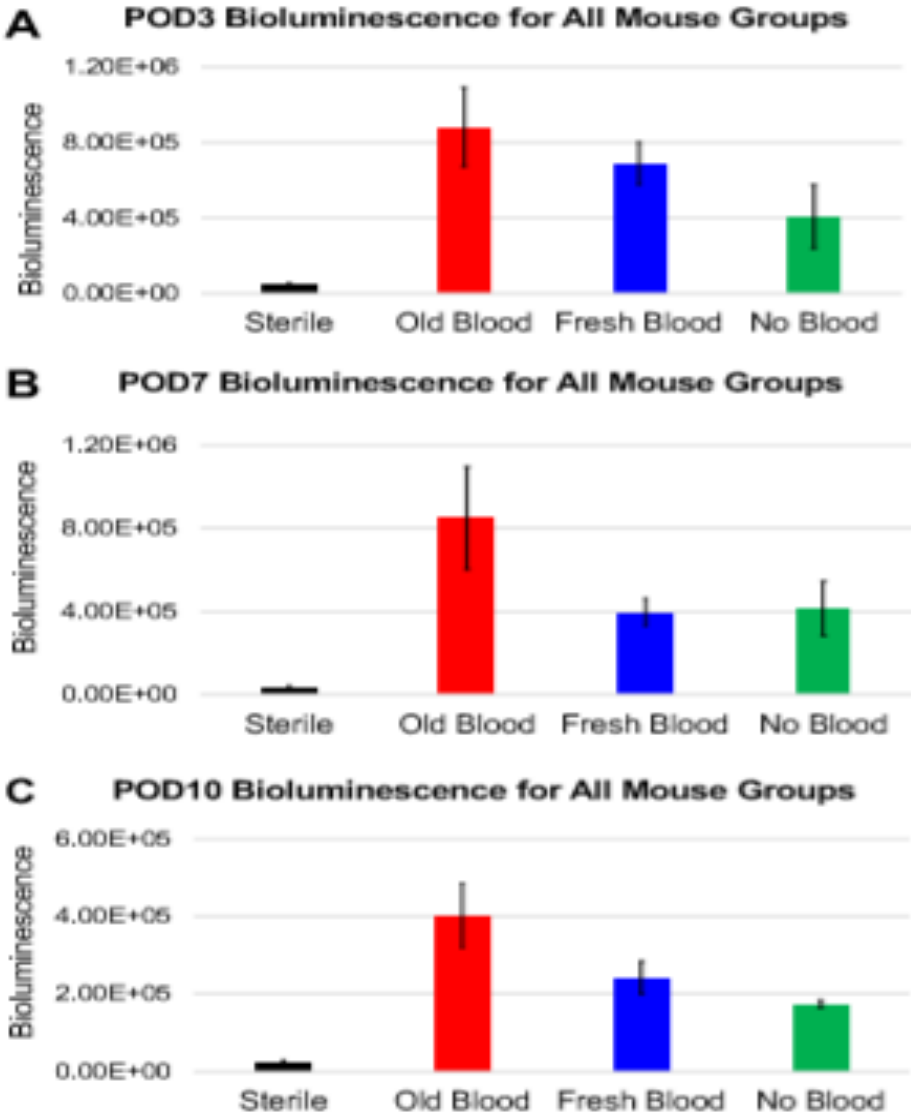


Figure 1. In vivo bioluminescence (BLI) for all mouse groups. A: On postoperative day (POD) 3, both old blood and fresh blood groups had higher BLI than the no blood group. B: On POD7, the old blood group had higher BLI than fresh blood and no blood groups. C: On POD10, the old blood group had higher BLI than fresh blood and no blood groups.

Corresponding Author Peter P Hsiue

E-Mail Address phsiue@mednet.ucla.edu
Institution David Geffen School of Medicine at UCLA
Department Orthopaedic Surgery
Address 10833 Le Conte Avenue, 76-143 CHS
City, State Los Angeles, CA
Zip / Postal Code 90095
All Authors Peter P Hsiue; Chad R Ishmael; Kellyn R Hori; Clark J Chen; Cristina Villalpando; Howard Y Park; Steve D Zoller; Kevin P Francis; Nicholas M Bernthal

Title Translational Challenges of Fluorescence Image-Guided Surgical Debridement in a Mouse Model of Spine Implant Infection

Background / Rationale 1D9-700DX is a combination of a fully-human monoclonal antibody (1D9) that targets staphylococcal antigen A (IsaA) and a fluorescent photosensitizer (700DX). Recent in vivo mouse studies have demonstrated accurate co-localization of the fluorescent (FLI) probe signal with the bioluminescent (BLI) signal from Xen36, a BLI strain of Staphylococcus aureus. However, it is unclear how effective 1D9-700DX is for image-guided surgical debridement.

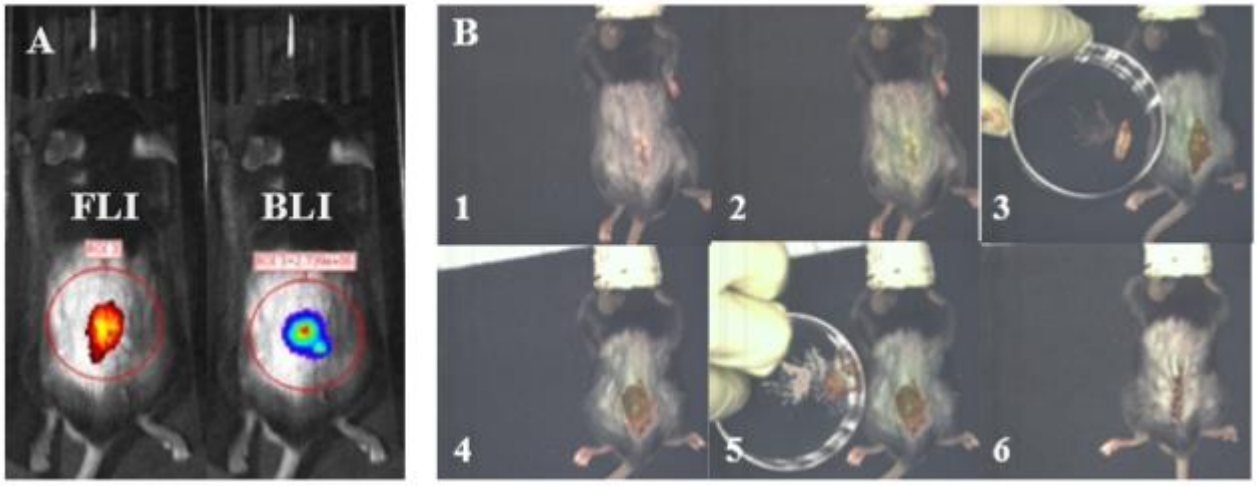
Study Question We aim to answer the following: can 1D9-700DX be used for image-guided surgical debridement in a mouse model of spine implant infection?

Methods To model a spine implant infection in C57BL/6 mice, a stainless-steel wire was surgically placed in the L4 spinous process and inoculated with Xen36. Mice were injected retro-orbitally with 70 micrograms of 1D9-700DX on postoperative day (POD) 4. On POD6, BLI and FLI imaging was performed using the IVIS Lumina X5 Imaging System (PerkinElmer, Hopkinton, MA) to assess co-localization of BLI and FLI signals. FLI image-guided surgical debridement was then performed using a novel open-air fluorescence image-guided surgical system (Solaris) (PerkinElmer, Hopkinton, MA). Postoperatively, in vivo BLI imaging was used to assess effectiveness of debridement.

Results On POD6, all Xen36 infected mice that received 1D9-700DX demonstrated accurate co-localization of bacterial BLI and probe FLI. The FLI signal was visualized using the Solaris, but the signal was not specific enough to accurately guide surgical debridement. Post-debridement, in vivo imaging demonstrated initial decreased BLI. However, there was a rebound in BLI in mice that had undergone fluorescence image-guided debridement.

Discussion Although image-guided surgical debridement holds enormous clinical potential, our findings highlight several key challenges of translating optical co-localization to clinical efficacy. Specifically, we noted decreased clarity and specificity of probe signal when visualized with an open-air imaging system like Solaris and in the presence of a bloody surgical field. In addition, use of a mouse model made surgical debridement difficult due to the small size of the animal.

Conclusion Despite accurate co-localization of probe FLI signal and bacterial BLI signal, there are still numerous translational challenges for image-guided surgical debridement with 1D9-700DX.


A
FLI
BLI
B
1
2
3
4
5
6

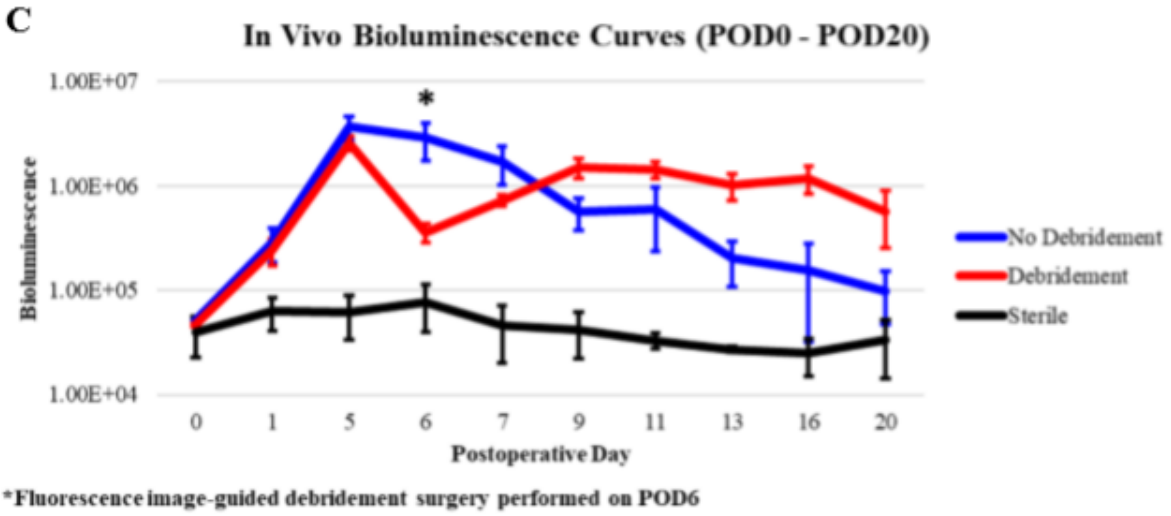


Figure 1. A: Accurate co-localization of 1D9-700DX fluorescence (FLI) and Xen36 bioluminescence (BLI) using IVIS Lumina X5 Imaging System (PerkinElmer, Hopkinton, MA). B: Decreased specificity and clarity of 1D9-700DX FLI using open-air FLI image-guided surgical system (Solaris) (PerkinElmer, Hopkinton, MA). C: Debridement surgery on postoperative day (POD) 6 decreased BLI initially followed by a gradual increase in BLI until POD9.

Corresponding Author Zoe L Harrison
E-Mail Address ZLHRRSON@MEMPHIS.EDU
Institution University of Memphis
Department Biomedical Engineering
Address 330 Engineering Technology
City, State MEMPHIS
Zip / Postal Code 38152
All Authors Zoe Harrison; J. Amber Jennings

Title Fatty acid dispersal signals affect monocyte activation and nitric oxide release

Background / Rationale Cells of the innate immune system, including monocytes and macrophages, play an important role in battling infection. Biofilm-associated bacteria may release mediators of inflammatory responses to evade phagocytosis. Previous in vitro and in vivo evaluations of biofilm-dispersing fatty acids cis-2-decenoic acid (C2DA) and a recently synthesized analog 2-heptylcyclopropane-1-carboxylic acid (2CP) has identified biofilm inhibition and dispersion of the cis-analogs over the trans-analog (T2DA). While preliminary cytocompatibility of C2DA and analogs indicate minimal effects on representative osteoblast cell lines, effects on monocyte activation have not been previously explored.

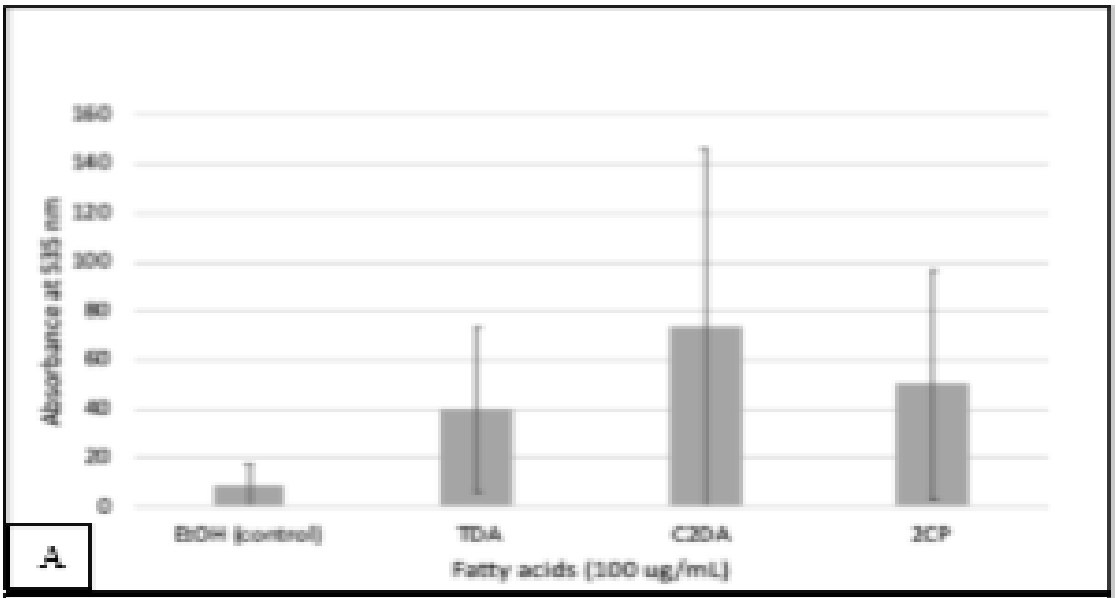
Study Question Do C2DA or its analogs affect monocyte activation with or without the presence of bacterial lipopolysaccharide (LPS)?

Methods RAW 264.7 mouse macrophage cells (ATCC) were seeded at 1.8 x 105 cells/well in 24-well plates and incubated for 24 hours in DMEM supplemented with 10% FBS containing ¬100 µg/mL Normocin. Fatty acid analogs or ethanol controls were added to each well at 100 ug/ml and incubated for 24 hours, with addition of 0 or 100 ng/ml of LPS. Nitric oxide (NO) concentration in the cultured medium was determined via the Griess reaction as an indicator of activation. NO determination was normalized to DNA content in cell lysates measured using a PicoGreen (Quant-iT).

Results In the absence of LPS, all 3 fatty acids increased NO release from monocytes, though at low levels compared to controls treated with LPS (Fig 1a). In the presence of LPS, T2DA and C2DA decreased NO production, while 2CP increased NO release over controls (Figure 1b).

Discussion Because C2DA and T2DA are both naturally released by bacteria within a biofilm, these results indicate that fatty acid dispersal signals may also act to inhibit immune cell activation as this would be beneficial to bacterial survival. The synthetic cyclopropanated analog had no inhibitory effects and has previously been demonstrated to have greater activity in inhibition, dispersal, and synergism with antimicrobials.

Conclusion The effects of antimicrobials on immune cell activation are not often considered, but could affect clearance of microorganisms from a contaminated surgical site. Local delivery of 2CP as an adjunct to systemic antimicrobials could increase efficacy of antibiotic therapy and support immune cell phagocytosis of biofilm microorganisms.



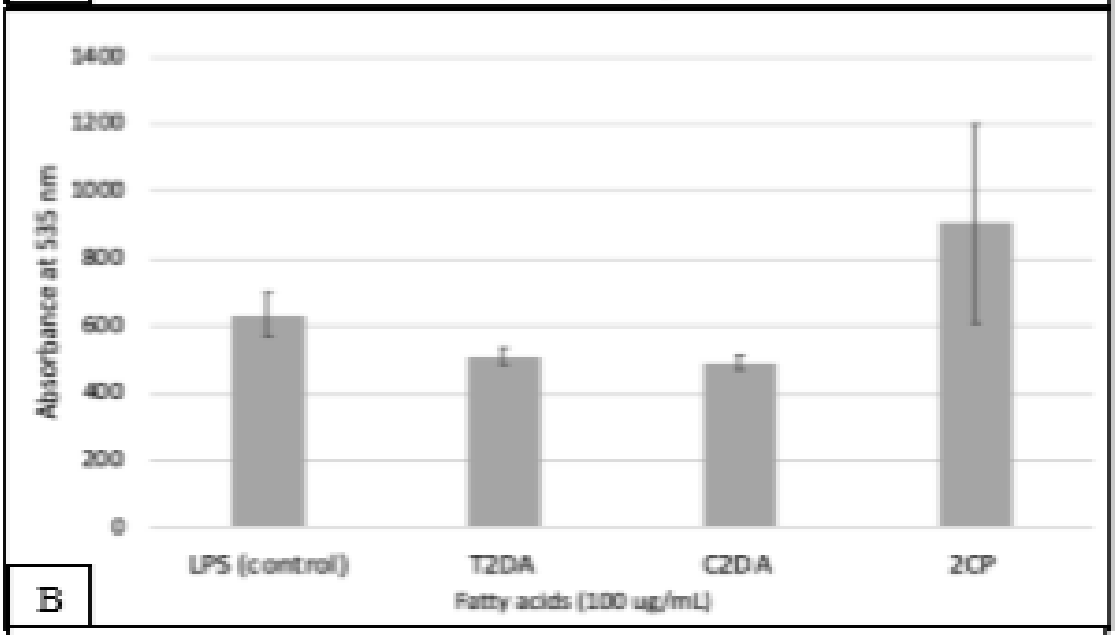


Figure 1. (A) Nitric oxide release from monocytes treated with fatty acids without addition of LPS. (B) Nitric oxide release from monocytes treated with fatty acids in combination with LPS.

Corresponding Author Leslie R Pace
E-Mail Address lrpace@memphis.edu
Institution University of Memphis
Department Biomedical Engineering
Address 303b Engineering Technology
University of Memphis
City, State Memphis, TN
Zip / Postal Code 38152
All Authors Leslie R Pace; Logan R Boles; Karen Beenken; Mark Smeltzer; J Amber Jennings

Title Injectable mannitol chitosan blended paste prevents osteomyelitis in rabbit model

Background / Rationale Local antibiotic delivery as an adjunct to systemic antibiotics ranges from the practice of "sprinkling" antibiotic to antibiotic-loaded bone cement. Recently, antibiotic-loaded chitosan pastes have shown advantages in coverage of complex musculoskeletal defects. Mannitol, previously shown to activate persister cell metabolism and increase antibiotic susceptibility of biofilm, was added to an injectable paste composed of chitosan and polyethylene glycol (PEG).

Study Question We asked the question, does mannitol-chitosan blend paste prevent bacterial growth and attachment in bone, soft tissue, and implanted biomaterials?

Methods Pastes were made in a 0.85% acetic acid solution with 1% chitosan, 0% or 2% mannitol, and 1% PEG, frozen, lyophilized, and ground before hydrated with a solution of 10 mg/mL amikacin and vancomycin in buffered saline at a ratio of 1gram/7.5 mL for chitosan-PEG paste (ChPEG) and 1gram/2.5 mL for mannitol-chitosan PEG paste (ChMPEG). Radial defects 1 cm in length were created in female New Zealand White rabbits (2-3 kg) and inoculated with 10^4 colony forming units (CFU) of S. aureus at both proximal and distal ends. Titanium pins (0.9 mm diameter, 2 cm length) were inserted into defects, with treatment in the following 5 groups (n=6/group) placed around the pin: no treatment, PMMA with amikacin and vancomycin (15 mg/implant), vancomycin sprinkle (10 mg), ChPEG, and ChMPEG. Rabbits were euthanized after 3 weeks with tissues samples harvested for histological and bacteriological analysis.

Results Fewer breakthroughs in soft tissue and bone were observed for mannitol blend pastes compared to non-mannitol blends (Fig 1 a, b). All treated groups had significantly lower CFU counts of biofilm on the pin, but only paste groups had no breakthroughs (Fig 1c).

Discussion Both paste groups were capable of preventing implant associated biofilm. Mannitol released from the blends may have increased persister cell susceptibility to amikacin. Further, the ability of paste to conform to and adhere to the defect and implant may increase the antibiotic concentration in tissue and bone to prevent spread of contaminating microorganisms.

Conclusion Blends of chitosan and mannitol form an injectable paste effective at preventing osteomyelitis, which may be useful for trauma or one-stage revisions of implants at high risk of infection. Future studies will determine efficacy of chitosan pastes in treatment of established biofilm.

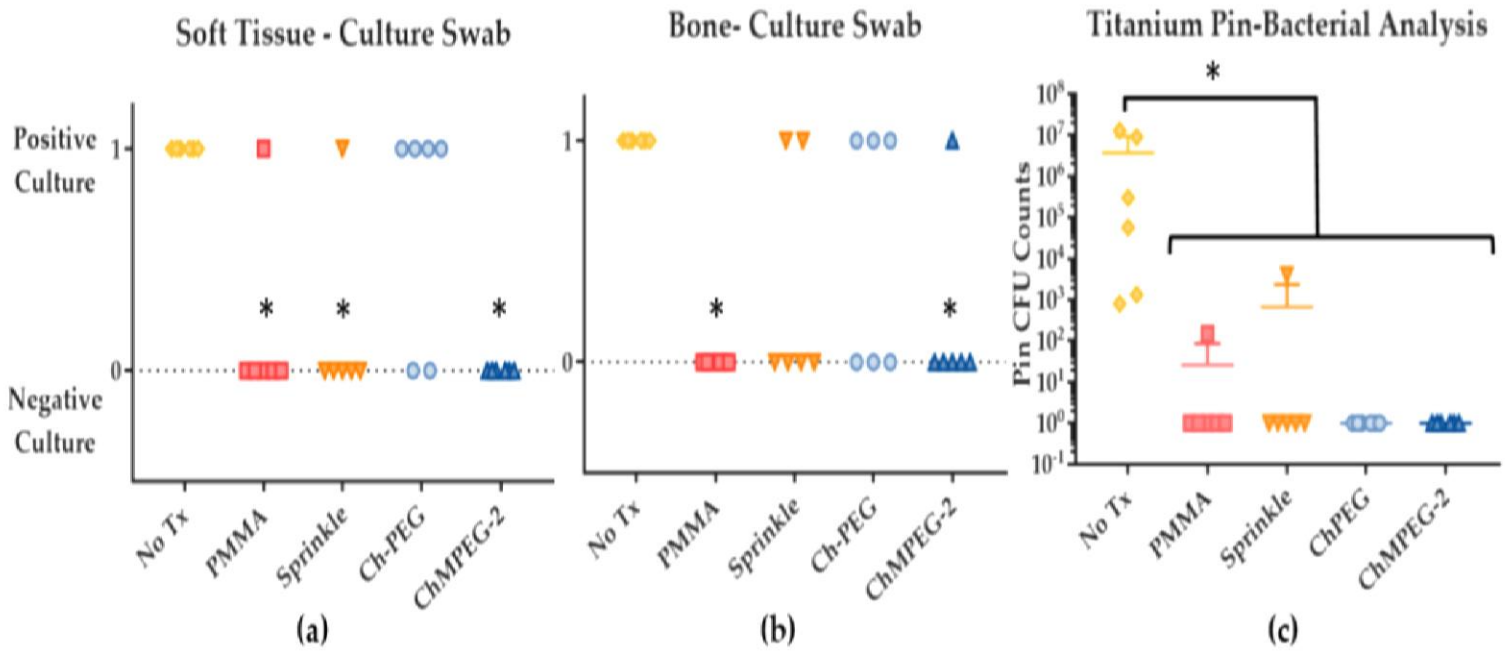


Figure 1. Scatterplot **(a)** indicates the positive (bacterial growth) and negative (no bacterial growth results of the surrounding soft tissue (n=6) and **(b)** indicates the positive and negative results of the bone (n=6). Scatterplot **(c)** shows the CFU counts of S. aureus (UAMS-1) collected from the harvested Titanium pin of each rabbit (n=6). Statistical significant difference from the no treatment (No Tx) group is indicated with a *.

Symposium #5

Molecular Diagnostics for Musculoskeletal Infection

Next Generation Sequencing

Moderator: Thomas W. Bauer, M.D., PhD

Andy O. Miller, M.D.
Infectious Diseases Consultant, Hospital for Special Surgery
Associate Professor of Clinical Medicine,
Weill-Cornell University Medical Center
New York, NY

Laura Donlin, PhD
Co-Director Derfner Foundation Precision Medicine Laboratory
Assistant Scientist, Hospital for Special Surgery Research Institute
Assistant Professor, Weill-Cornell University Medical Center
New York, NY

Karan Goswami, M.D.
PhD Candidate, Rothman Institute
Research Fellow, Department of Orthopaedic Surgery
Philadelphia, PA

*This symposium is supported by **Heraeus** and **MicroGenDX** as an educational endeavor, but the content and the selection of speakers are entirely controlled by the MSIS*

Session VII

Clinical Studies

Moderators: Elie Berbari, M.D.; Arvind Nana, M.D.

Corresponding Author Anita R. Modi
E-Mail Address modia@ccf.org
Institution Cleveland Clinic
Department Infectious Disease
Address 9500 Euclid Avenue, Suite G21
City, State Cleveland, OH
Zip / Postal Code 44195
All Authors Bethany Lehman; Anita R. Modi; Maja Babic; Christopher Karakasis; R. Douglas Orr; Faisal Bakaeen; Steven M. Gordon

Title Mycobacterium chimera (MC) Spondylodiscitis—A Medical and Surgical Collaboration

Background / Rationale Contaminated Stockert 3T heater-cooler devices used in cardiopulmonary bypass has recently led to a worldwide epidemic of disseminated MC. While several case reports detail MC endocarditis, our understanding of MC spondylodiscitis is limited.

Study Question MC spondylodiscitis—a medical or surgical entity?

Methods We describe MC spondylodiscitis in two patients who underwent aortic valve replacement (AVR) with intraoperative exposure to contaminated Stockert 3T heater-cooler devices at outside institutions, developing prosthetic valve endocarditis and disseminated disease.

Results Case 1 developed night sweats, weight loss, and back pain two years after AVR. Magnetic resonance imaging (MRI) demonstrated spondylodiscitis of the L2-3 disc and biopsy revealed granulomatous disease with MC growth. Redo AVR and homograft root replacement were performed, followed by discectomy, debridement, and fusion of L2-3. Recurrent disease at L4-5 prompted repeat debridement and fusion extension from L2-5 18 months later. Case 2 presented with fevers, transaminitis, and back pain two years after elective AVR. MRI demonstrated L2-3 spondylodiscitis. Liver and disc biopsy samples revealed granulomatous disease and grew MC. His disease progressed despite two years of antimycobacterial therapy, ultimately meriting similar surgical intervention for both cardiac and spinal sites of infection.

Discussion Unlike Pott's disease, featuring Mycobacterium tuberculosis [MTB] and managed with antimycobacterial therapy alone, NTM infections of the spine including MC spondylodiscitis require surgical intervention in addition to medical therapy to achieve cure. NTM are intrinsically more resistant to antimycobacterial therapy than MTB and relapsed infections have been reported even in patients with susceptible isolates. Surgical intervention often involves repeat debridement and hardware removal for progressive disease

Conclusion We present our institution's experience diagnosing and managing MC spondylodiscitis in two patients with prosthetic valve endocarditis and disseminated disease. Both patients grew MC on culture of the disc involved and developed disease progression on antimycobacterial therapy, meriting discectomy, debridement, and fusion. Further clarification is needed regarding the role for imaging and the optimal antimycobacterial course duration in the management of NTM infections of the spine.

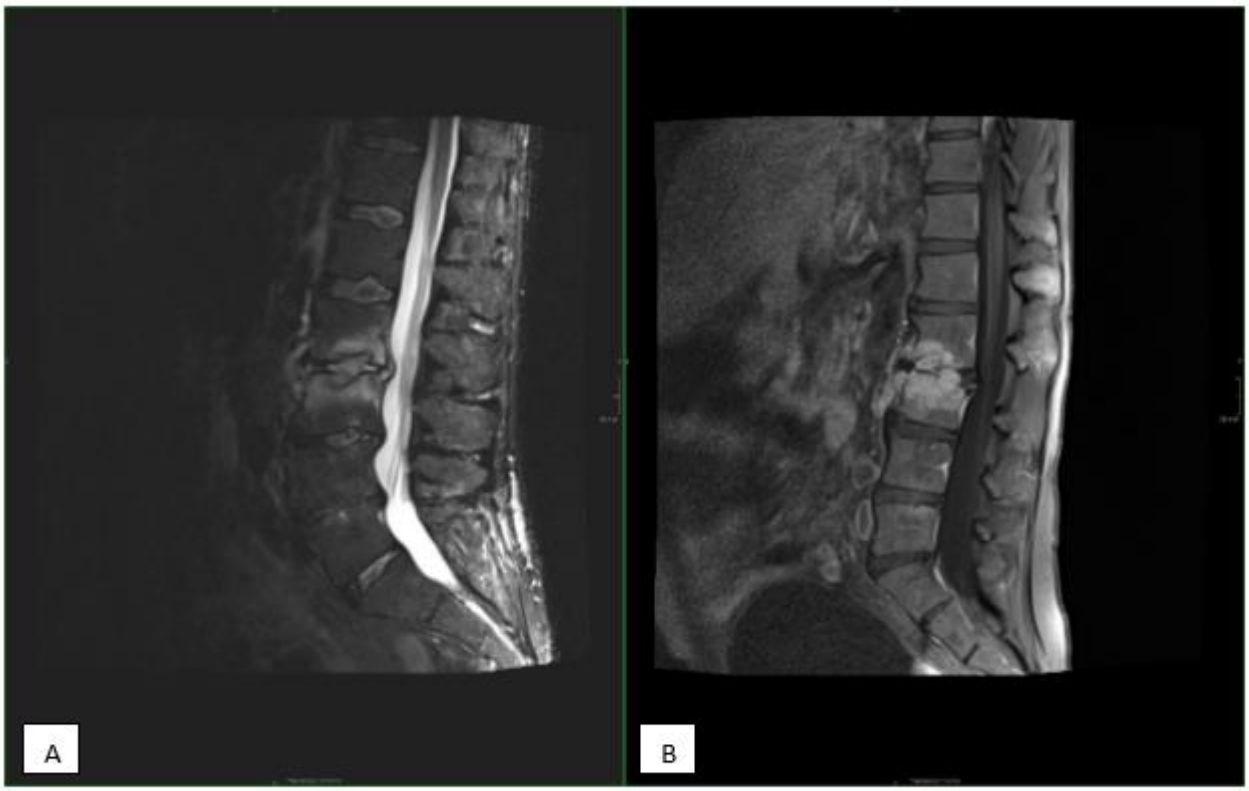


Figure 1A. Case 1. Sagittal STIR image of the lumbar spine demonstrates T2 hyperintensity in the intervertebral disc and endplates consistent with L2-3 spondylodiscitis and early epidural and ventral paraspinal abscess formation, as well as L4-5 early endplate edema. Figure 1B. Case 2. Sagittal postcontrast T1 fat-saturated image of the lumbar spine demonstrates abnormal enhancement at the intervertebral disc and endplates of L2-3 consistent with spondylodiscitis and ventral paraspinal abscess formation. Early enhancement at L5 superior endplate is also noted.

Corresponding Author	Akash A Shah
E-Mail Address	kerry
Institution	UCLA Medical Center
Department	Orthopaedic Surgery
Address	10833 Le Conte Avenue, 76-119 CHS
City, State	Los Angeles, CA
Zip / Postal Code	90095
All Authors	Akash A Shah; Aditya V Karhade; Christopher M Bono; Mitchel B Harris; Sandra B Nelson; Joseph H Schwab

Title Development of a machine learning algorithm for prediction of failure of non-operative management in spinal epidural abscess

Background / Rationale Non-operative management has emerged as a viable treatment strategy for spinal epidural abscess (SEA) in recent decades. Data regarding risk of failure of non-operative management in SEA are limited. Given the dire consequences associated with treatment failure, a tool that accurately predicts the probability of failure would be of great utility.

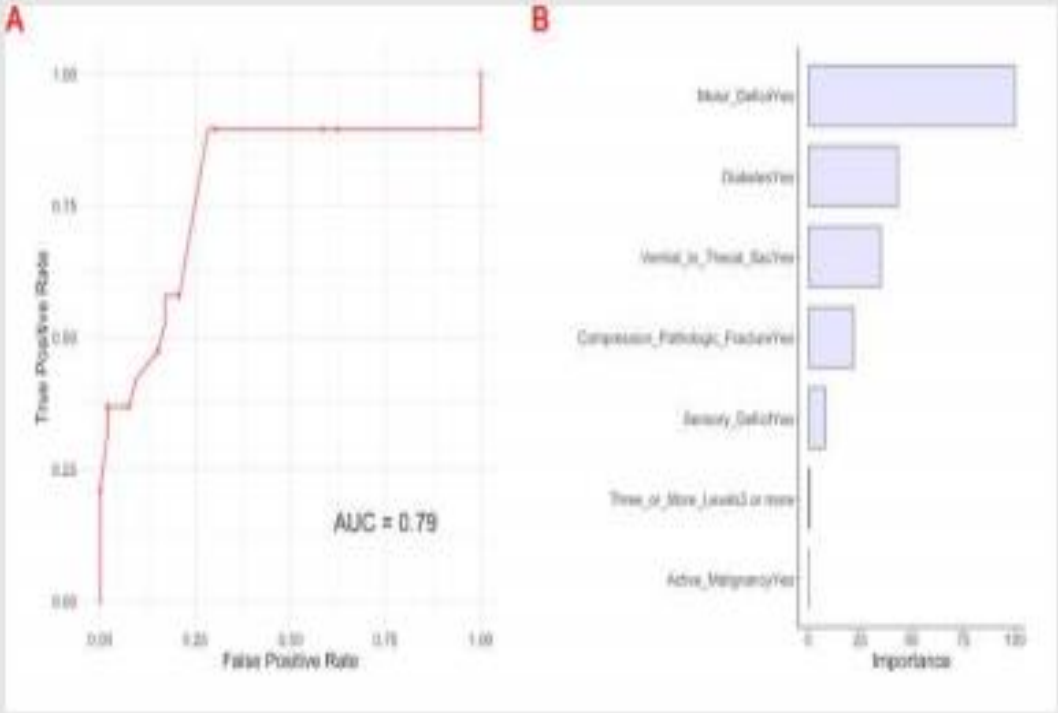
Study Question We aim to build a machine learning (ML) model using independent predictors of non-operative management failure. Secondarily, we aim to develop an open access web-based application that generates a probability of treatment failure.

Methods This is a retrospective cohort study of 367 patients older than 18 years diagnosed with SEA and initially managed non-operatively between 1993-2016. The primary outcome was treatment failure defined as neurologic deterioration, worsened back/radicular pain, or persistent symptoms despite antibiotic therapy. Using a stratified 80:20 split, the population was divided into derivation and validation cohorts. Five ML algorithms were developed, each trained on the derivation set for feature selection and tested with ten-fold cross validation.

Results Ninety-nine (27%) patients failed non-operative management. Factors included in the model were: motor deficit, diabetes, ventral component of abscess relative to thecal sac, compression/pathologic vertebral fracture, sensory dysfunction, active malignancy, and involvement of >3 vertebral levels. Of the five models, the Stochastic Gradient Boosting model was found to have superior discrimination, calibration, and overall performance (Figure 1). This model was incorporated into an open access web application for prediction of treatment failure (https://sorg-apps.shinyapps.io/seanonop/).

Discussion Accurate prediction of non-operative management failure is crucial given the risk of clinical deterioration and protracted time of antibiosis incurred through treatment failure. Using the largest cohort of non-operatively managed patients with SEA, we report the first ML algorithm for prediction of non-operative management failure. Furthermore, we incorporate the model into an open access digital interface to facilitate direct use of this algorithm by clinicians.

Conclusion We report an open access web-based application that employs a ML algorithm to generate probability of non-operative management failure in SEA, the first use of ML for musculoskeletal infections.


A
True Positive Rate
False Positive Rate
AUC = 0.79
B
Importance

Corresponding Author Talha Riaz
E-Mail Address talhariaz240@gmail.com
Institution Mayo Clinic, Rochester, MN
Department Division of Infectious Diseases
Address 200 First Street SW
City, State Rochester, Minnesota
Zip / Postal Code 55905
All Authors Talha Riaz; Matthew T Howard; ; Aaron J Tande; Paul M Huddleston; Elie F Berbari

Title Introducing a Novel Test for the Diagnosis of Native Vertebral Osteomyelitis

Background / Rationale Native vertebral osteomyelitis (NVO) is suspected based on clinical symptoms and abnormal imaging. Aspiration of intervertebral disc space or vertebral bone is often done to confirm the diagnosis. An organism is not identified in more than 50% of specimens, often due to prior receipt of antimicrobial therapy. To our knowledge, a study examining the utility of cell counts and differentials of the aspirated fluid in the diagnosis of NVO has not been previously done.

Study Question We hypothesize that cell count and differential obtained from disc space fluid in patients with suspected NVO is a useful diagnostic tool in establishing the diagnosis of NVO.

Methods In this feasibility study, we prospectively enrolled patients with a suspected diagnosis of NVO referred to the neuroradiology department for CT guided needle aspiration of the intervertebral disc. The aspirated fluid is sent to the laboratory for microscopic analysis, histopathology and culture. In this study, manual cell count was done on the aspirated fluid, following by differential using the cytospin technique and the touch prep.

Results Between January- April 2019, 10 biopsies on 8 patients were performed. Median age was 70 years (55-77). All patients had abnormal MRI findings and elevated inflammatory markers. Lumbo-sacral and thoracic spine were involved in 6 and 2 patients respectively. Six specimens were bloody. The median manual cell count was 36 cells per unit volume (0-1612), median neutrophil percentage by differential on touch prep was 64% (range, 5-84%) and median neutrophil percentage by differential on the cytospin slide was 63.5% (range, 0- 98%). Bacterial cultures were positive in 1 patient where methicillin resistant Staphylococcus epidermidis (MRSE) was recovered (manual cell count 1612, 98 % neutrophils on cytospin). In another patient, broad range PCR detected DNA of group G beta hemolytic streptococcus (manual cell count 24, 88% neutrophils on cytospin).

Discussion Based on the results, we observed that a high manual cell count on the aspirate with neutrophilic predominance portends infection.

Conclusion In this feasibility study assessing a novel diagnostic method to diagnose patients with suspected NVO, a manual cell count with neutrophilic predominance may confirm the diagnosis of NVO. A larger study assessing the accuracy of this novel test is warrant

Patient	Age	Gender	Prior ABX	Biopsy site	Manual cell count/unit vol.	Neutrophil % by differential Cytospin	Neutrophil % by differential touch prep	Microbiology	Treatment
1	65	M	Yes	L4-L5	728	33	55	Negative	6 wks Dap/ Cef
				L5-S1	260	63	43		
2	55	F	No	T8-T9	0	46	NA	Negative	None
3	77	M	Yes	L2-L3	52	64	26	Negative	9 wks Vanc
4	64	M	Yes	T5-T6	48	0	5	Negative	8 wks of Vanc/CFX/RIF
5	66	F	Yes	L3-L4	0	88	73	Negative	6 wks CFX
				L1-L2	0	55	75		
6	77	F	Yes	L4-L5	0	84	84	Negative	6 wks Dap/ CFX
7	75	F	No	L5-S1	1612	98	NA	MRSE	6 wks Vanc
8	76	F	1 dose Cipro	L3-L4	24	88	76	PCR positive for Group G Streptococcus	6 wks CFX

Table 1. Patient's demographics, clinical information and pertinent results

Corresponding Author Nathan Mesko
E-Mail Address jxf305@case.edu
Institution Cleveland Clinic
Department Orthopaedic Surgery
Address Cleveland Clinic
Department of Orthopaedic Surgery
Orthopaedic and Rheumatologic Institute, Mail Code A41
9500 Euclid Avenue
City, State Cleveland, OH
Zip / Postal Code 44195
All Authors Joseph Featherall; Joshua Lawrenz; Jaymeson Gordon; Jaret Karnuta; Deepak Ramanathan; Claus Simpfendorfer; Lukas Nystrom; Nathan Mesko; Maja Babic

Title Factors Associated with In-Hospital Mortality in Necrotizing Fasciitis

Background / Rationale Necrotizing fasciitis is a rare, but often lethal soft tissue infection requiring treatment with intravenous antibiotics and surgical intervention. There is a limited and varied literature regarding the clinical features associated with mortality. Improved understanding of factors associated with in-hospital mortality will aid physicians in identifying high mortality risk cases, and may guide early or more aggressive therapy.

Study Question What clinical factors are associated in hospital mortality in patients with necrotizing fasciitis?

Methods A retrospective chart review was conducted at a large integrated health system between September of 2010 and June of 2018. Cases were separated into groups based on in-hospital mortality or survival until discharge. Bivariable analyses were conducted using Student's t-test and Fisher's exact test to identify between group differences.

Results 45 cases of necrotizing fasciitis were identified, 10 of which died in the hospital. Characteristics associated with survival versus in hospital mortality included age (53.0 vs. 67.0 years ($p = 0.006$)), history of coronary artery disease (25.7% vs. 70% ($p = 0.021$)), hypotension (60.0% vs. 100.0% ($p=0.019$)), elevated creatinine (mean: 2.10 mg/dL vs. 3.94 mg/dL ($p=0.004$)), elevated lactate (mean: 1.95 mmol/L vs. 3.24 mmol/L ($p=0.043$), elevated prothrombin time (mean: 13.73 sec vs. 20.79 sec ($p=0.005$)), and decreased platelet count (mean: 250.6 k/uL vs.112.9 k/uL ($p=0.004$)). Most common causes of in-hospital death were: cardiopulmonary arrest (n=3) and multi-organ failure (n=2).

Discussion Patient factors (age, and prior history of coronary artery disease) and clinical findings (hypotension, elevated creatinine, elevated lactate, elevated prothrombin time, and decreased platelet count) were associated with in hospital mortality. This is corroborated by the observed causes of death as a large portion of the deaths occurred due to cardiac causes and multi-organ failure.

Conclusion In bivariable analyses, history of coronary artery disease, advanced age, hypotension, elevated creatinine, elevated lactate, elevated prothrombin time, and decreased platelet count were associated with in hospital mortality. These factors may aid clinici

Corresponding Author	Simon Garceau
E-Mail Address	simon.garceau1@gmail.com
Institution	Mount Sinai Hospital
Department	The Granovsky Gluskin Division of Orthopedics
Address	600 University Ave
City, State	Toronto, Ontario
Zip / Postal Code	M5G 1X5
All Authors	Simon Garceau; Yaniv Warschawski; Omar Dahduli; Ibrahim Alshaygy; Jesse Wolfstadt; David Backstein

Title Patient Institutional Transfer During the Inter-stage Period of Two-Stage Periprosthetic Knee Infection Treatment Leads to Inferior Results

Background / Rationale The effects of patient transfer to specialized arthroplasty centers between the first and second stage (inter-stage) of periprosthetic joint infection (PJI) treatment in total knee arthroplasty (TKA) remains largely unknown. Current models of care would benefit from an evidenced-based approach to the transfer of this patients population to tertiary referral centers.

Study Question 1) Does patient transfer during the inter-stage impact final implant survivorship and re-infection, soft tissue complications, degree of bone loss and requirements for specialized implants?
2) What is the effect of repeat debridement and spacer reinsertio

Methods A search of our institutional database was performed to identify patients having undergone two-stage revision TKA for PJI. Two cohorts were created: continuous (CC) and transferred care (TC). Baseline characteristics and outcomes were collected and compared between cohorts. A minimum two year follow up was selected for the outcomes of implant survivorship and re-infection.

Results A total of 137 patients (CC: 105, TC: 32) were identified. PJI organism virulence was greater in the CC cohort (56.7% vs. 18.5%, p = 0.030). TC patients had a higher recalcitrant infection rate (53.6% vs. 13.4%; p<0.001), soft tissue complications (31.3 vs. 14.3%; p= 0.030), and decreased requirement for porous metal augments (78.1% vs. 94.3%; p = 0.006). Repeat first stage after transfer led to greater flap requirements (58.3% vs. 0.0%; p<0.001).

Discussion 1)Patients transferred during the inter-stage of knee PJI leads to higher re-infection rates and greater soft tissue complications.
2)Although repeat debridement and spacer re-insertion may decrease this re-infection risk, this appears to translate into significantly greater soft tissue complications.
As such, we suggest that unless urgent care is required, referral of PJI patients for the totality of treatment at specialized arthroplasty referral centers may optimize patient outcomes.

Conclusion Patient transfer during the inter-stage of PJI treatment for TKA leads to inferior outcomes compared to patients receiving CC at a specialized arthroplasty center. Care models may benefit from providing total PJI care at specialized arthroplasty centers.

Table 2 – Comparative Results of Both Cohorts					
	Specialized Referral Center		Outside Institution		p-Value
Implant* Survivorship (%)	89.7		78.6		0.121
Re-Infection* (%)	13.4		53.6		<0.001
All Soft Tissue Complications (%)	14.3		31.3		0.030
Amputation (%)	2.9		9.4		0.115
Flap Requirement (%)	12.4		21.8		0.183
Combined Bone Defect Score	5.6		5.4		0.577
Augment Requirement (%)	94.3		78.1		0.006
Cone Requirement (%)	32.4		28.1		0.650
Implant Constraint (%)	PS/CCK	84.6	PS/CCK	74.2	0.183
	RHK /DFR	16.4	RHK/DFR	25.8	

Minimum two-year follow-up

Corresponding Author Elie S Ghanem
E-Mail Address eghanem@uabmc.edu
Institution University of Alabama at Birmingham
Department Orthopaedic Surgery
Address Suite 207
1313 13th St S
City, State Birmingham, AL
Zip / Postal Code 35205
All Authors Kyle H Cichos; Maxwell Detweiler; Javad Parvizi; Gerald McGwin; Johnatha H Quade

Title The Fate of Positive Intraoperative Cultures Following Conversion Total Hip Arthroplasty

Background / Rationale Studies indicate a high incidence of PJI in patients undergoing conversion THA for failed fixation of hip and acetabular fractures.

Study Question The purpose of this study is to present the treatment and outcomes of patients found to have positive intraoperative cultures during conversion THA.

Methods We reviewed all patients at two institutions who underwent conversion THA from either prior ORIF of acetabular and hip fractures or hemiarthroplasty for displaced femoral neck fractures from 2011-2018. Intraoperative cultures were taken in 80 patients. Patients with positive intra-operative cultures at time of conversion were managed in collaboration with an infectious disease specialist. The outcomes of THA, including PJI rates at 90-days and 1-year were documented.

Results Overall, 19 of 80 patients (25%) undergoing conversion THA had positive intraoperative cultures, with highest rates in the hemiarthroplasty 7/13 (54%) and acetabular ORIF 9/42 (21%) groups. The 19 patients with positive culture received IV antibiotics (8 patients), oral antibiotics (one patient), or no additional antibiotics (10 patients). All 7 hemiarthroplasty patients were PJI free at 1-year and did not require further surgical interventions. Four of the 9 acetabular fracture conversions developed PJI at 1-year, where 3 patients required multiple irrigation and debridement/polyethylene exchanges to control the infection while the remaining patient required two-stage exchange arthroplasty. Of the 10 patients receiving no additional antibiotics, 3 were acetabular fractures 2 were ORIF femur fractures, and 5 were hemiarthroplasty. Only 1 of these 10 patients developed PJI at 1-year, and it was from the acetabular ORIF cohort.

Discussion Based on the findings of this study, it appears that patients with prior ORIF of acetabular fracture who undergo conversion THA are at particular risk of PJI. In the latter group of patients who have a positive culture from conversion surgery, strong consideration should be given to early surgical debridement and antibiotic treatment. Hemiarthroplasty patients undergoing conversion THA are at particularly high risk of having positive cultures, bringing to light that the persistent pain in these patients may not necessarily be due to mechanical failure.

Conclusion Further research is warranted in this patient population since the MSIS criteria for diagnosing PJI preoperatively in this patient population is not possible.

Table 2: Management and outcomes of positive intraoperative culture cases

Case (n=19)	Intraoperative Culture Organism	Initial Treatment	Length of Initial Treatment	PJI in 90 days	PJI in 1-year	Aseptic revision THA	Time between conversion and PJI revision
1	CoNS	IV Vancomycin	6 weeks	No	No	No	-
2	CoNS	IV Vancomycin	6 weeks	No	No	No	-
3	*Citrobacter koseri*	IV Ceftriaxone + PO Ciprofloxacin	6 weeks (IV) 3 months (PO)	No	No	No	-
4	*Enterococcus durans/hirae* (VRE)	IV Daptomycin	8 weeks	No	No	No	-
5	*Streptococcus sp.*	None	-	No	No	No	-
6	*Staphylococcus aureus* (MSSA)	IV Nafcillin	6 weeks	No	No	No	-
7	*Proprionobacter acnes*	None	-	No	No	No	-
8	*Staphylococcus aureus* (MSSA)	IV Nafcillin + PO Rifampin	6 weeks	No	No	Yes (liner exchange)	-
9	CoNS	None	-	No	No	No	-
10	*Staphylococcus aureus* (MSSA)	None	-	No	No	No	-
11	*Staphylococcus aureus* (MSSA)	None	-	No	No	No	-
12	MRSA	None	-	Yes	Yes	No	23 days (I&D, poly-exchange, IV televancin 6wks)
13	*Staphylococcus hominis* (CoNS)	None	-	No	No	No	-
14	*Staphylococcus capitis* (CoNS)	IV Daptomycin then IV Ceftaroline	2 weeks (Dapto) then 4 weeks (Ceft.)	Yes	Yes	No	55 days (I&D, poly-exchange)
15	*Staphylococcus epidermidis*	None	-	No	No	No	-
16	*Klebsiella pneumoniae*	IV Ceftriaxone	3 weeks	Yes	Yes	No	22 days (2-stage exchange)
17	MRSA	PO Bactrim	7 months	No	Yes	No	315 days (I&D, poly-exchange)
18	*Corynebacterium cdc group g*	None	-	No	No	No	-
19	*Staphylococcus epidermidis*	None	-	No	No	No	-

*PJI, periprosthetic joint infection; THA, total hip arthroplasty; IV, intravenous; PO, oral; I&D, irrigation and debridement; MRSA, methicillin-resistant *Staphylococcus aureus*; CoNS, coagulase-negative *Staphylococcus aureus*

Corresponding Author Paul Kuzyk
E-Mail Address paul.kuzyk@sinaihealthsystem.ca
Institution University of Toronto
Department Orthopaedics
Address 600 University Avenue
City, State Toronto, Ontario
Zip / Postal Code M5G 1X5
All Authors Simon Garceau; Ethan B Sanders; Alan Gross; Oleg Safir; Paul Kuzyk

Title Investigating the Role of Serum Inflammatory Markers in Predicting Success of Two-Stage Prosthetic Hip Infection Revision

Background / Rationale Prosthetic joint infection remains one of the most serious complications of hip arthroplasty. The gold standard for treatment is a two-stage procedure involving the use of an antibiotic cement spacer followed by the insertion of a definitive prosthesis. This study is designed to investigate the role of serum biomarkers, specifically ESR and CRP, and their role in predicting timing and success of a second stage of revision, clear of infection.

Study Question What is the role of serum inflammatory markers in predicting success of two-stage revision of prosthetic hip infection?

Methods A search of the institutional database was performed, creating two retrospective cohorts: successful vs. unsuccessful two stage revisions. Success was determined by the absence of infection, with minimum 12 months of follow-up.

Results The cohort contained 49 (73.1%) successful and 18 (27.9%) infected patients. Participants were between the ages of 47-85, 31 male and 30 female participants. The rate of decline of serum inflammatory markers, as well as numerous different cut points were calculated for analysis in addition to the raw values. The data was analyzed using Independent Sample T-Test, as well as a Binary Logistic Regression. Following analysis, no variables, with numerous cut off points used (see Table 1), were found to be predictive of success of the two-stage procedure. There was a significant difference in the means observed for the CRP value prior to the second-stage of revision, with successful two-stage procedure having a mean CRP of 9.8, and unsuccessful revision mean of 25.3 ($p=0.011$).

Discussion While serum inflammatory markers represent a convenient method of information to support the decision to continue with the second stage of a two-stage revision, their role in predicting success is minimal. Despite the robust analysis of numerous calculation such as rate, presence of decline and cut-points, the role for ESR and CRP remains controversial. While these markers can be used to support decision making, they cannot function alone, and further research must be done to discover a biomarker capable of predicting success of two stage revisions.

Conclusion In conclusion, ESR and CRP, serum inflammatory markers, have a limited role in predicting the success of two stage prosthetic hip infection revisions. Further research must be conducted to determine the optimal timing of a second stage revision

Variable	Test Value	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Association with Outcome-Binary Logistic Regression
ESR (mm/hr)	30	58.82%	63.27%	35.71%	81.58%	0.403
	20	64.71%	44.90%	28.95%	78.57%	0.723
	10	82.85%	18.37%	25.93%	75%	0.611
CRP (mg/L)	10	47.05%	72.92%	38.01%	79.55%	0.541
	5	64.71%	54.17%	33.33%	81.25%	0.892
	1	100%	6.25%	27.42%	100%	0.999

Corresponding Author Adam S Olsen
E-Mail Address olsenas2@upmc.edu
Institution University of Pittsburgh Medical Center
Department Orthopaedic Surgery
Address 3471 Fifth Avenue
Suite 1010
City, State Pittsburgh, PA
Zip / Postal Code 15213
All Authors Adam S Olsen; Alan E Wilson; Rebecca I Minorini; Michael J O'Malley; Kenneth L Urish; Brian R Hamlin; Lawrence S Crossett; Brian A Klatt

Title Sonication cultures obtained during presumed aseptic revision hip and knee arthroplasty are not predictive of future periprosthetic joint infection

Background / Rationale In the setting of known or suspected periprosthetic joint infection, sonication cultures of explanted hip and knee arthroplasty components have demonstrated high sensitivity and specificity, especially in the setting of perioperative antibiotic administration. The utility of this technique during presumed aseptic revision arthroplasty has yet to be established.

Study Question The goal of this study was to determine if sonication cultures obtained during presumed aseptic revision hip and knee arthroplasty were predictive of subsequent periprosthetic joint infection at a minimum follow-up of 2 years

Methods Between 2013 and 2016, sonication cultures of explanted arthroplasty components were performed on a total of 248 presumed aseptic revision arthroplasties. None of these cases met MSIS criteria for periprosthetic joint infection preoperatively, and tissue cultures were negative in all cases. Sonication cultures were positive in 55 cases (22%). Patients were followed for a minimum of 2-years, and postoperative infection was diagnosed based on MSIS criteria. Of those patients with positive sonication cultures, 13 (24%) received short-term postoperative antibiotic suppression.

Results Sonication cultures were negative in 193 (78%) patients, and positive in 55 (22%). When comparing sonication-positive and sonication-negative groups, there were no differences in BMI (31 ± 6.6 vs 31 ± 6.8, p=0.63) or age (64 ± 12 vs 64 ± 12, p= 0.76). Within the sonication-positive group, there were 4 (7.3%) periprosthetic joint infections, versus 12 (6.2%) in the sonication-negative group, no significant difference, $X2(1,N=248)= 0.08$, p= 0.78. There was a trend toward shorter duration to infection in the sonication-positive group (1.4 ±1.8 months vs 9.6 ± 14.2, p=0.07). Among patients with positive sonication cultures that went on to periprosthetic joint infections, the late infecting organism was different from the sonication organism in all cases.

Discussion Positive sonication cultures were not predictive of future periprosthetic joint infection, and although there was a trend toward shorter duration to infection in the sonication-positive group, sonication organisms were different from infecting organisms.

Conclusion Although advantageous in the setting of suspected periprosthetic joint infection, sonication cultures are not useful in presumed aseptic revision arthroplasty

Corresponding Author	Alan E Wilson
E-Mail Address	wilsona8@upmc.edu
Institution	University of Pittsburgh Medical Center
Department	Orthopaedic Surgery
Address	University of Pittsburgh Department of Orthopaedic Surgery 3471 Fifth Avenue
City, State	Pittsburgh, PA
Zip / Postal Code	15213
All Authors	Alan E Wilson; Richard A Wawrose; Elena S Nikonova; Michael J O'Malley; Kenneth L Urish; Lawrence S Crossett; Brian A Klatt

Title The presence of a draining sinus is not a risk factor for two-stage exchange arthroplasty treatment failure

Background / Rationale Reinfection rates after two-stage exchange arthroplasty for PJI have been reported as high as 33% in the literature. Understanding risk factors for treatment failure will help to preoperatively counsel patients on the likelihood of successful treatment and possibly influence the surgeon's treatment algorithm.

Study Question Is the presence of a draining sinus tract a risk factor for two-stage exchange arthroplasty treatment failure?

Methods We performed a single institution, multi-center retrospective chart review of patients treated for PJI with two-stage exchange arthroplasty between June 2006 and May 2016. For patients treated prior to 2011, PJI was defined based on the preoperative work-up and intraoperative findings as determined by the attending surgeon. After 2011, PJI was defined using MSIS consensus criteria. All patients had a minimum of two years follow-up or treatment failure prior to two years. Treatment failure was defined as reinfection or failure to complete two-stage exchange secondary to persistent infection or other host factors. Operative reports and clinical notes were reviewed to assess for presence of a draining sinus tract.

Results 240 patients were treated for PJI with intended two-stage exchange arthroplasty. The overall rate of treatment failure was 29.6% (71/240) while the overall rate of reinfection was 13.3% (32/240). 39 patients did not complete second stage revision; final treatment for these patients was amputation, fusion, or chronic antibiotic suppression. 55 of 240 patients (22.9%) had a draining sinus tract at presentation. Treatment failure occurred in 34.5% (19/55) patients with a draining sinus tract compared to 28.1% (52/185) patients without a draining sinus tract The relative risk of treatment failure given the presence of a draining sinus tract was 1.23 (95% CI [0.80 to 1.89], p = 0.35).

Discussion A draining sinus tract represents a chronic deep infectious process with ultimate compromise of overlying soft tissues, thus we hypothesized it would be a risk factor for treatment failure. We did not find this to be a statistically significant risk factor. This study is limited by inherent risks of retrospective analyses.

Conclusion In this study, the presence of a draining sinus tract was not a significant risk factor for treatment failure.

Electronic Posters

Monitor #1 - 1st Poster **-** presented

Corresponding Author	WEIPING REN
E-Mail Address	as7606@wayne.edu
Institution	Wayne State University
Department	
Address	6135 Woodward Ave. WSU IBIO Center
City, State	Detroit, MI
Zip / Postal Code	48201-123
All Authors	Weiping Ren; Tong Shi; David Markel

Title Sustained release of Vancomycin from polymeric brushite cement (P-DCPD) for infected bone defect regeneration

Background / Rationale Treatment of contaminated bone defects remains a clinical challenge. Many efforts have been made aiming to use calcium phosphate cements (CPCs) as an antibiotics delivery bone-filler for the treatment of contaminated bone defects. Unfortunately, there is still no good solution for the problem of the burst drug release. The aim of this study was to evaluate the in vitro release of Vancomycin (Vac) from injectable self-setting polymeric brushite-forming cement (P-DCPD).

Study Question Determine whether a new polymeric P-DCPD cement can be used as a ceramic device of controllable Vancomycin release for the treatment of orthopedic infection.

Methods P-DCPD was prepared by reacting of calcium polyphosphate (CPP) gel with tetracalcium phosphate. After setting, the end product is brushite. Vac was mixed with CPP gel before adding TTCP for setting (final 75 mg/g). Vac released was quantified by UV/vis spectrophotometer. The bactericidal activity of released Vac was tested using a bacterial growth inhibition assay developed in the PI's lab.

Results A cumulative Vac release from P-DCPD for up to 40 days was observed. A sustained Vac release is mainly due to the ionic binding of Vac to the polyphosphate structure of P-DCPD cement. The released Vac was stable and active. P-DCPD remained the bactericidal activity of Vac above MIC level for at least two weeks and lasted for up to 40 days.

Discussion We propose that the Vac release is closely linked with the P-DCPD degradation rate. P-DCPD represents a better device for a sustained and sufficient (> MIC) Vac release for at least 40 days. The initial Vac release provides an instant protection against bacterial adhesion and growth. Subsequently a controllable and sustained Vac release was observed through a diffusion of Vac from the slow-degrading P-DCPD, until the release /degradation is completed.

Conclusion The synergy between bioceramics and pharmacology has opened a wide field of possibilities, especially in the field of bone defect healing and the treatment of bone infections. We believe that P-DCPD cement represents unique injectable bone cement with a plethora of applications by including other antibiotics and other biomolecules. The therapeutic efficacy of antibiotics-loaded P-DCPD cements in the treatment of contaminated bone defect in animal models are currently underway in our lab.

Monitor #1 – 2nd Poster **-** presented

Corresponding Author	Karan Goswami
E-Mail Address	research@rothmanortho.com
Institution	Rothman Orthopaedic Institute
Department	
Address	125 S 9th St. Ste 1000
City, State	Philadelphia, PA
Zip / Postal Code	19107
All Authors	Karan Goswami; Alexander J Shope; Timothy L Tan; James J Purtill; Javad Parvizi

Title The Microbiome of Osteoarthritic Hip and Knee Joint: A Prospective Multicenter Investigation

Background / Rationale Recent advances in high-throughput DNA sequencing technologies have made it possible to characterize microbial communities (i.e. microbiomes) in anatomical sites previously assumed to be sterile.

Study Question We used this approach to explore (1) the composition within the hip and knee joint of osteoarthritic patients, and (2) the impact of intra-articular steroid injection on the joint microbiome.

Methods This prospective multicenter study involving 14 academic institutions recruited 83 patients undergoing primary total joint arthroplasty between 2017–2018. We included 30 patients with end-stage hip osteoarthritis (Tönnis Grade 4) and 53 with knee osteoarthritis (Kellgren-Lawrence >3). Demographics and prior intra-articular injections were noted. Synovial fluid, tissue samples and swabs were obtained at the time of surgery and shipped to a centralized laboratory for testing. Following DNA extraction, microbial 16S ribosomal RNA next generation sequencing (NGS) was performed. Bioinformatic analyses were conducted to generate taxonomic units for quantitative and comparative statistical analyses.

Results After removal of reagent contamination, microbial DNA from 22 species with average abundances >0.5% were identified in osteoarthritic hip joints. The three most abundant genera identified in the hip samples were Escherichia, Cutibacterium and Acinetobacter. This microbial composition was present irrespective of the type of hip specimen sampled (synovial fluid vs. tissue vs. swabs; $F=0.74;p=0.80$). Although microbiomes in hips versus knees were statistically different ($F=2.86;p=0.001$), joint type explained <1% of compositional variation. Of note, Acinetobacter radioresistens was statistically higher in patients sampled following a steroid injection into the hip joint (p<0.001).

Discussion Our collaborative findings indicate the presence of a microbiome in the osteoarthritic hip and knee joints, which exhibit 99% compositional similarity. To our knowledge, this is the first report of a microbiome in the native arthritic hip and knee joint.

Conclusion Baseline characterization of the NGS signal in the hip and knee joint may help establish a context for the interpretation of sequencing diagnostics in suspected periprosthetic joint infection.

Monitor #1 – 3rd Poster **-** presented

Corresponding Author	Carlos A Higuera-Rueda
E-Mail Address	higuerc@ccf.org
Institution	Cleveland Clinic
Department	
Address	2950 Cleveland Clinic Blvd.
City, State	Weston, FL
Zip / Postal Code	33331
All Authors	Anabelle Visperas; Yushi Miyamae; Alison K Klika; Nicolas Piuzzi; Wael K Barsoum; Minseon Ju; Sameera Wickramasinghe; Monica Navarreto-Luvango; Anna CS Samia; Carlos A Higuera-Rueda

Title	Development of a clinically relevant rabbit model of periprosthetic joint infection
Background / Rationale	Periprosthetic joint infection (PJI) is a devastating complication of total joint arthroplasty accounting for 12% of hip and 19% of knee revisions and estimated to cost over $1.6 billion/year by 2020. While the field has gained insight into the pathogenesis of bacterial biofilm associated with PJI using animal models including mouse, rabbits, and dogs, these models are lacking in complete clinical relevance, cost effectiveness, and minimal space to test for novel interventions that could promote implant preservation.
Study Question	Can we develop a clinically relevant rabbit model of knee PJI with debridement, antibiotics, irrigation, and retention (DAIR) treatment?
Methods	New Zealand white rabbits were implanted with a titanium tibial implant that was fully conducive to full weight bearing and use of the limb ~7 days after surgery (Figure 1A). Knees were inoculated with control saline or 5x10^4 to 5x10^7 CFU Xen36 (bioluminescent Staphylococcus aureus) intraarticularly prior to capsule closure. Two weeks later, rabbits underwent irrigation and debridement (I&D) or were sacrificed for biofilm analysis via scanning electron microscopy (SEM) and bacterial burden via CFU and bioluminescence from swabs taken from tissues and synovial fluid. Two weeks later, rabbits were sacrificed for final assessment of biofilm and bacterial burden. All rabbits were treated with enrofloxacin antibiotics throughout entire experimental course.
Results	At two weeks post-inoculation, productive biofilm formation was evident on implant infected with Xen36 but absent on control implant inoculated with saline via SEM (Figure 1B). Four weeks after inoculation, no bacterial colonies grew from swabs and synovial fluid isolated from control animals, while infected rabbits showed productive infection by OD and bioluminescence after culturing (Figure 1C).
Discussion	This rabbit model has expanded upon current models for PJI by taking into account multiple aspects of the treatment course for PJI with DAIR. This model employs an implant that allows for full range of motion and weight-bearing, a clinically relevant bacterial strain, addition of an I&D procedure, and is a mid-range sized animal that is cost-effective and has a joint space volume that is appealing to test future local treatment modalities.
Conclusion	We have developed an experimental rabbit PJI model that is clinically relevant and can be used to develop new local treatment strategies for PJI.

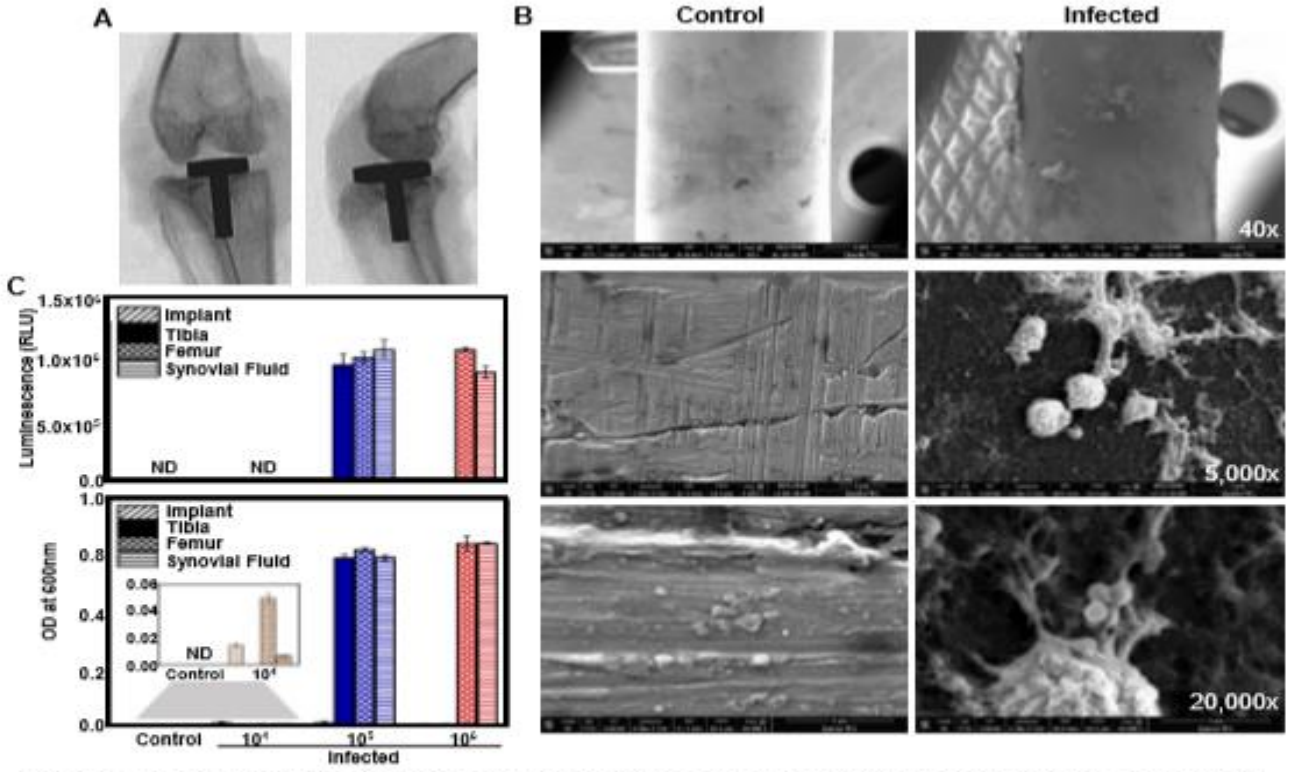


Figure 1. Development of a clinically relevant model of PJI (A) AP and Lateral views of rabbit knee after implant placement **(B)** Scanning electron microscopy (SEM) of implant two weeks after implantation and bacterial inoculation with *Xen36* (bioluminescent *S. aureus*) showing biofilm formation **(C)** Luminescence and OD readings from cultured swabs and synovial fluid taken from control and infected animals 4 weeks post-op/14 days post-I&D. ND = Not detected

Monitor #1 – 4th Poster **–** presented

Corresponding Author	Xu Yang
E-Mail Address	yangx@hss.edu
Institution	Hospital for Special Surgery
Department	
Address	535 East 70th Street
City, State	New York, NY
Zip / Postal Code	10021
All Authors	Branden Sosa; YingZhen Niu; Kathleen Turajane; Kevin Staats; Vincentius Suhardi; Alberto Carli; Vincent Fischetti; Mathias Bostrom; Xu Yang

Title Bacteriophage-Derived Lysin Combination With Vancomycin Demonstrates Superior Antimicrobial Potential in Murine DAIR Model of PJI

Background / Rationale Methicillin-Susceptible Staphylococcus aureus (MSSA) is the most common organism causing Periprosthetic joint infection (PJI) and has been shown to have significant biofilm forming capabilities. Biofilm increases antibiotic resistance posing a significant challenge in the treatment of PJI. In this study, we explore the efficacy of a bacteriophage-derived lysin, PlySs2, against in-vitro biofilm on titanium implant surfaces and in an acute murine debridement antibiotic implant retention (DAIR) model of PJI.

Study Question Is PlySs2 lysin capable of killing MSSA biofilm at different maturities on titanium implant surfaces? Does the combination of Vancomycin and lysin enhance bacterial clearance in a murine DAIR model of PJI?

Methods Xen 36 MSSA biofilms were grown on 3-D printed Ti-6Al-4V mouse implants for 24-hours or 5-days. Implants were subsequently treated with Vancomycin (1000x MIC), PlySs2 (5x MIC), or positive control (TSB) for 4 hours at 37?C. After treatment, implants were washed, sonicated, and plated for evaluation of CFUs overnight. A 3-D printed Ti-6Al-4V mouse implant was inserted into the proximal tibia of 16-week female C57BL/6J mice (n=21). An intra-articular injection of 104 CFU of Xen36 was administered. After 5 days, mice were separated into three groups (n=7/group): (1) no further surgical intervention, (2) irrigation and debridement (I&D) with saline, (3) I&D with PlySs2. No implant-exchange was performed to mimic a DAIR therapeutic strategy. All mice received Vancomycin SQ from Day 5-10 and group 3 was also given PlySs2 IP from Day 5-10. All mice were sacrificed at Day 10 and analyzed for tissue and implant CFU counts.

Results The in-vitro biofilm assay confirmed the ability of PlySs2 to significantly reduce CFU counts on the surface of the tibial implant. The addition of lysin to Vancomycin treated mice demonstrates the ability to reduce bacterial load in the periprosthetic tissue and implant.

Discussion PlySs2 significantly reduces bacterial CFU counts of S. aureus biofilm on Ti-6Al-4V implant compared to Vancomycin. Local and systemic PlySs2 results in a reduction of bacterial load in an acute DAIR PJI model.

Conclusion PlySs2 exhibits superior anti-microbial effect compared to Vancomycin on implants with different biofilm maturities. The addition of PlySs2 to Vancomycin treatment of an acute established PJI demonstrates reduced tissue and implant CFU.

Monitor #1 – 5th Poster **-** presented

Corresponding Author	Taylor Paziuk
E-Mail Address	paziuk14@gmail.com
Institution	Rothman Orthopaedic Institute at Thomas Jefferson University
Department	Orthopaedic Surgery
Address	The Rothman Orthopaedic Institute 925 Chestnut, 5th Floor Philadelphia, PA 19107
City, State	Philadelphia, PA
Zip / Postal Code	19107
All Authors	Taylor Paziuk; Gerard Chang; Brianna Fram; John Strony; James Krieg

Title A Potential New Indicator for the Diagnosis of Fracture-Related Infections: Platelet Count to Mean Platelet Volume Ratio

Background / Rationale Diagnosing fracture related infection preoperatively is difficult. Although traditional serum biomarkers are used, they are often misleading and therefore often add a monetary burden to a diagnostic evaluation without providing any additional clinical information. Platelets are a known acute phase reactant who parameters are assessed in all patients undergoing surgery via standard preoperative complete blood count.

Study Question Are platelet indices, specifically that of platelet count (PC) and mean platelet volume (MPV), useful in the diagnosis of fracture-related infections (FRI) relative to other serum biomarkers.

Methods A retrospective review of all fracture nonunion revision surgeries performed at our single institution between 2013 and 2018. All patients undergoing revision surgery for a nonunion were included. Nonunion was defined as an arrest in the biologic fracture repair process, as seen on imaging, for three consecutive months with a minimum of six months between the index procedure and diagnosis. Positive intraoperative cultures defined the FRI cohort. Preoperative ESR, CRP, and platelet indices were assessed for each patient using ROC curve analysis.

Results Sensitivity, specificity, and Area Under the Curve (AUC) of the ROC curve analysis of the PC to MPV ratio were 100%, 55.56%, and 0.814, respectively. The ratio by itself outperformed ESR and CRP individually and in combination with each other. Finally, the diagnostic performance of ESR, CRP, and the ratio together had an AUC of 0.879 on ROC curve analysis.

Discussion Platelets have a clear association with FRI. The PC to MPV ratio outperformed traditional biomarkers like ESR and CRP in the assessment of PJI. All patients get a preoperative CBC, so platelet indices add no temporal or monetary burden in the assessment of patients with potential FRI.

Conclusion The PC to MPV ratio can serve as a cost-effective and reliable screening test for FRI. Utilizing ESR, CRP, and the PC to MPV ratio in conjunction with one another optimizes the diagnostic performance of a preoperative FRI assessment.

Abstract Figures

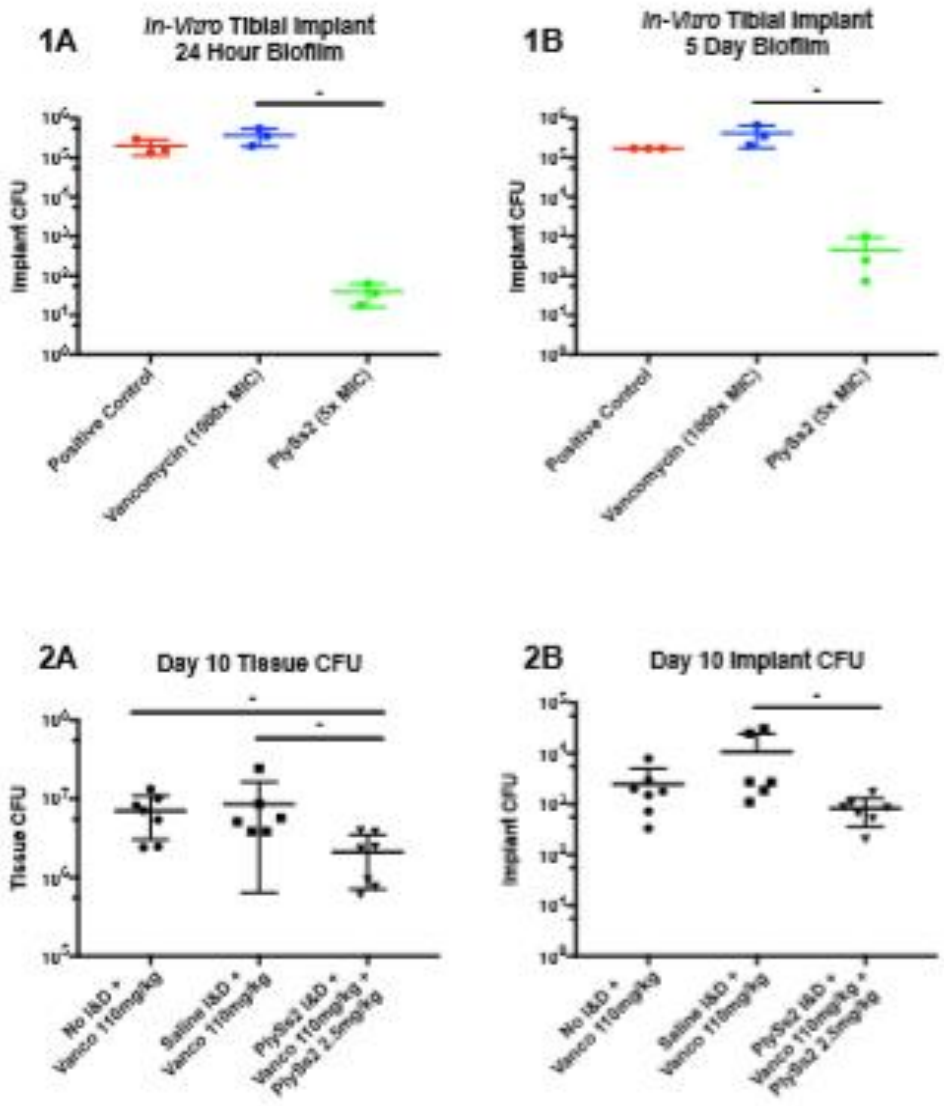


Figure 1. *A* and *B* represent biofilm grown on the surface of the implant for 24 hours (A) and 5 days (B), respectively. Implants were administered one of the following treatments for 4 hours: TSB (positive control), 2mg/mL Vancomycin (1000x MIC), or 320ug/mL PlySs2 (5x MIC). Implants were subsequently sonicated and plated for CFU counting. (*p<0.05)

Figure 2. All groups received Vancomycin 110mg/kg SQ from day 5-10 with each group undergoing 1) no I&D 2) saline I&D or 3) 2mg/mL PlySs2 I&D. The PlySs2 treated group also received PlySs2 2.5mg/kg IP. (*p<0.05)

Monitor #1 – 6th Poster

Corresponding Author	Karan Goswami
E-Mail Address	research@rothmanortho.com
Institution	Rothman Orthopaedic Institute
Department	
Address	125 S 9th St. Ste 1000
City, State	Philadelphia, PA
Zip / Postal Code	19107
All Authors	Karan Goswami; Kamolsak Sukhonthamarn; Chi Xu; Timothy L Tan; Javad Parvizi

Title New Criteria and Cut-off Values in Acute Postoperative Periprosthetic Joint Infection

Background / Rationale Diagnosis of periprosthetic joint infection (PJI) in the early postoperative period remains a challenge as many of the usual serum and synovial markers are frequently elevated following recent surgery. While studies have established that serum C-reactive protein (CRP) and synovial markers are useful, recent work suggests that current cut-offs may lack sensitivity.

Study Question The purpose of this study was thus to: (1) examine the role of serum CRP, ESR, synovial fluid white blood cell (SF-WBC) count, and polymorphonuclear (PMN) percentage in the diagnosis of acute postoperative PJI and (2) identify the optimal cut-off threshol

Methods We conducted a retrospective review of 1,478 patients who were re-admitted within 90 days of their index total joint arthroplasty, between January 2000 to September 2017. Of these, 84 patients (42 PJIs, 42 controls) underwent serum laboratory tests and joint aspiration. Receiver operating characteristic (ROC) and area under the curve analysis was performed to determine the efficacy of each test and optimal cut-off values. Sensitivity, specificity, positive predictive values (PPV), and negative predictive values (NPV) were also calculated. The parameters were then combined to detect performance for diagnosis of acute postoperative PJI.

Results The optimal cut-off values identified were 5,500 cells/?L for SF-WBC (95% sensitivity, 87% specificity, 87% PPV, and 95% NPV), 35.5 mg/L for serum CRP (93% sensitivity, 78% specificity, 82% PPV, 91% NPV), 60 mm/h for ESR (63% sensitivity, 90% specificity, 90% PPV, 63% NPV), and 80% for PMN (95% sensitivity, 45% specificity, 64% PPV, 90% NPV). On re-analysis of the thresholds using a 30-day or 45-day definition for acute PJI, there were no significant differences noted in the cut-offs for CRP or PMN%. Of note, however, the optimal cut-off for SF-WBC was twice as high (10,805 cells/?L) when using a 30-day and 45-day definition versus a 90-day definition for acute PJI.

Discussion The calculated cut-offs identified in our study for serum and synovial parameters were substantially lower than those currently recommended for the diagnosis of acute PJI.

Conclusion While further multi-institutional validation is required, these new threshold values should be considered for implementation as traditional cut-offs appear to lack sensitivity in the acute postoperative period.

Monitor #1 – 7th Poster

Corresponding Author	Austin Fragomen
E-Mail Address	FragomenA@hss.edu
Institution	HSS
Department	Orthopedics
Address	535 E 70th STchen
City, State	New York
Zip / Postal Code	10021
All Authors	Austin Fragomen; Aaron Lam; Joshua Buksbaum; Shawn Richardson; Michael Henry; Andrew O Miller; S. Robert Rozbruch

Title Predictors of Successful Limb Salvage for Patients with Chronic Osteomyelitis of the Tibia and Ankle

Background / Rationale Osteomyelitis is a potentially devastating complication of orthopedic trauma and surgery whose treatment requires collaboration between orthopedic surgery, plastic surgery, and infectious disease teams. The management of osteomyelitis at an academic center using a team approach was evaluated by asking the following questions:

Study Question (1) how effective was the treatment at controlling infection, (2) how effective was our treatment for infected nonunions, (3) what were the predictors of failure of the treatment protocol in eradicating infection and healing nonunions?

Methods 67 patients were treated for fracture related infection (88%) or other infection (12%) with surgical debridement and 6 weeks of IV antibiotics. The orthopedic complex limb reconstruction team performed tissue excision and bony stabilization, plastic surgery performed soft tissue coverage, and the infectious disease team provided advise for local antibiotics and post op antibiotic management. Cultures were taken at surgery. Most patients (84%) suffered from infected nonunions (Ceirny grade 4) and required nonunion repair or arthrodesis surgery.

Results An average of 3.6 salvage surgeries were performed to control infection and heal the nonunion. Soft tissue coverage was required in 30% of cases. Intravenous antibiotics were administered or an average of 5.9 weeks with oral suppression given for an average of 2.7 additional months. Mean follow up was 3.9 years. Infection was controlled in 61/67 patients (91%). Infected nonunions were united after treatment in 48/54 patients (88%). Four of the patients where the infection remained uncontrolled also failed nonunion repair. Risk factors for failing the treatment of osteomyelitis or infected nonunion were diabetic neuropathy and need for an increasing number of limb salvage surgeries.

Discussion Diabetic neuropathy and salvage treatment failure requiring additional salvage surgeries are statistically significant risk factors impacting the success of limb salvage. Further studies are needed to address the cost effectiveness of limb salvage for diabetic neuropathic patients presenting with lower extremity osteomyelitis to aide in the decision to pursue limb salvage or amputation.

Conclusion Limb salvage with an integrated multidisciplinary team approach is successful in treating complex chronic osteomyelitis and associated non-union involving the lower extremities.

Monitor #1 – 8th Poster

Corresponding Author	Katherine L Given
E-Mail Address	Katherine.Given@middlemore.co.nz
Institution	Middlemore Hospital
Department	Infectious Diseases (Division of Medicine)
Address	Middlemore Hospital 100 Hospital Road, Otahuhu 2025, Auckland, New Zealand
City, State	Auckland, New Zealand
Zip / Postal Code	2025
All Authors	Stephen McBride; David Holland; Christopher Luey; Christopher Hopkins; Dinshaw Mistry; Katherine L Given

Title Normal Serum C-reactive protein native joint septic arthritis in adults

Background / Rationale Assessment of inflammatory monoarthritis routinely includes measurement of serum C-reactive protein (CRP) when a diagnosis of native joint septic arthritis (NJSA) is being considered.

Study Question How common is an initial normal CRP in NJSA, and which factors are associated with normal initial CRP, in comparison to NJSA with an elevated CRP?

Methods We assessed initial CRP in patients from a large single centre retrospective cohort study of 543 episodes of NJSA from 2009-20141. NJSA episodes with normal initial CRP (?5mmol/L) were compared to cases with elevated CRP.

Results In total, 10.3% (56/543) of episodes of NJSA had a normal initial CRP; 48/250 small joint NJSA (SNJSA) and 8/302 large joints NJSA (LNJSA) ($p \leq 0.0001$). Newman's Criteria positive cases only were 43/230 SNJSA and 8/269 LNJSA ($p \leq 0.0001$), and microbiologically-proven cases were 31/200 SNJSA and 8/245 LNJSA ($p \leq 0.0001$). Normal CRP was statistically significantly associated with lower Charlson Comorbidity Index score (proportion >0 in normal CRP 3.6% vs. elevated CRP 26.1%, $p \leq 0.0001$). Normal CRP was strongly associated with shorter mean hospital length of stay (normal CRP 7.03 days vs. elevated CRP 15.11 days, $p \leq 0.0001$), however no statistically significant differences were found for other outcomes including treatment failure for the cohort, LNJSA and SNJSA, death within 90 days, and requirement to return to theatre.

Discussion A normal initial CRP does not exclude NJSA, for both large and small joints. Normal CRP NJSA's association with low comorbidity scores and short length of stay is likely explained by the known association of these factors with SNJSA, in which a normal initial CRP is more common compared to LNJSA.

Conclusion In our study, NJSA was associated with normal initial CRP levels in 10.3% of cases. Normal CRP NJSA is more common in small joint NJSA, and is associated with a shorter length of hospital stay and lower Charlson Comorbidity Index score.

References:

1. McBride S, Mowbray J, Caughey W, Wong E, Luey C, Siddiqui A et al. Epidemiology, management and outcomes of large and small native joint septic arthritis in adults. Clin Infect Dis. Epub ahead of print; 2019 April 3.

Monitor #1 – 9th Poster

Corresponding Author	Gregory J Kirchner
E-Mail Address	kirchnergj@gmail.com
Institution	Drexel University College of Medicine
Department	
Address	216 N Broad Street
City, State	Philadelphia
Zip / Postal Code	19102
All Authors	Yehuda Kerbel; Alexander M Lieber; Andre Jakoi; Amrit Khalsa; Gregory J Kirchner

Title The Cost-Effectiveness of Vancomycin Powder in Lateral Lumbar Interbody Fusion

Background / Rationale Intra-wound application of vancomycin powder has demonstrated dramatic reductions of
infection rate in spine surgery. The economic benefit of this protocol has been previously validated for lumbar fusion in general, but the cost-effectiveness is less clear for lateral lumbar interbody fusion (LLIF).

Study Question Is vancomycin powder cost-effective for preventing infection following LLIF.

Methods The product cost of vancomycin powder was obtained from our institution's purchasing records. Infection rate and revision cost for LLIF were obtained from the literature. A break-even analysis [Break-even Infection Rate = (Initial Infection Rate – Cost of Protocol) / Cost of Treatment] was then performed to determine the absolute risk reduction (ARR) in
infection rate to make prophylactic application of vancomycin powder cost-effective.

Results Costing $3.06 per gram at our institution, vancomycin powder was determined to be cost-effective in LLIF if the infection rate of 0.14% decreased by an ARR of 0.0035%. At the highest cost reported in the literature, $44.00 per gram of vancomycin powder, prophylactic vancomycin powder would need to result in an ARR of 0.05% to be cost-effective. Varying the baseline infection rate to similar rates reported for anterior lumbar
interbody fusion (>5.0%) did not influence the ARR for LLIF using the product cost of vancomycin at our institution.

Discussion This break-even analysis demonstrates that prophylactic vancomycin powder can be highly cost-effective for LLIF depending on the product cost. At our institution, vancomycin
powder is economically justified if it prevents at least one infection out of 28,000 LLIF surgeries. Alternatively, the initial infection rate would need to be reduced by over one third in order to economically justify vancomycin powder usage at higher product price
points.

Conclusion Prophylactic vancomycin powder is cost-effective for preventing infections following lateral lumbar interbody fusion.

Monitor #2 - 1st Poster **-** presented

Corresponding Author	Michael Mont
E-Mail Address	mmont@northwell.edu
Institution	Lenox Hill Hospital
Department	
Address	130 E 77th St
City, State	New York, NY
Zip / Postal Code	10075
All Authors	Hiba Anis; Rushabh Vakharia; Nipun Sodhi; Bilal Mahmood; Giles Scuderi; Carlos Higuera; Martin Roche; Michael Mont;

Title Opioid Use and the Risk of Infection in Primary Total Knee Arthroplasty

Background / Rationale Opioids have been shown to impair immune parameters in patients. However, there is little evidence on the effect of opioid use disorder (OUD) on the risk of infection after primary total knee arthroplasty.

Study Question Therefore, the purpose of this study was to determine whether patients with OUD are at an increased risk of 1) surgical site infections (SSI) and 2) peri-prosthetic joint infections (PJI) compared to patients without OUD.

Methods All primary TKAs performed between 2005 and 2014 were extracted from an administrative database using the International Classification of Disease (ICD-9) code 81.54. The study group was formed of patients with a 90-day history of OUD prior to TKA who were matched 1:1 by age, gender, and Elixhauser comorbidity index scores to control patients yielding a total study population of 23,680. Measured outcomes included 90-day SSI incidence and 2-year PJI incidence. Logistic regression analysis was used to calculate odds ratios (OR), 95% confidence intervals (95% CI), and p-values. A p-value less than 0.05 was considered statistically significant.

Results SSI rates in the 90-day post-operative period were higher in OUD patients compared to matched control patients (3.53 vs. 2.08%). OUD patients were at a significantly increased risk of 90-day SSIs compared to matched controls (OR 1.72, 95% CI 1.46 to 2.02, p<0.001). Moreover, 2-year PJI rates were higher for the OUD cohort compared to the matched control cohort (5.59 vs. 4.32%). There was a significantly increased 2-year PJI risk among OUD patients compared to the control patients (OR 1.31, 95% CI 1.16 to 1.47, p<0.001).

Discussion This study found that after accounting for age, gender, and comorbidities, patients with a history of OUD were at a significantly increased risk of developing post-operative SSIs and PJIs. Future studies should evaluate the effect of strategies to reduce pre-operative opioid use on outcomes after TKA.

Conclusion OUD was associated with an increased risk of infection after primary TKA. These findings should be used to help guide pre-operative patient optimization and counseling to improve outcomes.

Monitor #2 – 2nd Poster **-** presented

Corresponding Author	Michael Mont
E-Mail Address	mmont@northwell.edu
Institution	Lenox Hill Hospital
Department	
Address	130 E 77th St
City, State	New York, NY
Zip / Postal Code	10075
All Authors	Hiba Anis; Rushabh Vakharia; Bilal Mahmood; Nipun Sodhi; Joseph Ehiorobo; Eric Grossman; Martin Roche; Michael Mont

Title Opioid Use Disorder is Associated with an Increased Risk for Infection after Revision Total Knee Arthroplasty

Background / Rationale Opioids have been shown to suppress the immune response. However, there is little evidence on the impact of opioid use disorder (OUD) on infection rates in patients undergoing revision total knee arthroplasty (TKA).

Study Question The purpose of this study was to determine whether revision TKA patients with OUD are at an increased risk of developing: 1) surgical site infections (SSI) and 2) peri-prosthetic joint infections (PJI).

Methods An administrative claims database was queried for all revision TKAs performed between 2005 and 2014 using International Classifications of Disease (ICD-9) coding. The study group comprised of patients with a history of OUD within 90 days prior to surgery. OUD patients were matched 1:1 according to age, sex, and Elixhauser comorbidity index (ECI) scores to control patients. This query yielded 7,592 patients. Primary outcomes analyzed were the incidence of developing SSIs 90 days post-operatively and PJIs 2 years post-operatively. Logistic regression analysis was performed to calculate odds-ratios (OR), 95% confidence intervals (95% CI), and p-values. A p-value less than 0.05 was considered statistically significant.

Results Revision TKA with OUD had higher rates of SSI compared to matched controls without OUD (7.50 vs. 4.11%). OUD patients were almost twice as likely to develop SSIs compared to matched control patients (OR 1.88, 95% CI 1.53 to 2.29, p<0.001). Additionally, 2-year PJI incidence was higher in the OUD cohort compared to the matched cohort without OUD (23.84 vs. 5.95%). Patients with OUD were 5 times more likely to develop PJIs in the 2-year post-operative period compared to matched controls (OR 4.94, 95% CI 4.24 to 5.76, p<0.001).

Discussion Opioid abuse and dependence has been rising at an alarming rate in recent years. Our study found that opioid use disorder significantly increases the risk of both SSIs and PJIs after revision TKA. These findings may help guide providers in the peri-operative management of patients in order to mitigate the risk of infection after revision TKA.

Conclusion Revision TKA patients with OUD were found to be at a significantly higher risk for post-operative infection.

Monitor #2 – 3rd Poster **-** presented

Corresponding Author	Michael Mont
E-Mail Address	mmont@northwell.edu
Institution	Cleveland Clinic
Department	
Address	130 E. 77th St
City, State	New York, NY
Zip / Postal Code	10075
All Authors	Hiba Anis; Nipun Sodhi; Rushabh Vakharia; Nicholas Arnold; Joseph Ehiorobo; Eric Grossman; Michael Mont; Martin Roche;

Title Infection Risk after Revision Total Hip Arthroplasty in Octogenarians and Nonagenarians

Background / Rationale Patients over the age of 80 years are at an increased risk of complications after revision total hip arthroplasty (THA). It is important to determine risk factors for post-operative infection in this growing patient population.

Study Question Therefore, the purpose of this study was to investigate risk factors for 1) surgical site infections (SSIs) and 2) prosthetic joint infections (PJIs) in octogenarians and nonagenarians undergoing revision THA.

Methods Revision THAs performed on patients aged 80 years or older between 2005 and 2014 were queried from an administrative claims database using International Classification of Disease (ICD-9) and Current Procedural Terminology (CPT) coding. The query yielded a study population of 36,256 patients. The measured outcomes were 90-day SSI incidence and 2-year PJI incidence. Several risk factors that comprise the Elixhauser and Charlson comorbidity indices were included for analysis (Table 1). Multivariate binomial logistic regression analysis was performed to calculate odds (OR), along with their respective 95% confidence intervals (95%CI), p-values. Bonferroni-adjusted correction was performed and a p-value less than 0.002 was considered statistically significant.

Results Among patients aged 80 years or older, electrolyte imbalance (OR 1.48, 95% 1.23 to 1.79, p<0.0001) and iron deficiency anemia (OR 1.63, 95% CI 1.35 to 1.99, p<0.001) were significantly associated with an increased risk for 90-day SSIs. Electrolyte imbalance (OR 1.74, 95% CI 1.48 to 2.08, p<0.0001) and iron deficiency anemia (OR 1.72, 95% CI 1.45 to 2.06, p<0.0001) were also risk factors for 2-year PJIs. Additionally, men (OR 1.33, 95% CI 1.17 to 1.52, p<0.0001) and patients with rheumatoid arthritis (OR 1.35, 95% CI 1.17 to 1.56, p<0.0001) were also at an increased risk for PJIs.

Discussion Due to an aging population and the success of arthroplasty procedures, there is a growing proportion of arthroplasty patients presenting later in life. These results demonstrated that octogenarians and nonagenarians with iron deficiency anemia and electrolyte imbalances are at an increased risk for post-operative infections. Additionally, men and patients with rheumatoid arthritis are at increased risk of PJI.

Conclusion Findings from this study may guide patient counseling and pre-operative patient optimization of octogenarians and nonagenarians to help mitigate the infection risk after revision THA.

Table 1. Multivariate regression models evaluating risk factors for 90-day surgical site infection incidence (SSI) and prosthetic joint infection (PJI) incidence following revision total hip arthroplasty.

Variable	Odds ratio	95% Confidence interval	p-value
90-day SSI incidence			
Male	1.15	0.99 – 1.34	0.052
Alcohol abuse	0.79	0.52 – 1.15	0.252
BMI < 19kg/m^2	0.67	0.40 – 1.07	0.121
BMI 19 – 24kg/m^2	1.19	0.82 – 1.66	0.315
BMI 25 – 29kg/m^2	1.10	0.76 – 1.53	0.591
BMI 30 – 39kg/m^2	1.44	1.11 – 1.85	0.004
BMI 40 – 70kg/m^2	1.41	0.89 – 2.13	0.116
Cannabis abuse	1.28	0.61 – 10.53	0.030
CHF	1.24	1.07 – 1.45	0.003
Coagulopathies	1.12	0.96 – 1.31	0.131
Depression	1.23	1.06 – 1.42	0.004
Diabetes mellitus	1.02	0.88 – 1.18	0.734
Electrolyte/fluid imbalance	1.48	1.23 – 1.79	**<0.0001**
Hypertension	1.27	0.90 – 1.84	0.182
Hypothyroidism	0.94	0.81 – 1.09	0.443
Iron deficiency anemia	1.63	1.35 – 1.99	**<0.0001**
Opioid use disorder	1.15	0.56 – 2.07	0.664
Peptic ulcer disease	0.91	0.73 – 1.13	0.437
Peripheral vascular disease	1.06	0.91 – 1.22	0.410
Renal failure	1.00	0.79 – 1.23	0.998
Rheumatoid arthritis	1.10	0.92 – 1.31	0.256
Sleep apnea	0.82	0.65 – 1.03	0.101
2-year SSI incidence			
Male	1.33	1.17 – 1.52	**<0.0001**
Alcohol abuse	0.91	0.65 – 1.23	0.579
BMI < 19kg/m^2	1.17	0.82 – 1.61	0.356
BMI 19 – 24kg/m^2	1.50	1.14 -1.96	0.002
BMI 25 – 29kg/m^2	1.23	0.91 – 1.62	0.157
BMI 30 – 39kg/m^2	1.40	1.11 – 1.74	0.002
BMI 40 – 70kg/m^2	1.38	0.93 – 1.99	0.092
Cannabis abuse	8.48^{e+09}	N/A	0.953
CHF	1.00	0.88 – 1.13	0.984
Coagulopathies	1.09	0.95 – 1.25	0.176
Depression	1.17	1.03 – 1.33	0.010
Diabetes mellitus	1.03	0.90 – 1.17	0.616
Electrolyte/fluid imbalance	1.74	1.48 – 2.08	**<0.0001**
Hypertension	1.39	1.02 – 1.94	0.040
Hypothyroidism	0.95	0.83 – 1.08	0.456
Iron deficiency anemia	1.72	1.45 – 2.06	**<0.0001**
Opioid use disorder	0.80	0.39 – 1.44	0.504
Peptic ulcer disease	1.00	0.83 – 1.20	0.931
Peripheral vascular disease	1.03	0.91 – 1.17	0.616
Renal failure	1.01	0.83 – 1.21	0.899
Rheumatoid arthritis	1.35	1.17 – 1.56	**<0.0001**
Sleep apnea	1.09	0.91 – 1.31	0.301

BMI=body mass index; CHF=congestive heart failure

Monitor #2 – 4th Poster **-** presented

Corresponding Author	Michael Mont
E-Mail Address	mmont@northwell.edu
Institution	Lenox Hill Hospital
Department	
Address	130 E. 77th St
City, State	New York, NY
Zip / Postal Code	10075
All Authors	Rushabh Vakharia; Nipun Sodhi; Hiba Anis; Peter Gold; Luke Garbarino; Matthew Hepinstall; Michael Mont; Martin Roche

Title Risk Factors for Post-Operative Infection in Octogenarians and Nonagenarians after Total Hip Arthroplasty

Background / Rationale Patients over the age of 80 years old are forming an increasing proportion of the (total hip arthroplasty) THA patient population. Understanding risk factors for specific complications can help guide pre-operative patient optimization as well as post-operative surveillance in order to improve outcomes.

Study Question The purpose of this study was to investigate risk factors for 1) surgical site infections (SSIs) and 2) prosthetic joint infections (PJIs) in patients over 80 years old undergoing primary THA.

Methods All primary THA patients over the age of 80 years old between 2005 and 2014 were queried with International Classification of Disease (ICD-9) and Current Procedural Terminology) codes 81.51 and 27130, respectively using an administrative claims database. The query yielded 162,489 patients. The measured outcomes were 90-day SSI incidence and 2-year PJI incidence. Multivariate binomial logistic regression models were constructed to evaluate the effect of risk factors on infection incidence. Several risk factors from the Elixhauser and Charlson comorbidity indices were included in the models (Table 1). Bonferroni-adjusted correction was performed and a p-value <0.002 was considered statistically significant.

Results There was a significantly increased risk of 90-day SSIs with obesity (BMI 30 to 39 kg/m2, p<0.0001) and morbid obesity (BMI 40 to 70 kg/m2, p<0.0001). Congestive heart failure (p=0.0001), coagulopathies (p<0.0001), depression (p<0.0001), electrolyte imbalance (p<0.0001), and iron deficiency anemia (p<0.0001) were also associated with an increased risk for 90-day SSIs. Additionally, male gender (p<0.0001), obesity (p<0.0001), and morbid obesity (p<0.0001) were associated with increased 2-year PJI risk. Pre-existing coagulopathies (p<0.0001), depression (p<0.0001), electrolyte imbalance (p<0.0001), iron deficiency anemia (p<0.0001), and rheumatoid arthritis (p<0.0001) were also associated with increased PJI risk.

Discussion Patients >80 years have been reported to be at an increased risk of post-operative complications. This study found that obesity and several pre-existing conditions, including iron deficiency anemia and electrolyte imbalance, are associated with increased infection risk after THA among octogenarians and nonagenarians.

Conclusion This study revealed risk factors associated with developing SSIs and PJIs after primary THA among patients aged 80 years and older.

Table 1. Multivariate regression models evaluating risk factors for 90-day surgical site infection incidence (SSI) and prosthetic joint infection (PJI) incidence following primary total hip arthroplasty.

Variable	Odds ratio	95% Confidence interval	*p*-value
90-day SSI incidence			
Male	1.15	1.02 – 1.29	*0.013*
Alcohol Abuse	0.87	0.62 – 1.19	*0.423*
BMI < 19kg/m^2	0.87	0.58 – 1.26	*0.508*
BMI 19 – 24kg/m^2	1.23	0.91 – 1.63	*0.153*
BMI 25 – 29kg/m^2	1.23	0.95 – 1.63	*0.088*
BMI 30 – 39kg/m^2	1.91	1.60 – 2.26	***<0.0001***
BMI 40 – 70kg/m^2	2.58	1.95 – 3.36	***<0.0001***
Cannabis abuse	4.48	2.32^{e-24} – 0.02	*0.943*
CHF	1.24	1.11 – 1.39	***0.0001***
Coagulopathies	1.12	0.99 – 1.27	*0.060*
Depression	1.26	1.13 – 1.42	***<0.0001***
Diabetes mellitus	1.00	90.89 – 1.12	*0.948*
Electrolyte/fluid imbalance	1.57	1.38 – 1.78	***<0.0001***
Hypertension	1.21	0.96 – 1.56	*0.113*
Hypothyroidism	1.08	0.97 – 1.21	*0.140*
Iron deficiency anemia	1.71	1.50 – 1.96	***<0.0001***
Opioid use disorder	1.12	0.61 – 1.88	*0.669*
Peptic ulcer disease	1.00	0.84 – 1.17	*0.977*
Peripheral vascular disease	1.01	0.90 – 1.12	*0.894*
Renal failure	1.06	0.88 – 1.26	*0.502*
Rheumatoid arthritis	1.21	1.06 – 1.38	*0.003*
Sleep apnea	1.20	1.03 – 1.40	*0.015*
2-year PJI incidence			
Male	1.48	1.33 – 1.64	***<0.0001***
Alcohol abuse	1.16	0.90 – 1.47	*0.213*
BMI < 19kg/m^2	0.97	0.69 – 1.33	*0.894*
BMI 19 – 24kg/m^2	1.40	1.09 – 1.77	*0.005*
BMI 25 – 29kg/m^2	1.45	1.16 – 1.80	*0.0006*
BMI 30 – 39kg/m^2	1.81	1.54 – 2.12	***<0.0001***
BMI 40 – 70kg/m^2	2.37	1.81 – 3.05	***<0.0001***
Cannabis abuse	9.13^{e-09}	1.34^{e-15} – 0.006	*0.913*
CHF	1.19	1.08 – 1.32	*0.0005*
Coagulopathies	1.26	1.13 – 1.41	***<0.0001***
Depression	1.62	1.47 – 1.79	***<0.0001***
Diabetes mellitus	1.01	0.91 – 1.12	*0.754*
Electrolyte/fluid imbalance	1.62	1.44 – 1.83	***<0.0001***
Hypertension	1.37	1.08 – 1.75	*0.009*
Hypothyroidism	1.06	0.96 – 1.17	*0.201*
Iron deficiency anemia	1.95	1.71 – 2.20	***<0.0001***
Opioid use disorder	0.75	0.04 – 1.27	*0.336*
Peptic ulcer disease	1.06	0.92 – 1.22	*0.386*
Peripheral vascular disease	0.91	0.83 – 1.01	*0.095*
Renal failure	1.05	0.90 – 1.23	*0.494*
Rheumatoid arthritis	1.33	1.18 – 1.49	***<0.0001***
Sleep apnea	1.13	0.98 – 1.29	*0.083*

BMI=body mass index; CHF=congestive heart failure

Monitor #2 – 5th Poster **–** presented

Corresponding Author	Michael Mont
E-Mail Address	mmont@northwell.edu
Institution	Lenox Hill Hospital
Department	
Address	130 E 77th St
City, State	New York, NY
Zip / Postal Code	10075
All Authors	Rushabh Vakharia; Nipun Sodhi; Hiba Anis; Nequesha Mohamed; Iciar Dávila Castrodad; Ronald Delanois; Michael Mont; Martin Roche

Title	Increased Infection Risk after Revision Total Hip Arthroplasty with Pre-Operative Opioid Use Disorder
Background / Rationale	Opioid consumption has been increasing at an alarming rate in recent years. Opioids have been shown to impair immune parameters in patients, however, there is a paucity of literature on the effect opioid use disorder (OUD) on infection rates after revision total hip arthroplasty (THA).
Study Question	The purpose of this study was to compare the incidences of 1) surgical site infection (SSI) and 2) prosthetic joint infection (PJI) between revision THA patients with OUD and matched control patients without OUD.
Methods	An administrative claims database was queried for all revision THAs between 2005 and 2014 using International Classification of Disease (ICD-9) coding. The inclusion criteria for the study group consisted of patients with a 90-day history of OUD prior to revision THA. Study group patients were matched 1:1 to control patients according to age, sex, and Elixhauser Comorbidity Index (ECI) scores. The query yielded 8,116 patients. Primary outcomes analyzed were 90-day SSI incidence and 2-year PJI incidence. Binomial logistic regression analysis was performed to calculate odds-ratios (OR), 95% confidence intervals (95% CI), and p-values. A p-value less than 0.05 was considered statistically significant.
Results	Patients with OUD had higher rates of 90-day SSIs compared to control patients matcbed by age, sex, and comorbidities (6.67 vs. 3.64%). OUD patients were almost twice as likely to develop an SSI compared to matched control patients (OR 1.89, 95% CI 1.53 to 2.32, p<0.001). Similarly, there was a higher 2-year PJI rate among OUD patients compared to controls (23.43 vs 6.72%). Patients with OUD were 4 times more likely develop a PJI compared to matched controls (OR 4.24, 95% CI 3.67 to 4.89, p<0.001).
Discussion	OUD was found to be significantly associated with an increased risk for SSI and PJI following revision THA after accounting for age, sex, and comorbidity burden. These findings should help guide providers in pre-operative patient optimization and counseling as well as post-operative surveillance in order to reduce the risk of infection.
Conclusion	A history of opioid use disorder increases the likelihood of developing SSIs and PJIs after revision total hip arthroplasty.

Monitor #2 – 6th Poster

Corresponding Author	Talha Riaz
E-Mail Address	talhariaz240@gmail.com
Institution	Mayo Clinic
Department	Infectious Diseases
Address	200 First Street SW
City, State	Rochester, MN
Zip / Postal Code	55905
All Authors	Talha Riaz; Ramez Dagher; Aaron Tande; Douglas Osmon; Anil Jagtiani; James Steckelberg; Tad Mabry; Elie Berbari;

Title Prosthetic Joint Infection due to Actinomyces Species: Mayo Clinic Experience and Review of Literature

Background / Rationale The epidemiology, risk factors, diagnosis and management of patients with Actinomyces prosthetic joint infection (APJI) are not well described. There is scant information to guide the optimal antimicrobial and surgical management of APJI.

Study Question The purpose of this study was to characterize the demographics, management and outcome of patients with prosthetic joint infections caused by Actinomyces spp.

Methods Using a retrospective cohort study design, the medical records of all patients with Actinomyces spp. total hip or knee arthroplasty infection (APJI) seen at the Mayo Clinic Rochester between January 1, 1969 and December 31, 2016 were reviewed.

Results Eleven cases were identified over a 10 year study period. Seven patients (64%) were female. The mean age at the time of diagnosis of infection was 71 years (range, 57-89). The knee was involved in six cases (55%) followed by the hip in 5 (45 %) cases. Three out of 11 cases had dentures, broken teeth, or poor dentition. Actinomyces odontlyticus was the most commonly found subspecies. ESR and CRP values were elevated in most cases. Ten of eleven patients (91%) were managed with 2 stage exchange. All patients received a course of beta-lactam therapy for 3-6 months. Ten of 11 cases (91%) were free of failure after a mean of follow-up of 2.71 years (range: 8 months – 5 years).

Discussion To our knowledge, this is the largest published case series of APJI. Our case series shows an even distribution of infection among the hips and knees. The higher proportion of women in patients with APJI may be related to colonization of Actinomyces spp. in the female genital tract. Most patients were treated with a 2 stage revision approach and were free of failure at the time of last follow up.

Conclusion Based on our study, Actinomyces PJI presents as a late peri-prosthetic infection. It is associated with a history of revision procedures. Treatment includes resection arthroplasty and beta- lactam therapy for 3-6 months.

Demographic Information	Number of patients (%)
Hypertension	6 (55%)
Obesity	4(45%)
Tobacco use	4(36%)
Dentures, broken teeth, or poor dentition	3(27%)
Diabetes	3(27%)
History of hysterectomy	3(27%)
History of prior appendix/hernia surgery	2(18%)
Tooth manipulation	1(9%)
History of gout	1(9%)
History of prior colon surgery	1(9%)

Table 1: Comorbidities in 11 cases of Actinomyces PJI seen at the Mayo Clinic 1969-2016

Signs and symptoms	Number of patients (%)
Local pain around prosthesis	10 (91%)
Tenderness	7(63%)
Purulent discharge	7(63%)
Swelling	5(45%)
limitation of range of motion	4(36%)
Walking difficulty/antalgic gait	3(27%)
Pain with passive motion	3(27%)
Paresthesia/numbness	3(27%)
Elevated temperature	3(27%)
Erythema	2(18%)
Warmth	2(18%)
Soft tissue thickening	2(18%)
Sinus tract	2(18%)
Limping	1(9%)
Joint instability	1(9%)

Table 2: Presenting Signs and symptoms in 11 cases of Actinomyces PJI seen at the Mayo Clinic 1969-2016

Monitor #2 – 7th Poster

Corresponding Author	Gerhard E Maale
E-Mail Address	gerhardmaale53@gmail.com
Institution	DFW Sarcoma Group/Medical City Plano
Department	Orthopedic Oncology
Address	4708 Alliancew Blvd suite 710
City, State	Plano, Texas
Zip / Postal Code	75093
All Authors	Gerhard E Maale; William K Montgomery; Daniel K Mohammadi; Flavio A Calderon

Title Nickel Allergies Associated with Multi-Directional Instability Following Primary TKR Mimicking Infection

Background / Rationale Nickel allergies associated with multidirectional instability (M.D.I) of the knee, hasn't been reported. Usually these allergies, are seen in patients suffering from arthrofibrosis after primary knee replacement (TKR). M.D.I patients have warm knee effusions, audible clunking, varus and valgus instability without end points, and pain on any range of motion about the knee. X-rays show a well-fixed primary total knee. Infection is in the differential diagnosis.

Study Question How does M.D.I present? What do pre-op staging look like?: How common is it after primary TKR. How frequent is it encountered with metal allergies, What are the demographics of the patients?

Methods 94 patients presented with clinical symptoms related to M.D.I. All of the patients had tri-phase bone scans, CT scans, plain X-rays and labs with sed rates and CRP. 16 of the patients had WBC scan scans. Metal allergy testing was with the lymphocyte activation assay. Depending on results patients were replacement with titanium prosthesis, zirconium or niobium coated ones that were fully constrained.

Results Of the 94 patients experiencing M.D.I, 60 patients had metal allergies (64%). 83% to nickel, 8.3% to aluminum, 3.3% to vanadium and cobalt, and 1.7% to zirconium. The p value for significance with nickel is <0.001. The nickel allergy was seen in only 1.5 % of 792 TKR's. 76.7% were females. The gender specificity had a p Value <0.001.All the patients with M.D.I had chronic inflammation and fibrosis as well histologically. WBC scan was performed on 16 patients and 10 were positive with 1 proven infection. CRP and send rate were elevated in 2 patients. All patients had had hypervascular synovium on bone scan. Skin changes occurred in only 7 patients. All patients got some pain relief after placement of constrained knee.

Discussion Metal allergies after primary TKR are usually associated with arthrofibrosis not M.D.I. The presenting symptoms are not unlike infection with warm, swollen joints that majority on hot on WBC scans, but the clinical syndrome of instability, pain that get worse with time and audible clunking pain on getting up from sitting position.

Conclusion M.D.I after TKR should have metal allergy testing. This is more common in females. Revision requires constrained knee with coatings of niobium or zirconium in allergy patients.

Monitor #2 – 8th Poster

Corresponding Author	Antonia F. Chen
E-Mail Address	afchen@bwh.harvard.edu
Institution	Brigham and Women's Hospital, Harvard Medical School
Department	Orthopaedic Surgery
Address	75 Francis Street
City, State	Boston, MA
Zip / Postal Code	02115
All Authors	Caleb M. Yeung; Nathan H. Varady; Shane C. Eizember; Yang Song; Hongyi Shao; Daniel M. Estok; Antonia F. Chen

Title

A Comparison of Periprosthetic Joint Infection Patient Demographics, Microbial Organisms and Antibiotic Sensitivity Between the United States and China

Background / Rationale

Periprosthetic joint infection (PJI) after total joint arthroplasty (TJA) occurs throughout the world, but the identities and sensitivities of PJI organisms and patient demographics between US and Chinese populations have not been well-studied.

Study Question

To compare patient demographics and the identity and sensitivities of organisms in Chinese vs. US PJI patients.

Methods

A retrospective study was conducted comparing PJI patients from 2016-2018 between 2 academic institutions in China and the US. Early PJI was defined within 2 years of index operation. Mann-Whitney U and chi-squared tests were used for comparisons between continuous and categorical variables, respectively. Statistical significance was p<0.05.

Results

There were 57 Chinese and 46 US PJI patients. Chinese patients were younger (64 v. 70, p<0.0001) with lower BMI (26.7kg/m2 vs 32.3) (p<0.001). Synovial WBC was 8,574 cells/μL (IQR 1,800-21,109) in Chinese PJI vs 46,380 (IQR 23,736-90,000) in US PJI (p=0.004), with PMN% of 60% (IQR 25%-88%) in Chinese PJI vs 90% (IQR 84%-96%) in US PJI (p=0.003). Serum WBC was 6.4 (IQR 4.8-7.6) in Chinese PJI vs 8.5 (IQR 6.7-11.5) in US PJI (p<0.001). Presenting ESR and CRP were 39mm/hr (IQR 20-57) and 9.08mg/L (IQR 7.13-22.8) in Chinese PJI, respectively, vs 63 (IQR 24.5-90.5) and 63.1 (IQR 15.1-106.0) in US PJI (ESR p=0.017, CRP p<0.001). In Chinese PJI, organisms were coagulase-negative Staphylococcus (CoNS, 42%), MRSA (7%), Streptococcus (7%), gram-negative bacteria (7%), other (14%), MSSA (1%), P.aeruginosa (1%), and culture-negative (19%). In US PJI, the most frequent organisms were CoNS (20%), MRSA (13%), Streptococcus (13%), MSSA (9%), other (8%), P.aeruginosa (4%), gram-negative bacteria (2%), and culture-negative (30%). Chinese PJI had a higher proportion of CoNS (p=0.001) relative to MRSA and MSSA. Antibiotic resistance was similar between cohorts, as was early vs. late PJI infections (43% early PJI for both).

Discussion

PJI patients in China were younger with lower BMI. Local and systemic markers of infection were lower in Chinese PJI. There was a greater proportion of CoNS within all Staphylococcal infections in Chinese PJI, suggesting that initial coverage of PJI infections should be potentially biased towards coverage of CoNS.

Conclusion

Demographics, infection laboratory values, and organisms differ between US and China PJI patients.

Monitor #2 – 9th Poster

Corresponding Author	Matthew V. Dipane
E-Mail Address	MDipane@mednet.ucla.edu
Institution	UCLA
Department	Department of Orthopaedic Surgery
Address	1250 16th St.
City, State	Santa Monica
Zip / Postal Code	90404
All Authors	Edward J. McPherson; Stephen T. Duncan; Matthew V Dipane

Title	Clinical Effectiveness of a Biofilm Disrupting Surgical Lavage in Reducing Bacterial Contamination in Total Knee Arthroplasty Revision Surgery in Known Cases of Prosthetic Joint Infection

Background / Rationale	A novel wound irrigation solution was designed to potentially disrupt biofilm and remove both adherent and planktonic bacteria from intra-articular PJI wounds. In this study, the solution was evaluated for its ability to reduce bacterial bioburden in infected arthroplasty patients.
Study Question	Is the solution effective in its ability to reduce bacterial bioburden in infected TKA?
Methods	40 subjects undergoing either irrigation & debridement (40%) or 1st stage of a 2-stage revision (60%) for infected total knee arthroplasty were washed with the solution, and the joints were evaluated pre/post wash for total white blood cell count, culturable bacteria, and bacterial species. Subjects were followed for 90 days postoperative to monitor for complications and infection status.
Results	White blood cell count was obtained for all 40 subjects, plate counts were obtained for 37 subjects, and PCR data were obtained for 38 subjects. 35 subjects completed the study per protocol. The data demonstrated statistically significant reductions in debris and bacterial count within the surgical site after use of the surgical lavage. There was a 2.3 log reduction in white blood cells in all patients (p<0.01) and a 3.8 log reduction in bioburden in patients with countable bacteria (p<0.01) prior to washing. The following bacterial genera were found in over 15% of patients: Staphylococcus (53%), Escherichia (42%), Cutibacterium (37%), Corynebacterium (21%), Acinetobacter (18%), Pseudomonas (16%) and Streptococcus. For patients who completed the study (31/40), the 90-day infection rate was 12.9%. No complications related to the irrigation solution were observed.
Discussion	Collectively, these data show a reduction in total debris and bacterial bioburden in the PJI wound site against a broad spectrum of bacterial species and complex polymicrobial colonies. It supports effective resolution of periprosthetic joint infection.
Conclusion	The solution demonstrated an effective ability to reduce bacterial bioburden and warrants further study.

Monitor #3 - 1st Poster **-** presented

Corresponding Author	Robin Patel
E-Mail Address	Patel.Robin@mayo.edu
Institution	Mayo Clinic
Department	
Address	200 1st St. SW GU502
City, State	Rochester, MN
Zip / Postal Code	55905
All Authors	Kerryl E Greenwood-Quaintance; Morgan Ivy; Aaron J Tande; Douglas R Osmon; Elie F Berbari; Christopher P Beauchamp; Arlen D Hanssen; Matthew P Abdel; Darci R Block; Robin Patel

Title Synovial Fluid Alpha-Defensin Lateral Flow (ADLF) has Comparative Sensitivity and Specificity to Leukocyte Count and Neutrophil Percentage (LCNP) to Detect Prosthetic Joint Infection (PJI)

Background / Rationale Accurate PJI diagnosis is crucial to guide patient surgical and antimicrobial management. Ideally, biomarkers to detect PJI are assayed prior to surgery using blood and/or synovial fluid. LCNP is performed in a laboratory, resulting in findings not being immediately available and requires interpretation of the values obtained. A synovial fluid biomarker test which can be performed in 10 minutes and reported as "positive" or "negative" offers a possible solution.

Study Question We evaluated whether synovial fluid Synovasure® ADLF Test Kit (CD Diagnostics, now part of Zimmer Biomet, Warsaw, IN) is comparable to LCNP to detect PJI.

Methods We analyzed Mayo Clinic patients undergoing joint aspiration as part of routine work-up for pain after total hip arthroplasty (THA) or total knee arthroplasty (TKA). So as not to bias the analysis, PJI was diagnosed using a modified (with the omission of LCNP) 2013 MSIS definition (the 2018 definition was not used as alpha-defensin is part of the definition). Patients not meeting this definition were defined as aseptic failure. ADLF was performed by trained personnel according to manufacturer guidelines; LCNP was performed as per usual clinical practice. The combined cut-offs of ?3,000 leukocytes plus ?80% neutrophils for hip fluid or ?1,700 leukocytes plus ?65% neutrophils for knee fluid were used.

Results 127 patients were analyzed (23 hip, 104 knee); 41 had PJI (5 hip, 36 knee) and 86 aseptic failure (18 hip, 68 knee). The sensitivity and specificity of ADLF versus LCNP to detect PJI was 90.2% and 94.2%, versus 87.8% and 94.2%, respectively. Eight patients had early-onset PJI (<90 days after THA or TKA); a subgroup analysis excluding those patients showed a sensitivity and specificity of ADLF versus LCNP to detect non-early-onset PJI of 91.2% and 95.3%, versus 88.2% and 95.3%, respectively. Twenty-nine samples were frozen prior to ADLF testing; a subgroup analysis excluding those samples showed sensitivity and specificity of ADLF to detect PJI of 93.3% and 94.2%, respectively.

Discussion The sensitivities and specificities of the two tests were not statistically different (p=0.32 and 1.00, respectively).

Conclusion The 10 minute ADLF yielded comparative sensitivity and specificity to LCNP for PJI detection.

Monitor #3 – 2nd Poster **-** presented

Corresponding Author	Alberto V Carli
E-Mail Address	carlia@hss.edu
Institution	Hospital for Special Surgery
Department	Adult Reconstruction & Joint Replacement
Address	Hospital for Special Surgery 535 East 70th Street
City, State	New York City
Zip / Postal Code	10021
All Authors	Alberto V Carli; Christopher J Hernandez; Xu Yang; Theresa T Lu; Mathias PG Bostrom

Title Disruption of the Gut Microbiome Increases Risk of Periprosthetic Joint Infection in Mice

Background / Rationale Periprosthetic joint infection (PJI) is one of the most devastating complications of total joint arthroplasty. Identifying modifiable risk factors for PJI may lead to improved patient care.

Study Question (1) Does disruption of the gut microbiota prior to surgery influence the likelihood that PJI will become established? (2) What changes in systemic markers of infection and local and systemic immune cell profiles occur following disruption of the gut micro

Methods Male C57Bl/6 mice were divided into two groups, those in which the constituents of the microbiome were modified using oral antibiotics (n = 40) and untreated mice (n = 42). Mice received a titanium tibial implant to mimic joint replacement and a local inoculation of S. aureus in synovial space (10^2 CFUs). The resulting infection was assessed through CFU counts at the implant surface and surrounding joint tissues, radiographs, analysis of gait, serum markers of inflammation and immune cell profiles. At five days after surgery/inoculation, animals developed either an established infection at the implant (more than 10^3 CFUs on the implant surface) or were uninfected/resisting infection (0 – 10 CFUs on the implant surface).

Results A greater proportion of animals with disrupted gut microbiota developed established infection (72.5%, 29/40) than untreated animals (50%, 21/42, p = 0.03). Established infection led to impaired joint health as measured by semi-quantitative scoring of radiographs and gait. Increases in serum amyloid A associated with established infection were greater in animals with altered gut microbiota. Untreated animals with established infection showed increases in neutrophil and monocyte numbers in the spleen and local lymph node, but such increases in immune cell populations were not associated with infection in mice with disrupted gut flora.

Discussion This study demonstrates in mice that the state of the microbiome prior to joint replacement can influence the establishment of a periprosthetic infection. Further investigations are required to determine the mechanism responsible for increased risk of infection.

Conclusion An impaired microbiome increases the likelihood PJI is established in a translational mouse mode. An impaired local and systemic immune response is implicated.

Monitor #3 – 3rd Poster **-** presented

Corresponding Author	Milan Kapadia
E-Mail Address	kapadiam@hss.edu
Institution	Hospital for Special Surgery
Department	
Address	535 E 70th Street
City, State	New York, New York
Zip / Postal Code	10021
All Authors	Michael Henry; Alberto Carli; Milan Kapadia; Yu-fen Chiu; Barry Brause; Andy O Miller

Title Treatment and Outcome of Methicillin-Resistant Staphylococcus aureus Hip and Knee Prosthetic Joint Infection

Background / Rationale Methicillin-resistant Staphylococcus aureus (MRSA) total hip and knee prosthetic joint infections (PJI) can be highly morbid and difficult to treat. Other clinical factors notwithstanding, explantation is usually recommended, although comparative treatment data are lacking. We sought to compare the success of implant retention to two-stage exchange in MRSA-infected PJI to better understand treatment options in this difficult cohort.

Study Question What are the characteristics and outcomes of MRSA PJI in the modern era?

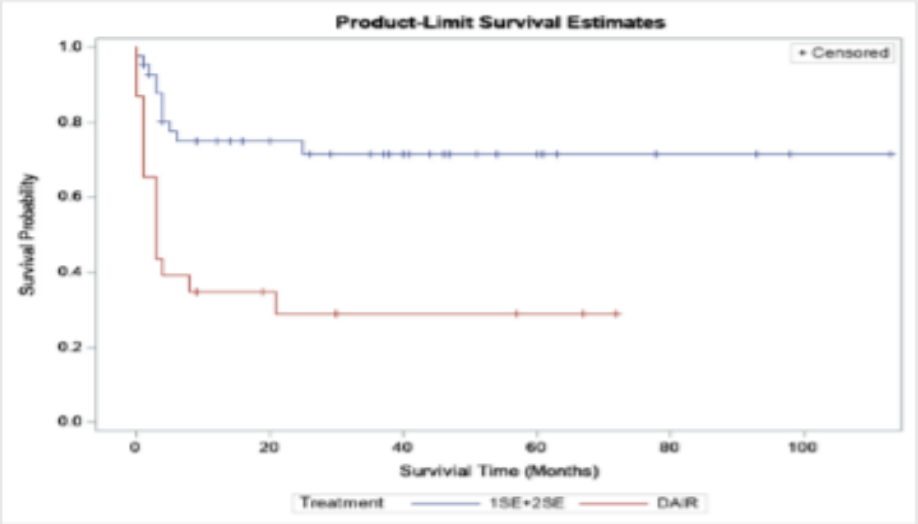
Methods A retrospective cohort of hip and knee PJIs from 2008 to 2016 were identified by ICD code and surgical treatment. All cases met MSIS criteria for PJI, and had culture-confirmed MRSA from synovial or intra-articular tissue culture. PJIs were either treated with exchange arthroplasty or debridement with antibiotic and implant retention (DAIR). Success was defined as no further surgical treatment for infection at two years. Kaplan-Meier estimates were used to calculate 2-year survival rate free from treatment failure. Univariate logistic regression was performed to identify risk factors associated with treatment failure.

Results 65 MRSA PJIs were identified with 42 undergoing explantation and 23 undergoing DAIR. Demographics, Charlson comorbidities, infection type(early post-operative, hematogenous or late chronic), and history of prior PJI were not significantly different between treatment groups. Survivorship at two years was 75% (95% confidence interval [CI] 61-88%) for exchange compared to 29% (95% CI 10-48%) for DAIR, p=.0002. Within the exchange group, knee PJIs were more likely to fail than hip PJI (odds ratio [OR] 7.1, CI 1.3-38, p=.02), and patients with diabetes were more likely to fail (OR 17, CI 1.6-178, p=.02).

Discussion MRSA PJIs treated with DAIR have worse outcomes than those treated with prosthesis exchange.

Conclusion Further investigation is needed to identify predictors of DAIR success, to optimize surgical treatment choice, and to improve outcomes of these difficult infections.

Figure 1 The Kaplan-Meier curve representing implant survivorship after methicillin-resistant *Staphylococcus aureus* prosthetic joint infection treatment was 75% (95% confidence interval [CI] 61-88%) for exchange (1SE and 2SE) compared to 29% (CI 10-48%) for debridement with antibiotic and implant retention (DAIR), p=.0002



Monitor #3 – 4th Poster **-** presented

Corresponding Author	Nicolas Piuzzi
E-Mail Address	piuzzin@ccf.org
Institution	Cleveland Clinic
Department	
Address	9500 Euclid Ave
City, State	Cleveland, OH
Zip / Postal Code	44195
All Authors	Hiba Anis; Jared Warren; Alison Klika; Siran Koroukian; Guangjin Zhou; Carlos Higuera; Wael Barsoum; Nicolas Piuzzi

Title Septic Total Hip Arthoplasty Patients Have a Higher Incidence of Mental Health Conditions

Background / Rationale Prosthetic joint infections (PJIs) after total hip arthroplasty (THA) are known to have a profound impact on patients' pain and function. However, there is little evidence on the effect PJIs have on the mental health of THA patients.

Study Question The purpose of this study was to compare the incidence of mental health conditions between patients undergoing 1) primary THA, 2) septic revision THA, and 3) aseptic revision THA.

Methods All THAs performed between 2007 and 2012 were queried using the Healthcare Cost and Utilization Project State Inpatient Databases. This yielded 117,412 patients. Patients were separated into cohorts based on procedure: primary, septic revision, and aseptic revision. Diagnoses of any mental health condition as well as the following specific conditions were compared among the three cohorts: schizophrenia/delusion, bipolar disorder, depression/mood disorder, personality disorder, anxiety/somatic/dissociative disorder, eating disorders, ADHD/conduct/impulse control, alcohol abuse, and drug abuse. Univariate analysis was performed to assess differences and trends in mental health conditions among the three cohorts.

Results There was a significantly higher incidence of mental health conditions overall among patients in the septic revision cohort (n=1,115, 28.1%) compared to the primary (n=49,587, 15.2%, p<0.001) and aseptic revision (n=4,688, 21.0%, p<0.001) cohorts. Specifically, septic revision THA patients had a significantly higher (p<0.001) incidence of schizophrenia, bipolar disorder, depression, anxiety, eating disorders, alcohol abuse, and drug abuse compared to primary THA patients. Additionally, there was a significantly higher (p<0.001) incidence of schizophrenia, bipolar disorder, depression, anxiety, eating disorders, alcohol abuse, and drug abuse among septic revision patients compared to aseptic revision patients.

Discussion Overall, rates of mental health conditions were higher among septic revision patients. Alcohol and drug abuse were approximately twice as prevalent among patients undergoing revision THA for infection compared to primary or aseptic revision patients. Future studies should investigate the incidence of self-harm and suicide in arthroplasty patients and evaluate strategies for mental health support in the perioperative period.

Conclusion Patients undergoing revision for infection after THAs had significantly higher rates of several mental health conditions.

Mental health condition (ICD-9 codes)	Primary THA (%) N=325,924	Septic revision THA (%) N=3,970	Aseptic revision THA (%) N=22,343	p-value primary vs. septic	p-value septic vs. aseptic	p-value primary vs. aseptic
Schizophrenia/Delusion (295.XX, 297.XX, 298.0, 298.4, 298.9)	2,559 (0.8)	63 (1.6)	186 (0.8)	***<0.001***	***<0.001***	***0.019***
Bipolar (296.0X-296.1X, 296.4X-296.9X)	2,287 (0.7)	74 (1.9)	253 (1.1)	***<0.001***	***<0.001***	***0.002***
Depression/Mood (296.2X-296.3X, 300.4, 309.XX (except 309.81), 311.XX, V79.0)	28,634 (8.8)	679 (17.1)	2,877 (12.9)	***<0.001***	***<0.001***	***<0.001***
Personality (301.XX)	95 (0.0)	*	*	*0.702*	*1.000*	*0.676*
Anxiety/Somatic/Dissociative (300.0X, 300.11-300.15, 300.21-300.23, 300.3-300.7, 300.8X, 300.9, 309.81)	22,323 (6.8)	445 (11.2)	2,172 (9.7)	***<0.001***	***0.004***	***<0.001***
Eating disorders (307.1, 307.5X)	27 (0.0)	*	*	***<0.001***	***0.010***	*0.684*
ADHD/Conduct/Impulse control (312.XX, 314.XX)	400 (0.1)	*	*	*0.055*	*0.601*	***0.022***
Alcohol abuse (265.2, 291.1-291.3, 291.5-291.9, 303.XX, 305.0X, 357.5, 425.5, 535.3X, 571.0-571.3, 980.X, V11.3)	4,935 (1.5)	129 (3.2)	409 (1.8)	***<0.001***	***<0.001***	*0.365*
Drug abuse (292.XX, 304.XX, 305.2X-305.9X, V65.42)	2,867 (0.9)	113 (2.8)	289 (1.3)	***<0.001***	***<0.001***	***0.015***
All mental health conditions combined	49,587 (15.2)	1,115 (28.1)	4,688 (21.0)	***<0.001***	***<0.001***	***<0.001***

ICD-9=International Classification of Disease, ninth revision; THA=total hip arthroplasty; ADHD=attention defecit hyperactivity disorder

* n<11, m

Monitor #3 – 5th Poster

Corresponding Author	Elie S Ghanem
E-Mail Address	eghanem@uabmc.edu
Institution	University of Alabama at Birmingham
Department	Orthopaedic Surgery
Address	Suite 207 1313 13th St S
City, State	Birmingham, AL
Zip / Postal Code	35205
All Authors	Kyle Cichos, Khalid Mahmoud, Clay Spitler, Ahmed M Kamel Abdel Aal, Gerald Mcgwin, Elie Ghanem

Title

Risk Factors for Surgical Site Infection after Operative Fixation of Acetabular Fractures: Is Psoas Density a Useful Metric?

Background / Rationale

Studies indicate pelvic artery embolization and increased ICU stay are risk factors for infection after ORIF of acetabular fractures. The psoas muscle density is indicative of sarcopenia and associated with increased mortality in elderly patients sustaining acetabular fractures.

Study Question

The purpose of this study is to identify risk factors for surgical site infection (SSI) in patients undergoing ORIF of acetabular fractures.

Methods

We reviewed 628 patients undergoing ORIF of acetabular fractures at our level I trauma center treated from 2012-2017. The mean follow-up was 15 months. Patient demographics, comorbidities, operative and in-hospital variables were analyzed. SSI was defined by positive cultures during irrigation and debridement (I&D) procedure. Bivariate analysis was conducted using Fishers exact and Chi-squared tests for categorical variables and Student t test for continuous variables.

Results

Overall, 42 of 628 patients (6.7%) were diagnosed with SSI. There was no difference in the mean psoas muscle density between patients who developed SSI and those who were infection free (50.9 Hounsfield units [HU] vs 51.4 HU, p=0.691). The associated risk factors identified were female gender (p=0.037), higher BMI (p=0.0195), diabetes mellitus (p=0.041), intravenous drug use (p=0.004), longer operative time (p<0.0001), higher blood loss (p=0.0004), and higher rate of intraoperative blood transfusion (p=0.043). There was no difference in the rate (p=0.340) or length (p=0.460) of ICU stay, pelvic embolization (p=0.156), associated abdominal injury (p=0.161) and genitourinary/pelvic injury (p=0.164), tobacco use (p=0.263), age (p=0.866), injury severity score (p=0.137), ASA score (p=0.066), use of intrawound antibiotics prior to closure (p=0.802), or surgical approach (p=0.896).

Discussion

Patient related risk factors for SSI after ORIF of acetabular fractures include female gender, increased BMI, diabetes mellitus, and intravenous drug use. Prolonged operative times, increased intraoperative blood loss, and intraoperative blood transfusion are important risk factors reflective of case complexity.

Conclusion

Although psoas muscle density is a surrogate for sarcopenia, it was unable to predict SSI in our patient population. Contrary to previous studies, pelvic embolization, abdominal injuries, genitourinary injuries, and ICU stay are not significant risk factors.

Monitor #3 – 6th Poster

Corresponding Author	Kelly G Vince
E-Mail Address	kellyvince@mac.com
Institution	Whangarei Hospital-Northland District Health Board
Department	Orthopedic Surgery
Address	Private Bag 9742 Whangarei
City, State	Whangarei, Northland, New Zealand
Zip / Postal Code	0148
All Authors	Kelly G Vince; Jessica Mowbray; Che Siu Lim

Title Revision TKA for PJI with Tantalum Cone Augments in All Cases

Background / Rationale Sepsis and loosening are the 2 most common failure modes after revision for infection. Debridement eradicates infection but impairs fixation. Porous augments substitute bone but may increase infection.

Study Question Do porous metal augments reduce:
i. infection by permitting more aggressive debridement
ii. loosening by improving fixation?

Methods All patients presenting with PJI of a primary or revision TKA between 2010 and 2018 were followed prospectively with clinical examination and radiographs. Data were collected regarding Cierny-Mader Classification
Post-operative radiographs included full length views of mechanical alignment. AP and lateral radiographs were evaluated with a new method to quantify tibial bone defects.
Surgical technique included a trabecular metal tibial augment (to reconstruct bone loss and enhance fixation), non-linked constrained articulation and press fit diaphyseal stem extensions in every case.

Results 31 patients with presumed TKA PJI by MSIS criteria. 3 patients were excluded after multiple negative intra-operative cultures. One patient was not reimplanted. 27 patients were reimplanted, ages 55.9-84.8 yrs (70.2). Patients were followed from 0.6 to 7.2 years (mean 3.7 years) None were lost.One patient died within 3 months of reimplantation, clear of PJI. Six patients ultimately died of non-septic causes at 0.9-7.5 years (mean 4.5) years after reimplantation and are included in the analysis. One failed due to persistent infection and renal failure requiring an amputation 8 months post revision. The other twenty-six patients retained functional arthroplasties without loosening; several required additional non-revision surgeries after reimplantation.
Radiographic quantification of tibial bone loss, demonstrated that porous metal cones were feasible in cases of severe bone deficiency.

Discussion These are not selected cases of porous metal augments; it is a consecutive series of revisions where they were used in every case. It is the largest series of infected TKA's treated with these implants.
One failure (3.7%) due to persistent infection, indicates that the extensive surface area of porous augments did not increase risk of sepsis.
No cases failed from loosening.

Conclusion Porous metal augments do not increase septic failure after revision for TKA PJI. More aggressive debridement is possible because severe bone defects can be reconstituted and fixation ensured with these devices.

Monitor #3 – 7th Poster

Corresponding Author	Andy O. Miller
E-Mail Address	milleran@hss.edu
Institution	Hospital for Special Surgery
Department	Infectious Disease
Address	Hospital for Special Surgery 535 E 70th St New York NY 10065
City, State	New York
Zip / Postal Code	10065
All Authors	Kelly Guerin; Eric Greenberg; Andy O. Miller

Title Off-label Use of Oritavancin for the Treatment of Prosthetic Joint Infections and Osteomyelitis

Background / Rationale Treatment of prosthetic joint infections (PJI) and osteomyelitis requires lengthy courses of antibiotics, and is associated with the potential for clinical failure, complications of antibiotics, and excess costs and inconvenience. Oritavancin is a semisynthetic lipoglycopeptide approved for use in acute bacterial skin and skin structure infections (ABSSSI). Limited case reports have documented the successful use of oritavancin in these scenarios.

Study Question Is there preliminary evidence that oritavancin may be safe and effective for off-label use in osteoarticular infections?

Methods A retrospective chart review of a large orthopedic specialty hospital investigated our oritavancin experience in PJI and osteomyelitis. Clinical data, including patient demographics, pathogens, drug dosing, safety indicators and clinical outcomes were collected.

Results Between December 2017 and February 2019, 7 patients received oritavancin (4 for osteomyelitis and 3 for PJI). The majority of these had indications for parenteral antibitoics and contraindications for placement of an indwelling catheter; oritavancin was selected as alternative therapy. Contraindications to central line included psychiatric disease and intravenous drug use. The median age was 62 years (range 29-78), 57 % were male and the median body mass index was 27 kg/m2 (range 18-42). Methicillin-resistant Staphylococcus epidermidis, methicillin-resistant Staphylococcus aureus and Enterococcus faecalis were isolated in 5, 1, and 1 patients respectively. Each patient received an initial 1200 mg dose, followed by 1 to 3 additional weekly doses of oritavancin. Three PJI patients received additional concurrent oral rifampin. 5 out of the 7 patients were placed on suppressive oral antibiotics after completion of oritavancin. The median follow-up was 6 months (range 1 to 14 months);none of the patients had a recurrence of infection during the post-treatment observation period. No infusion reactions, reported side effects, nephrotoxicity, rash, or other organ toxicities were reported.

Discussion Off-label use of oritavancin for the treatment of orthopedic infections was safe and effective in a limited set of patients in our institution.

Conclusion While cost remains a limiting factor, oritavancin represents a promising option in patients with osteoarticular infections who cannot be treated with oral antibiotics or safely maintain an indwelling venous catheter.

Monitor #3 – 8th Poster

Corresponding Author	Antonia F Chen
E-Mail Address	afchen@bwh.harvard.edu
Institution	Brigham and Women's Hospital, Harvard Medical School
Department	Orthopaedic Surgery
Address	75 Francis Street
City, State	Boston, MA
Zip / Postal Code	02115
All Authors	Caleb M. Yeung; Vincentius J. Suhardi; Nathan H. Varady; Shane C. Eizember; Paul M. Lichstein; James H. Maguire; Antonia F. Chen; Daniel M. Estok

Title Trends Of Periprosthetic Joint Infection Organisms And Recurrence For A Single High-Volume Arthroplasty Surgeon Over 20 Years

Background / Rationale The diagnosis and treatment of periprosthetic joint infection (PJI) following total joint arthroplasty (TJA) has changed over time.

Study Question To describe PJI organisms and sensitivities across over 20 years from a single high-volume revision TJA surgeon and the effect of a dedicated musculoskeletal infectious disease (MSK ID) consultant in PJI treatment.

Methods A retrospective study was conducted evaluating revision TJA patients treated for PJI between 1995-2018 by a single high-volume TJA surgeon. Dedicated MSK ID consultation became available in 2010; infection recurrence was analyzed as pre-MSK ID (1995-2009) and post-MSK ID (2010-2018).

Results There were 333 PJI patients, with a median age of 67 years (IQR 57-75). 28% were diabetic, 21% were on immunosuppressive drugs, 64 patients were overweight (body mass index [BMI]=25.0-29.9kg/m2), and 139 patients were obese/morbidly obese (BMI≥30.0kg/m2). Median presenting erythrocyte sedimentation rate and C-reactive protein were 70mm/hr (IQR 36-96) and 61.6mg/L (IQR 17.6-139.0),. Median presenting synovial fluid white blood cell (WBC) count was 31,880 cells/μL (IQR 6,000-72,500) with a median polymorphonucleocyte% of 90% (IQR 82%-95%). Most common organisms were coagulase-negative Staphylococcus spp.(22%), methicillin-sensitive S.aureus (20%), methicillin-resistant S.aureus (19%), Streptococcus spp. (16%), other (12%), gram-negative bacteria (9%), and P.aeruginosa (2%); 21% were culture-negative. Resistance was 70% penicillin, 49% methicillin, 32% fluoroquinolone and 3% vancomycin; these did not change significantly in pre- and post-MSK ID periods. Overall recurrence of infection after treatment was 28% (25% in the non-MSK ID group vs. 31% in the MSK ID group (p=0.19)). Diabetes/immunosuppression/BMI≥25kg/m2 were not significantly associated with recurrence.

Discussion Our study showed no significant differences in microbial or antibiotic resistance patterns for PJI over 20 years. MSK ID involvement did not reduce infection recurrence after treatment.

Conclusion The minimal differences in microbial and antibiotic resistance patterns over 20 years noted in our cohort suggest that current standards of treatment of PJI are still encouragingly valid. Institution of an MSK ID specialist did not reduce rates of infection.

Monitor #4 - 1st Poster **-** presented

Corresponding Author	Simon Garceau
E-Mail Address	simon.garceau1@gmail.com
Institution	Mount Sinai Hospital
Department	The Granovsky Gluskin Division of Orthopedics
Address	600 University Street
City, State	Toronto, Ontario
Zip / Postal Code	M5G 1X5
All Authors	Simon Garceau; Yaniv Warschawski; Ethan Sanders; Allan Gross; Oleg Safir; Paul Kuzyk

Title Hip Antibiotic-Spacer Dislocation Affects Final Implant Position and Outcomes

Background / Rationale Dislocation of dynamic antibiotic hip spacers during the treatment of periprosthetic joint infection is a well-described complication. Unfortunately, the repercussions of such events after re-implantation of the definitive prosthesis remain largely unknown. As such, we devised a study comparing the perioperative and post-operative outcomes of patients having undergone re-implantation with and without spacer dislocation.

Study Question Does spacer dislocation affect final implant radiographic and clinical outcomes?

Methods A search of our institutional database was performed. Two retrospective cohorts were created: dislocated and non-dislocated hip spacers. The radiographic and clinical outcomes for each cohort were collected and compared between cohorts.

Results The two retrospective cohorts contained 24 patients for the dislocated group and 66 for the non-dislocated group. Continuous variables noted to be significantly different between the dislocated and non-dislocated groups were as follows: clinical leg length discrepancy (1.35 cm vs. 0.41 cm, p = 0.027), acetabular center of rotation (1.34 cm vs. 0.60 cm, p = 0.011), total packed red blood cell transfusions (4.05 vs. 2.37, p = 0.019), operative time (177.4 min vs. 147.3 min, p = 0.002), and hospital length of stay (7.79 days vs. 5.89 days, p = 0.018). Categorical variables noted to be significantly different were requirement for complex acetabular reconstruction (58.3% vs. 13.7%, p<0.001), requirement of constrained liners (62.5% vs. 37.3%, p = 0.040), and dislocation after second stage (20.8% vs. 6.1%, p = 0.039).

Discussion Dislocation of dynamic hip spacers leads to inferior clinical results and perioperative outcomes after re-implantation of the definitive prosthesis. Additionally, complex acetabular reconstruction is often required. As such, every effort should be made to prevent hip spacer dislocation.

Conclusion Dislocation of dynamic hip antibiotic spacers leads to both inferior radiographic and clinical outcomes after re-implantation of the definitive prosthesis.

Table 2			
Continuous Variables	**Mean Non-Dislocated**	**Mean Dislocated**	**p-Value**
Clinical LLD (cm)	0.41	1.35	0.027
Acetabular COR Difference (cm)	0.60	1.34	0.011
Intraoperative Blood Loss (mL)	1018.0	1209.4	0.412
Total PRBC Transfusions (U)	2.37	4.05	0.019
OR Time (mins)	147.3	177.4	0.002
LOS (Days)	5.89	7.79	0.018
Categorical Variables	**Proportion Non-Dislocated**	**Proportion Dislocated**	
Complex Acetabular Reconstruction	7/66 (10.6%)	14/24 (58.3%)	<0.001
Constrained Liner	19/66 (28.8%)	15/24 (62.5%)	0.004
Dislocation after Second Stage	4/66 (6.1%)	5/24 (20.8%)	0.039
Sciatic Nerve Palsy	1/66 (1.5%)	1/24 (4.2%)	0.450

Monitor #4 – 2nd Poster **-** presented

Corresponding Author	Carlos A Higuera
E-Mail Address	higuerc@ccf.org
Institution	Cleveland Clinic Florida
Department	Orthopedic Surgery
Address	Cleveland Clinic Florida, Department of Orthopedic Surgery, 2950 Cleveland Clinic Boulevard
City, State	Weston, Fl
Zip / Postal Code	33331
All Authors	Jared A Warren; Oliveer Scotting; Hiba K Anis; Alison Klika; Nicolas S Piuzzi; Carlos A Higuera

Title ESR and CRP Diagnostic Thresholds for Prosthetic Joint Infection in Revision Hip Hemiarthroplasties

Background / Rationale Diagnostic thresholds used to standardize the definition for PJI have largely focused on the primary total joint setting. The Musculoskeletal Infection Society (MSIS) diagnostic criteria for PJI include thresholds for erythrocyte sedimentation rate (ESR) and C reactive protein (CRP). However, no such criteria exist for PJI in revision hip hemiarthroplasty (HHA).

Study Question The purpose of this study was to establish thresholds for 1) ESR and 2) CRP to diagnose PJI revision in HHAs.

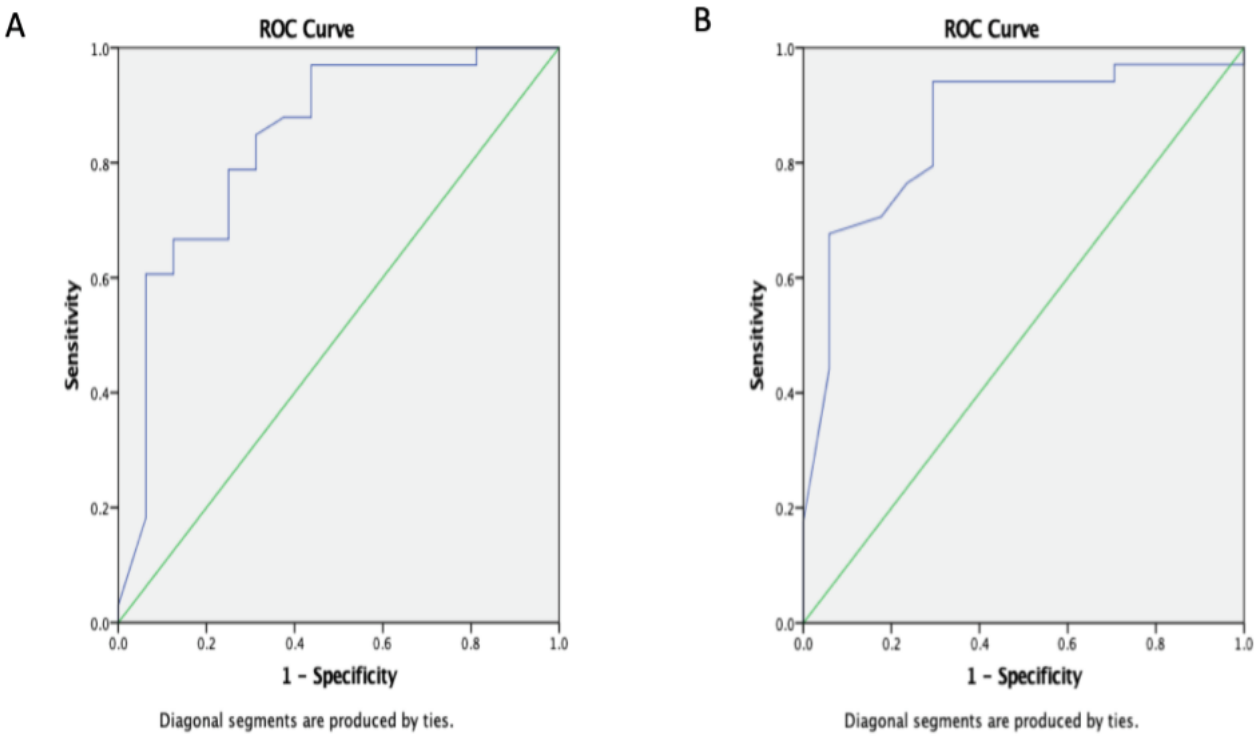
Methods Between 1/2017 and 12/2018 data were collected on a prospective cohort of patients undergoing orthopedic surgery in a single healthcare system, including 70 revision HHAs. These were categorized as septic or aseptic revisions according to MSIS criteria. Twenty-nine patients with normal ESR and CRP values and no aspiration results were considered aseptic. There were 49 ESRs (n=33 aseptic, n=16 septic) and 51 CRPs (n=34 aseptic, n=17 septic) available for analysis. Two tailed T-tests compared mean ESR and CRP in aseptic and septic cases. Receiver operator characteristic (ROC) curves were generated to obtain diagnostic cut off thresholds using the Youden's Index (J) for ESR and CRP and Areas under the curve (AUC) were reported to validate the results.

Results The mean (? standard deviation) ESR was significantly higher in septic cases (50.3 mm/hr ? 30.6) compared to aseptic cases (17.3 mm/hr ? 17.6, p<0.001). Septic cases had a significantly higher mean CRP (2.98 mg/L ? 2.48) compared to aseptic cases (0.876 mg/L ? 2.615, p=0.008). The diagnostic threshold for PJI was 14.50 mm/hr for ESR (sensitivity=60.6%; specificity=93.8%; J=0.538; AUC=0.837) and 1.25 mg/L for CRP (sensitivity=94.1%; specificity=70.6%; J=0.647; AUC=0.862).

Discussion This represents the first investigation of thresholds for ESR and CRP to diagnose PJI in revision HHA. An ESR of 14.50 mm/hr had a sensitivity of 60.6% and a specificity of 93.8% for PJI, while a CRP value of 1.25 mg/L was 94.1% sensitive and 70.6% specific for PJI. Further investigations with larger cohorts are warranted to confirm these diagnostic thresholds for PJI in HHAs.

Conclusion This study found diagnostic thresholds for ESR and CRP values that are sensitive and specific for PJI in HHA, and may be considerably lower than current thresholds for total hip arthroplasty.

Figure 1: ROC Curves for both (A) ESR and (B) CRP in the diagnosis of PJI in Hip Hemiarthroplasties



Monitor #4 – 3rd Poster **-** presented

Corresponding Author	Alex C McLaren
E-Mail Address	amclaren@cox.net
Institution	UA COM-P
Department	Ortho
Address	4425 E Cotton Center Blvd
City, State	Phoenix
Zip / Postal Code	85040
All Authors	Jessica Burns; Rex Moore; Paulo Castaneda; Derek Overstreet; Alex C McLaren

Title Caspofungin Elution from Antifungal Loaded Bone Cement

Background / Rationale Fungal biofilm-associated, implant-related infections are problematic, necessitating high local antifungal levels for eradication. Caspofungin is used for azole resistant Candida spp and Aspergillus spp, but elution of caspofungin from PMMA has not been studied.

Study Question
1. What is the elution profile of caspofungin from PMMA?
2. Is the compressive strength of PMMA altered by caspofungin?

Methods
1. Antifungal loaded bone cement (ALBC) was prepared using Simplex P bone cement with caspofungin dose of 70 mg, 1 g or 5 g / 40 g batch and formed into test cylinders, 6 mm dia x 12mm length (ASTM F451-08). Five test cylinders for each caspofungin dose were eluted in 1 cc of deionized water under infinite sink conditions with total eluent exchange at 0.25, 0.5, 1, 2, 3, 5, 7, 9, 11, 14, 28, and 42 days. Caspofungin concentration was measured at each time point using UV spectroscopy (230 nm). Cumulative recovered mass was calculated. Bioactivity was confirmed using an agar diffusion bioassay against C. albicans.
2. Compressive strength of pre- and post-elution ALBC test cylinders was measured by load to failure in axial compression at 24.0 mm/min (ASTM F451-08) in a Test Resources load frame.

Results Caspofungin elution increased with increasing dose and time (p < 0.01) (Table 1). Half of deliverable caspofungin was eluted within 3 days. All eluted samples were bioactive. Compressive strength decreased with increasing caspofungin dose and elution (p < 0.01). Compressive strength of low-dose ALBC (< 4 g/batch) was above the ISO 5833 requirement of 70 MPa pre and post elution (Table 1). High-dose (5 g/batch) had compressive strength below 70 MPa pre and post elution, 57 and 40 MPa respectively.

Discussion Caspofungin release from ALBC is consistent with water-soluble antibacterials. ALBC with 1 g/batch has burst release then low 2nd stage level release, consistent with non-porous ALBC. ALBC with 5 g/batch provided higher release, consistent with therapeutic delivery from a porous material. Compressive strength was above 70 MPa following elution for 1 g/batch sufficient for implant fixation, for 5 g/batch was <70MPa, adequate for spacer fabrication; not implant fixation.

Conclusion Caspofungin release from 1 g/batch ALBC is consistent with low-dose/2nd stage delivery; from 5 g/batch is consistent with high-dose therapeutic delivery. In-vivo tissue levels and minimum biofilm eradication concentration for caspofungin are needed for clinical application.

Table 1

Caspofungin Dose	Cumulative Release (μg)		Compressive Strength (MPa)	
(g per 40g batch)	1 day	3 days	Pre-elution	Post-elution
0	0	0	88	89
0.07	564	770	91	98
1	1,790	2,215	83	76
5	24,215	36,320	57	40

Table 1: Caspofungin elution from PMMA and compressive strength of standardized test cylinders.

Monitor #4 – 4th Poster **–** presented

Corresponding Author	Antonia Faustina Chen
E-Mail Address	afchen@bwh.harvard.edu
Institution	Brigham and Women's Hospital
Department	Orthopaedic Surgery
Address	75, Francis Street
City, State	Boston, MA
Zip / Postal Code	02115
All Authors	Pierre-Emmanuel Schwab; Nathan Varady; Brielle Antonelli; Antonia F. Chen

Title Synovial Fluid Neutrophil-to-Lymphocyte Ratio (SF-NLR): A New Biomarker for Septic Arthritis Diagnosis

Background / Rationale Septic arthritis (SA) is a musculoskeletal emergency, and traditionally, synovial fluid (SF) white blood cell (WBC) count >50,000 cells/mm3 and % polymorphonucleocytes (%PMN) >90% have been utilized to distinguish between infected and non-infected joints. Although these are strong markers, SF-WBC count and SF-%PMN are not highly specific, and the results can be affected by patient comorbidities and immune status. During most bacterial infections, the absolute count of PMNs is higher than the absolute count of lymphocytes in synovial fluid. However, the ratio of SF-PMNs and SF-lymphocytes have not been utilized to evaluate the severity of infection, while the same neutrophil-to-lymphocyte ratio (NLR) in serum has been identified as a prognostic factor for treatment failure, mortality and morbidity in various clinical settings.

Study Question To determine the ability of SF-NLR to diagnose septic arthritis in native shoulder, hip and knee joints.

Methods A retrospective study was performed to identify 598 patients with native shoulder, hip and knee SA from 2000-2018. SF-NLR was calculated based on the SF-WBC count value and SF-%PMN and SF-%lymphocyte after arthrocentesis. The gold standard for the diagnosis of SA was bacterial blood or joint fluid culture performed on the same day of the arthrocentesis. Receiver operating curves were analyzed and areas under the curve (AUCs) were determined. The optimal threshold for SF-NLR was determined using Youden's test. Logistic regression was performed to determine the odds ratio (OR) for infection at the optimal NLR threshold value.

Results The AUCs were 0.80 (95%CI 0.76-0.83) for SF-WBC, 0.81 (95%CI 0.77-0.84) for SF-%PMN, and 0.85 (95%CI 0.82-0.88) for SF-NLR. The optimal threshold for SF-NLR was 25 (sens=78%, spec=81%). The OR for SA diagnosis with SF-NLR>25 was 15.60 (95%CI 10.45-23.24), SF-WBC>50,000 cell/mm3 (OR 5.27, 95%CI 3.65-7.59, sens=56%, spec=80%) and SF-%PMN>90% (OR 6.94, 95%CI 4.82-9.99, sens=65%, spec=78%). Positive likelihood ratios for SF-NLR, SF-WBC, and SF-%PMN were 4.11, 2.80, and 2.95 respectively.

Discussion SF-NLR is a promising new biomarker for the diagnosis of SA and may perform better than SF WBC count and %PMN to diagnose native shoulder, hip and knee joint SA.

Conclusion SF-NLR may be utilized as a first step to diagnose SA so that physicians can institute proper treatment intervention to preserve joint integrity and function.

Monitor #4 – 5th Poster **-** presented

Corresponding Author	Milan Kapadia
E-Mail Address	kapadiam@hss.edu
Institution	Hospital for Special Surgery
Department	
Address	535 E 70th Street
City, State	New York, New York
Zip / Postal Code	10021
All Authors	Alberto Carli; Milan Kapadia; Yu-fen Chiu; Michael Henry; Andy O Miller

Title Treatment and Outcome of Prosthetic Joint Infection in Unicompartmental Knee Arthroplasty

Background / Rationale Unicompartmental knee arthroplasty (UKA) is an increasingly popular alternative to total knee replacement due to easier recovery and greater satisfaction. However, limited evidence guides management of periprosthetic joint infection (PJI) in UKA specifically. We retrospectively reviewed the largest cohort of UKA PJI to date, providing our experience in a high volume tertiary institution.

Study Question How do unicompartmental knee arthroplasty PJIs present and what are their outcomes?

Methods An institutional PJI database was queried from 2008 to 2016 to identify all PJI cases with an index procedure of UKA. Treatment, diagnostic criteria, Charlson Comorbidity Index (CCI) and microbiology data were collected. Success was defined as no further surgical treatment for infection at 2 years. A chi-square test or Fisher's exact test was used for comparisons between treatment success and failure groups. Survival probability was calculated using the Kaplan-Meier method.

Results A total of 24 UKA PJIs were identified with 22 meeting MSIS criteria. Median age at infection was 65.9 years (range, 50.8-87.4), median BMI was 26.7 kg/m2 (range, 21.2-49.5), 75% male (18/24).The average follow-up time was 2.83 years. 9 patients presented with early (<4 weeks) post-operative infections, 9 with hematogenous infections (< 4 weeks of symptoms) and 6 with chronic infections (>4 weeks of symptoms). 63% (15/24) of PJI cases were staphylococcal and 8.3% (2/24) were culture negative. Patients were either treated with 1 stage exchange (n=3, 100% success), two stage exchange (n=5, 80% success) or implant retention (n=16, 75% success). Overall survivorship was 79% at 2 years (95% confidence interval [CI], 63%-95%). Overall there was no significant association between success and CCI (p=.46), infection type (p=.29), surgical therapy (p=.62) and microorganism (p=.05).

Discussion In this series, UKA PJIs tended to present more often as early post-operative or hematogenous infections. We observed no significant benefit with revision surgery.

Conclusion Therefore, implant retention should be considered as first line surgical treatment. Outcomes of UKA PJI appear comparable to those in TKA PJIs.

Monitor #4 – 6th Poster

Corresponding Author	Gregory J Kirchner
E-Mail Address	kirchnergj@gmail.com
Institution	Drexel University College of Medicine
Department	
Address	216 N Broad Street
City, State	Philadelphia
Zip / Postal Code	19102
All Authors	Yehuda Kerbel; Alexander M Lieber; Anthony Boniello; Ian D Kaye; Amrit Khalsa; Gregory J Kirchner

Title The Cost-effectiveness of Antibiotic Infection Prophylaxis in Same-Day Lumbar Microdiscectomy

Background / Rationale Outpatient lumbar microdiscectomy has been widely adopted in part because of lower infection rates compared to the conventional approach for treating lumbar disc herniation. As a result, the economic benefit of standard antibiotic infection prevention protocols warrants investigating as it relates to the low infection rates reported following lumbar microdiscectomy.

Study Question Are standard antibiotic protocols cost-effective for preventing infection following same-day lumbar microdiscectomy?

Methods The product cost of 2 grams of intravenous cephazolin was obtained from our institution's purchasing records. Four total protocols were assessed: pre-operative intravenous cephazolin alone, as well as pre-operative intravenous cephazolin with either one, three or five days of post-operative oral cephalexin. Baseline infection rate following same-day lumbar microdiscectomy and average direct costs for treating lumbar microdiscectomy infection were obtained from the literature. A break-even analysis [Break-even Infection Rate = (Initial Infection Rate – Cost of Protocol) / Cost of Treatment] was then utilized to determine the absolute risk reduction (ARR) needed in infection rate to make each protocol cost-effective.

Results At $1.64 at our institution, the use of 2 grams of intravenous cephazolin is economically justified if the initial infection rate (0.65%) of same-day lumbar microdiscectomy is lowered by an ARR of 0.01%. Adding one day of oral cephalexin at an average retail price of $11.18 would require an ARR of 0.07% to be cost-effective. At an average retail price $15.68 to add three days of oral cephalexin, an ARR of 0.10% is needed to make the
protocol cost-effective. Furthermore, adding five days of oral cephalexin at an average retail price of $20.45 would require an ARR of 0.13% to be economically justified.

Discussion At our institution's price point, use of pre-operative cephazolin is economically justified if is prevents at least one infection for every 10,000 lumbar microdiscectomy surgeries. However, adding post-operative oral antibiotic prophylaxis to this regimen appears to diminish cost-effectiveness as a factor of increasing protocol duration.

Conclusion This break-even analysis demonstrates that pre-operative intravenous cephazolin is an economically viable method for preventing infection following same-day lumbar microdiscectomy.

Monitor #4 – 7th Poster

Corresponding Author	Malcolm E. Dombrowski
E-Mail Address	dombrowskime@upmc.edu
Institution	University of Pittsburgh Medical Center
Department	Department of Orthopedic Surgery
Address	Kaufmann Medical Building, Suite 1010, 3471 Fifth Ave
City, State	Pittsburgh
Zip / Postal Code	15213
All Authors	Malcolm E. Dombrowski; Alan Wilson; Michael J. O'Malley; Kenneth Urish; Brian R. Hamlin; Lawrence S. Crossett; Brian A. Klatt

Title

Smoking is not a risk factor for re-infection after two-stage exchange arthroplasty for chronic PJI

Background / Rationale

Periprosthetic joint infection (PJI) is a leading cause of arthroplasty failure. Smoking status has been reported to be a risk factor for post-surgical complications after arthroplasty, including deep infection. This is a major topic of concern as 14.0% of the U.S. population are current cigarette smokers. Many arthroplasty centers consider smoking to be a modifiable risk factor with large amounts of healthcare dollars spent on smoking cessation programs.

Study Question

Are current smokers at a higher risk of re-infection after two-stage exchange arthroplasty for chronic PJI? Are smokers at higher risk of not making it to prosthesis reimplantation in two-stage exchange arthroplasty?

Methods

A retrospective review of all patients with chronic PJI that underwent two-stage exchange from 2007-2016 at a single US quaternary referral center with at least 2 years follow-up. PJI diagnosis and reinfection were determined by MSIS criteria. Smoking status was divided into current and nonsmokers based on chart review. Comparisons were made using an unpaired student t-test.

Results

240 patients were identified with chronic PJI from 2007-2016 with 20.8% as current smokers. 203 of which underwent two-stage exchange arthroplasty with subsequent reimplantation. Of those re-implanted after 2-stage exchange, 21.2% (N=43) were current smokers. The rate of re-infection after two-stage exchange was not statistically different in current smokers (8/43 = 18.6%) compared to nonsmokers (24/160 = 15.0%), P=0.567. Additionally, 15.4% (37/240) of patients never made it to re-implantation, and failure of prosthesis re-implantation was not statistically different in smokers (14%, N=7), and non-smokers (15.7%, N=30), P=0.756.

Discussion

Smoking as an isolated risk factor for reinfection after two-stage exchange needs to be re-examined. Smoking as a contraindication for reimplantation in two-stage exchange arthroplasty may be unnecessarily prolonging re-implantation. Additionally, costly smoking cessation programs may not be as impactful as once thought.

Conclusion

This analysis demonstrates that smoking status was not a risk factor for reinfection after two-stage exchange arthroplasty for chronic PJI. Additionally, smoking status was not a predictor of reimplantation, with equal rates of smokers and nonsmokers not

Monitor #4 – 8th Poster

Corresponding Author	Gregory J Kirchner
E-Mail Address	kirchnergj@gmail.com
Institution	Drexel University College of Medicine
Department	
Address	216 N Broad Street
City, State	Philadelphia
Zip / Postal Code	19102
All Authors	Yehuda Kerbel; Alexander M Lieber; Anthony Boniello; Ian D Kaye; Amrit Khalsa; Gregory J Kirchner

Title The Cost-effectiveness of Antibiotic Infection Prophylaxis in Same-Day MIS-TLIF

Background / Rationale Outpatient minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF) is gaining popularity for decompressing the lumbar spine. Despite the minimally invasive approach, post-operative infection remains a challenge for surgeons performing MIS-TLIF in the outpatient setting.

Study Question Are standard antibiotic protocols cost-effective for preventing infection following same-day MIS-TLIF

Methods The product cost of 2 grams of intravenous cephazolin was obtained from our institution's purchasing records. Average retail costs of oral cephalexin (500mg every 6 hours) for one, three, and five days were obtained from open access pharmacy data. Four total protocols were assessed: pre-operative intravenous cephazolin alone, as well as pre-operative intravenous cephazolin with either one, three or five days of post-operative oral cephalexin. Baseline infection rate following same-day MIS-TLIF and average direct costs
for treating MIS-TLIF infection were obtained from the literature. A break-even analysis [Break-even Infection Rate = (Initial Infection Rate – Cost of Protocol) / Cost of Treatment] was then utilized to determine the absolute risk reduction (ARR) needed in infection rate to make each protocol cost-effective.

Results At $1.64 at our institution, the use of 2 grams of intravenous cephazolin is economically justified if the initial infection rate (2.40%) of same-day MIS-TLIF is lowered by an ARR of 0.01%. Adding one day of oral cephalexin at an average retail price of $11.18 would require an ARR of 0.07% to be cost-effective. At an average retail price $15.68 to add three days of oral cephalexin, an ARR of 0.10% is needed to make the protocol costeffective. Furthermore, adding five days of oral cephalexin at an average retail price of $20.45 would require an ARR of 0.13% to be economically justified.

Discussion At our institution's price point, even the most expensive combination of pre-operative cefazolin and five days of post-operative cephalexin is economically justified if is prevents at least one infection for every 769 MIS-TLIF surgeries. From an economic standpoint, increasing the length of antibiotics for outpatient MIS-TLIFmay be a cost-effective method of potentially reducing infection after surgery.

Conclusion This break-even analysis demonstrates that both pre-operative intravenous cephazolin and post-operative cephalexin are economically viable methods for preventing infection following same-day MIS-TLIF.

Monitor #4 – 9th Poster

Corresponding Author	Gerhard E Maale
E-Mail Address	gerhardmaale53@gmail.com
Institution	DFW Sarcoma Group/ medical City Plano
Department	Orthopaedic Oncology
Address	4708 Alliance Blvd.
City, State	Plano, Texas
Zip / Postal Code	75093
All Authors	Gerhard E Maale; Aniruth Srinivasaraghavan

Title Proximal Placement of Knee Joint in Patients Undergoing Patellectomy for Infected Total Knee Joints

Background / Rationale Massive soft defects can be expected in cases that involve the quadraceps, infrapatella area and patella with infected total knees. In the past these patients most would require free flaps with loss of quadriceps function. These PJI's (prosthetic joint infections) require drop lock braces, post op, as well as hinged constrained knee replacement. As part of the one stage treatment of Knee PJI's proximal placement of the knee joint can for allow primary closure and with over sewing of the quadriceps mechanism, allowing enough extension tone to drive locking of a constrained hinge total knee revision.

Study Question Is proximal placement of the knee joint beneficial in infected total knees where there are anterior soft tissue defects Does it lower the need for free flaps and does it allow for some extensor function?

Methods 42 patients were reviewed who presented with McPherson stage III-C-3 infected knees. They all had extensive involvement of the patella and quadriceps mechanism, tibia and femur. Historically they had 5-7 operations for infection, with one patient having 19 prior to referral. The patient underwent pre-op staging for localization of infection, which showed proximal tibia and distal femoral involvement as well as patella. All the patients would have required free flaps for coverage of the open wounds during the one stage replacement and drop lock braces for the missing extensor mechanisms.

Results 17 patients required free flaps, and the others were handled with local flaps. 10 patients required amputations, four for failure of the flap, 3 open dislocations of a non locked total hinge, and another for disassociation of the locked hinge from the tibia. There were 2 other recurrences that underwent another successful one stage. 20 patients had enough extensor power to drive the hinge knee in swing phase to lock the knee in extension.

Discussion Large soft tissue defects can be encountered in knee PJI's where distal femur and tibia need to resection. Proximal placement of the knee joint can lower the need for free flaps and still give extensor tone to power the knee to lock the hinge in gait.

Conclusion Clearly these patients were high-risk management cases as demonstrated by the 24% need for amputation. Proximal placement of knee can lower the need for free flaps by 60% and provide enough power in extension in 47% of these patients without drop lock braces.

Monitor #5 - 1st Poster **-** presented

Corresponding Author	Gregory J Kirchner
E-Mail Address	kirchnergj@gmail.com
Institution	Drexel University College of Medicine
Department	
Address	216 N Broad Street
City, State	Philadelphia
Zip / Postal Code	19102
All Authors	Yehuda Kerbel; Alexander M Lieber; Ian D Kaye; Amrit Khalsa; Gregory J Kirchner

Title	The cost-effectiveness of antibiotic infection prophylaxis in same-day anterior cervical discectomy and fusion
Background / Rationale	Outpatient anterior cervical discectomy and fusion (ACDF) is associated with dramatically lower costs than the same procedure in the inpatient setting. Nevertheless, post-operative infection remains a concern due to its devastating medical and economic effects.
Study Question	Are standard antibiotic protocols for preventing infection following same-day ACDF cost-effective?
Methods	The product cost of 2 grams of intravenous cephazolin was obtained from our institution's purchasing records. Average retail costs of oral cephalexin (500mg every 6 hours) for one, three, and five days were obtained from open access pharmacy data. Four total protocols were assessed: pre-operative intravenous cephazolin alone, as well as pre-operative intravenous cephazolin with either one, three or five days of post-operative oral cephalexin. Baseline infection rate following same-day ACDF and average direct costs for treating ACDF infection were obtained from the literature. A break-even analysis [Break-even Infection Rate = (Initial Infection Rate – Cost of Protocol) / Cost of Treatment] was then utilized to determine the absolute risk reduction (ARR) needed in infection rate to make each protocol cost-effective.
Results	At $1.64 at our institution, the use of 2 grams of intravenous cephazolin is economically justified if the initial infection rate (0.20%) of same-day ACDF is lowered by an ARR of 0.02%. Adding one day of oral cephalexin at an average retail price of $11.18 would require an ARR of 0.10% to be cost-effective. At an average retail price $15.68 to add three days of oral cephalexin, an ARR of 0.10% is needed to make the protocol costeffective. Furthermore, adding five days of oral cephalexin at an average retail price of $20.45 would require an ARR of 0.19% to be economically justified.
Discussion	At our institution's price point, use of pre-operative cephazolin is economically justified if is prevents at least one infection for every 5,000 ACDF surgeries. Meanwhile, adding postoperative oral antibiotic prophylaxis to this regimen requires reducing the infection rate by greater than or equal to half the initial rate.
Conclusion	This break-even analysis demonstrates that pre-operative intravenous cephazolin is an economically viable method for preventing infection following same-day ACDF.

Monitor #5 – 2nd Poster **–** presented

Corresponding Author	Irvin Oh
E-Mail Address	Irvin_Oh@urmc.rochester.edu
Institution	University of Rochester
Department	
Address	601 Elmwood Avenue, Box 665
City, State	Rochester, NY
Zip / Postal Code	14642
All Authors	Irvin Oh; Stephanie Hao; James Brodell; Mark Ninomiya; Gowrishankar Muthukrishnan; John Daiss; Edward Schwarz

Title	Application of Pathogen-specific Newly Synthesized Antibodies for Diagnosis and Monitoring Treatment Response in S. aureus infected Diabetic Foot Ulcers
Background / Rationale	In the United States, the lifetime incidence rate of patients with DM developing infected diabetic foot ulcer (DFU) is approximately 20%. Staphylococcus aureus (S. aureus) is the most common offending pathogen (46-68%) of DFU. There is currently no sensitive and specific assay for diagnosing an active S. aureus diabetic foot infection (DFI), or tracking the efficacy of treatment. We developed immunoassay using medium enriched for newly synthesized antibody (MENSA), and showed the applicability of MENSA for diagnosis of S. aureus in DFI. We found that tracking MENSA has prognostic potential to guide clinical decisions. To further assess the diagnostic and prognostic utility of MENSA for DFI, we report the findings of a larger cohort
Study Question	We developed MENSA to diagnose and monitor DFI. In a clinical pilot study (n=26), we showed that MENSA can diagnose S. aureus, track treatment response, and identif0y the recurrence of pathogen specific infection. We tested whether: 1) MENSA can detect a
Methods	From July 2015 to May 2018, we enrolled 56 DFU patients who displayed clinical symptoms and signs of infection which necessitated hospitalization. At weeks 0, 4, 8 and 12, whole blood and serum samples were collected to measure the abundance of anti-S. aureus IgG in the serum and in MENSA. Sensitivity and specificity for detection of anti-S. aureus IgG were compared against the standard culture. We investigated the ability of MENSA to track therapy.
Results	At the enrollment, 33 patients (58.9%) were identified culture positive for S. aureus. Of the 56 DFI, 45 (80%) were polymicrobial infections. We noted 60% concordance rate between MENSA and culture. Duration of DFU did not show significant difference, whereas monomicrobial infection showed increased concordance rate between MENSA and culture. Multivariate analysis showed increases in diagnostic potential to detect S. aureus infection when combining titers against different antigens.
Discussion	The MENSA showed distinct titer changes associated with healing versus non healing DFU.
Conclusion	Species specific newly synthesized antibody immunoassay may serve for diagnosis and monitoring treatment response in S. aureus infected DFI.

Monitor #5 – 3rd Poster **–** presented

Corresponding Author	Antonia F. Chen
E-Mail Address	afchen@bwh.harvard.edu
Institution	Brigham and Women's Hospital, Harvard Medical School
Department	Orthopaedic Surgery
Address	75 Francis Street
City, State	Boston, MA
Zip / Postal Code	02115
All Authors	Caleb M. Yeung; Paul M. Lichstein; Nathan H. Varady; Bryant Bonner; Charles Carrier; Pierre-Emmanuel Schwab; James H. Maguire; Antonia F. Chen; Daniel M. Estok

Title Knee Arthrodesis For The Salvage Of Infected Total Knee Arthroplasty

Background / Rationale Knee arthrodesis (KA) and above knee amputation (AKA) are often used for salvage of failed total knee arthroplasty (TKA) after periprosthetic joint infection (PJI); reinfection after KA can lead to AKA. Factors that lead to failed KA and progression to AKA are not well understood.

Study Question Determine factors associated with failure of KA for PJI leading to AKA.

Methods This was a retrospective study from 2000-2016 on a single-surgeon series of failed TKA for PJI treated with KA with minimum 2-year follow-up. Demographics, comorbidities, surgical history, tissue compromise, and radiographic data were recorded. Failure was defined as AKA after KA for reinfection. Outcomes included reoperation, ambulatory status, non-union, visual analog scale (VAS) for pain and Western Ontario and McMaster Activity (WOMAC) score.

Results 51 knees underwent KA with median follow-up of 7 years (interquartile range (IQR) of 2-18 years). Median age was 71 years (IQR 47–98). M:F ratio was 23:28; median body mass index (BMI) was 34.3 kg/m2 (IQR 17.9-61). Infection was successfully treated in 47 knees(92.2%); 24 knees(47.0%) required no reoperation. 41 patients (83.6%) remained ambulatory after KA, with 10 patients (21.3)% requiring no ambulatory assistive devices. Median VAS following KA was 4.6 (range 0-10); median WOMAC was 36.2 (range 9-86). Three fusions (5.9%) underwent AKA for reinfection. Predictors of treating failed KA with AKA included chronic kidney disease (CKD) (odds ratio[OR] 4.0, 95% confidence interval 0.6-26.8), peripheral vascular disease (PVD) (OR 3.5, 0.3-44.7), AORI III bone loss (OR 2.6, 0.4-35.2), instability (OR 2.2, 0.2-15.9), and immunosuppression (OR 1.1, 0.1-7.8). Tobacco use (OR 8.6, 2.4-31.4), BMI>25kg/m2 (OR 3.8, 0.43-32.5) and instability prior to arthrodesis (OR 2.51, 0.77-8.21) were associated with non-union. Gender/diabetes/CKD/PVD/immunosuppression were not associated with failure.

Discussion Ability to establish statistical significance of predictive factors of failure of KA after PJI leading to AKA was limited by small sample size, but CKD, PVD, AORI III bone loss, instability, and immunosuppression trended towards significance. However, this is one of the largest series available for KA performed for TKA PJI in a single-surgeon series. Future studies are needed to validate the significance of these predictors.

Conclusion Knee fusions for PJI in severely compromised hosts provide a functional limb with rare conversion to AKA.

Monitor #5 – 4th Poster **–** presented

Corresponding Author	Suzanne E Kent
E-Mail Address	skent@nebh.org
Institution	New England Baptist Hospital
Department	
Address	125 Parker Hill Avenue
City, State	Boston, MA
Zip / Postal Code	02120
All Authors	Suzanne E Kent; Daniel Kent; Brian Hollenbeck; Samuel Golenbock; Stephen Camer; Frank Rand

Title Perioperative protocols to reduce risk of surgical site infections in adult spinal deformity surgery

Background / Rationale Adult spinal deformity (ASD) surgery can lead to more complications than other procedures due to long operation times and complex multilevel procedures. Historically, ASD patients at our orthopedic specialty hospital have done exceptionally well post-operatively; however, no previous analysis has been done to look at the surgeries performed, how they correlate with postoperative infection outcomes, and what standard procedures may account for these outcomes.

Study Question The aim of the current study was to 1) determine the SIR among a population of adult spinal deformity fusion patients over a five year span, and 2) present the routine perioperative protocol followed for these procedures.

Methods We conducted a retrospective chart review of ASD procedures performed by a single surgeon from 2013-2017 at an orthopedic specialty hospital (n=349). The number of predicted infections was calculated using procedure-specific models based on NHSN risk adjustment models (Mu et al. 2011). SIR was calculated overall and by procedure type (primary vs. revision fusion) by dividing the number of observed SSIs by the number of predicted infections. The specific perioperative protocol used during procedures is additionally described.

Results Participants were majority white (99%) and female (72%) with a median surgical invasiveness index of 18. Observed incidence of SSI was 0.7% among primary fusions (n=1) and 1.0% among revisions (n=2). Risk adjustment models predicted 22.7 total SSIs (mean risk=6.5%). Overall SIR was 0.132.

Discussion Assessing for the intrinsic risk factors of our surgical population, we found a much lower than expected rate of SSIs. Our figure explores aspects of our encounters that could contribute to these outcomes. Patients undergo pre-screening with MRSA decolonization. Intraoperative protocols include coverage of all instrumentation and antimicrobial soak of implants prior to insertion. Postoperative care includes antibiotics until drain removal and care by orthopedic specialists. This standardization of procedures has likely improved outcomes for these complex cases.

Conclusion Despite complex procedures in a population with many potential risk factors for SSIs, we have experienced exceptional outcomes when compared to national standards. Future research is needed to determine which aspects of the routine perioperative protocol

Perioperative Procedures

Preoperative

- Screening visit
- MRSA decolonization
- Central sterilization team with low contamination rates
- Antibiotic prophylaxis with expanded gram negative coverage
  - Usually a cephalosporin & gentamicin
  - MRSA +: vancomycin & gentamicin
  - Stage or revision: vancomycin & levofloxacin

Intraoperative

- Consistent surgical team with limited OR traffic
- Covered instrumentation for setup
- Alcohol prep→ dry → DuraPrep
- Implants open only when ready
- Implants soak in bacitracin/poly solution prior to insertion
- Re-prep field with Betadine solution
- Every instrument wiped with Betadine sponge after every use
- Towels around field changed
- Routine wound irrigation
- Glove change x 3
- Vancomycin powder
- Closure: absorbable suture, steri-strips, bacitracin, silver

Postoperative

- Continued cephalosporin antibiotic coverage until drain removal POD 2-3
- Initial dressing changed on day of discharge
- Wound kept dry for a week
- Disposition preferably home or to known rehab facility

Monitor #5 – 5th Poster **–** presented

Corresponding Author	William T Li
E-Mail Address	research@rothmanortho.com
Institution	Rothman Orthopaedic Institute
Department	
Address	125 S 9th St. Ste 1000
City, State	Philadelphia, PA
Zip / Postal Code	19107
All Authors	William T Li; Michael Yayac; Nicholas D'Antonio; Sreeram Penna; Javad Parvizi

Title Absolute Synovial PMN Count: Another Useful Metric for Diagnosis of PJI

Background / Rationale Prosthetic Joint Infection (PJI) is a devastating complication following joint arthroplasty. The International consensus meeting (ICM) (2013 & 2018) and Musculoskeletal Infection Society (MSIS) have proposed criteria for diagnosis. Both synovial white cell count (WCC) and polymorphonuclear percentage (PMN%) carry substantial diagnostic weight in confirming the presence of PJI, but absolute neutrophil count of synovial fluid has not been studied.

Study Question The purpose of our study was to assess the relationship between absolute synovial neutrophil count and PJI in order to determine its accuracy as a diagnostic tool for PJI.

Methods This is a Single-center, retrospective study on patients who underwent revision total joint arthroplasty (TJA) at an urban tertiary care institution from 2008-2018. A query of the database was performed and 514 cases were identified in which preoperative synovial fluid was analyzed for WCC and PMN%. PMN count was determined by multiplying the WCC by the PMN%. Diagnostic value of the test was assessed using sensitivity, specificity, positive likely hood ratio, negative likely hood ratio and receiver operating characteristic (ROC) curves.

Results Out of the 514 Cases, 251 had PJI and 263 had aseptic failure. ROC for Synovial absolute PMN count showed an area under the curve (AUC) of 0.931 a sensitivity of 84.4 and a specificity of 92.0 when using a cutoff criterion for PJI of 2636 cells. Absolute white cell count showed an AUC of 0.918 and Synovial PMN% showed AUC of 0.882.

Discussion The absolute synovial neutrophil count may be a useful additional parameter for diagnosis of PJI.

Conclusion The absolute synovial neutrophil count may be a useful additional parameter for diagnosis of PJI. Due to its ease of calculation and high specificity, physicians may be able to use this value as a way of ruling in PJI.

Monitor #5 – 6th Poster

Corresponding Author	P. Maxwell Courtney
E-Mail Address	p.maxwell.courtney@rothmanortho.com
Institution	Rothman Institute
Department	
Address	902 S Front St
City, State	Philadelphia, PA
Zip / Postal Code	19147
All Authors	P. Maxwell Courtney; Michael Yayac; Karan Goswami; Frederic Liss; Joseph Abboud; Javad Parvizi

Title Physician-Owned Specialty Hospitals Are Associated with a Lower Rates of Surgical Site Infection than Tertiary Medical Centers

Background / Rationale Recent evidence suggests that physician-owned specialty hospitals may allow for more streamlined and efficient care, resulting in shorter length of stay, lower costs, fewer complications, and increased patient satisfaction. Surgical site infection (SSI) can be a devastating complication of orthopaedic procedures that is often difficult to successfully treat, requiring substantial cost and resources.

Study Question The purpose of this study is to determine whether specialty hospitals had lower rates of SSI than tertiary care institutions.

Methods Records were retrospectively reviewed for all patients undergoing primary total hip, knee, or shoulder arthroplasty and single-level lumbar fusion from 2010-2017 at two urban academic tertiary centers and two orthopaedic specialty hospitals that are joint venture partnerships between the health systems and a physician group. Patient demographics, comorbidities, and development of SSI within one year of the index procedure were recorded and compared between the groups. Logistic regression analysis was performed to identify variables that significantly correlated with SSI rates.

Results Of the 13,287 patients in the study, 9,164 patients (69%) underwent surgery at a tertiary hospital, while 4,123 (31%) underwent a procedure at a specialty hospital. Specialty hospital patients had lower rates of one year SSI than tertiary hospitals (0.6% vs. 0.3%, p=0.033). Of the cases of SSI, 20 (27.8%) occurred in the knee, 13 (18.1%) in the hip, 24 (33.3%) in the spine, and 15 (20.8%) in the shoulder. Logistic regression identified BMI (OR=1.0737), lumbar fusion (OR=4.7285) and specialty hospital (OR=0.5352) as being significant predictors of PJI.

Discussion While tertiary hospitals care for older patients with more medical comorbidities, patients undergoing orthopaedic procedures at physician-owned specialty hospitals may be at a lower risk of developing PJI. Further study is needed to determine whether joint-venture partnerships between physician groups and academic centers can help reduce costs through demand matching for the determining the most appropriate hospital for care.

Conclusion Rates of SSI at orthopaedic speciality hospitals with physician ownership are lower than tertiary care centers.

Total (Hip, Knee, Shoulder, Spine)	Tertiary Center (N=9164)	Physician Owned Specialty Hospital (N=4123)	Total (N=13287)	Significance
Age	65.35 (11.41)	63.17 (10.28)	64.67 (11.12)	**<0.0001**[a]
Gender				**0.0456**[b]
Male	4269 (46.6)	1997 (48.4)	6266 (47.1)	
Female	4899 (53.4)	2126 (51.6)	7025 (52.9)	
BMI	30.15 (6.16)	29.20 (4.82)	29.86 (5.80)	**<0.0001**[a]
Ethnicity				**<0.0001**[b]
White	7709 (84.1)	3100 (75.2)	10809 (81.3)	
Black	861 (9.4)	334 (8.1)	1195 (9.0)	
Other	174 (1.9)	347 (8.4)	521 (3.9)	
Unknown	424 (4.6)	342 (8.3)	766 (5.8)	
Charlson CI	0.56 (1.01)	0.29 (0.67)	0.48 (0.93)	**<0.0001**[a]
Joint				**<0.0001**[b]
Hip	1615 (17.6)	1182 (28.7)	2797 (21.0)	
Knee	2329 (25.4)	1845 (44.7)	4174 (31.4)	
Shoulder	1405 (15.3)	207 (5.0)	1612 (12.1)	
Spine	3819 (41.7)	889 (21.6)	4708 (35.4)	
PJI within one year	58 (0.6)	14 (0.3)	72 (0.5)	**0.0332**[b]

Reported as mean (SD) or n (%) [a]Mann-Whitney U [b]N-1 Chi-Square

Monitor #5 – 7th Poster

Corresponding Author	Gregory J Kirchner
E-Mail Address	kirchnergj@gmail.com
Institution	Drexel University College of Medicine
Department	
Address	216 N Broad St, Philadelphia, PA 19102
City, State	Philadelphia
Zip / Postal Code	19129
All Authors	Yehuda Kerbel; Christine S Williams; Alexander M Lieber; Kevin Gingrich; Norman Johanson; Vincent Moretti; Gregory J Kirchner

Title Prophylactic Vancomycin Powder Does Not Decrease Infection After Joint Replacement

Background / Rationale Prophylactic intrawound vancomycin powder prior to closure has been shown to reduce infection in orthopaedic spine surgery. However, there is limited knowledge regarding its safety and efficacy in joint replacement surgery.

Study Question Do perioperative outcomes differ between patients treated with and without vancomycin powder after total joint arthroplasty?

Methods A total of 94 patients who underwent total knee arthroplasty (TKA) and 85 patients who underwent total hip arthroplasty (THA) by three joint arthroplasty surgeons between April 2015 and February 2019 were randomly selected from the electronic health records of at a single institution. 76 patients received intrawound vancomycin powder and 103 had standard wound closure with no vancomycin powder. Patient characteristics and information regarding postoperative infection, readmission and return to operating room (OR) were collected, and patients were categorized based on whether prophylactic intrawound vancomycin powder was applied intraoperatively. Logistic regression models were utilized to determine differences between groups.?

Results There were 5 (12.8%) infections within the vancomycin-treated TKA patients compared to only 2 (3.6%) infections in the non-vancomycin TKA patients. Likewise, 2 (5.4%) vancomycin-treated THA patients sustained an infection compared to 3 (6.3%) non-vancomycin THA patients.?Combined adjusted analysis of TKA and THA patients revealed that vancomycin did not significantly affect infection risk (odds ratio 0.28, 95% confidence interval 0.64-1.23). Furthermore, there were no significant differences in readmission or return to OR rates between groups. Pre-operative and post-operative creatinine values were not significantly different as a factor of vancomycin use in either TKA or THA patients.?

Discussion While the efficacy of intrawound vancomycin powder has been well established in the?orthopaedic?spine literature, this study shows that it may not be as effective at preventing infection in total joint arthroplasty.?

Conclusion Perioperative outcomes for TJA were similar for patients receiving prophylactic vancomycin powder and those who did not.

Monitor #5 – 8th Poster

Corresponding Author	Talha Riaz
E-Mail Address	talhariaz240@gmail.com
Institution	Mayo Clinic
Department	Division of Infectious diseases
Address	200 First Street SW
City, State	Rochester, MN
All Authors	Talha Riaz; Douglas Osmon; Irene Sia

Title Left hand extensor tenosynovitis due to Histoplasma capsulatum

Background / Rationale Histoplasma capsulatum is endemic along Ohio and Mississipi river valleys. Majority of human infections are asymptomatic, except in subjects with altered immunity who are at risk for progressive infection. Isolated extra pulmonary organ involvement due to histoplasmosis is uncommon.

Study Question We report the case of a 46 year old female from Minnesota who presented in summer of 2018 with one month history of left hand pain, swelling and warmth progressing to her MTP and PIP joints. She was diagnosed with dermatomyositis recently and had been on

Methods On presentation, her ESR was 32 mm/hr and CRP 8 mg/L. MRI of the left hand was noted for enhancing tenosynovitis of the extensor compartment (all 4 tendons). She underwent tenosynovectomy along with irrigation and debridement. Surgical pathology was noted for fibrinous exudate and severe chronic inflammation.

Results Fungal cultures grew Histoplasma capsulatum. She was started on itraconazole 200 mg bid and was gradually weaned off of immunosuppresson over the next 5 months. Six months later, she presented with weeping, nodular, white lesions along surgical incision marks. During debridement, fistulizing tracks were noted. Though cultures were negative, Histoplasma organisms and granulomatous inflammation was seen on pathology. We suspect she experienced immune reconstitution inflammatory syndrome (IRIS) and it is in this context, she developed sinus tracks around extensor tendons. Post- operatively, she was started on IV liposomal amphotericin for 10 days followed by oral itraconaozle as well as a prolonged steroid taper to address IRIS. At 3 month follow up, the lesions on her left hand had dried and scabbed.

Discussion Immune reconstitution inflammatory syndrome in non- HIV infected patients with histoplasmosis has not been previously described. Our treatment approach included re- initiation of oral steroid therapy to address IRIS along with continuation of antifungal therapy.

Conclusion Upper extremity swelling, pain and warmth in immunocompromised patients warrants special attention. Though uncommon, fungal tenosynovitis warrants a high index of suspicion in such patients and typically treated with open debridement and prolonged course

Timing	Histoplasma mycelial Ab titer	Histoplasma yeast Ab titer	Histoplasma immunodiffusion	Urine Histoplasma Antigen (ng/dl) Reference >=0.50 = Positive; 0.00-0.10 = negative
0 month	1: 1024	1: 512	H and M band +	2.04
3 months	1: 512	1: 512	H and M bands +	1.26
6 months	1: 246	1: 256	H and M bands +	0.05
9 months	1: 256	1: 256	H and M bands +	0.08

Table 1. Trend in Histoplasma serology and urine antigen. Ab: antibody

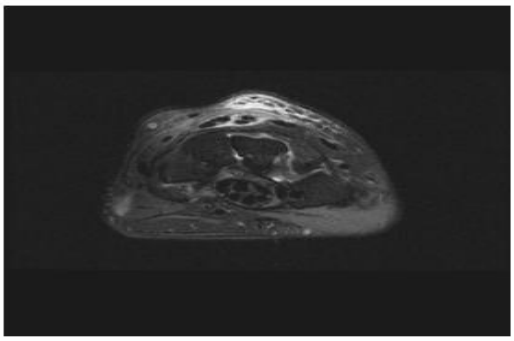


Figure 1. MRI left hand showing enhancement around extensor tendons

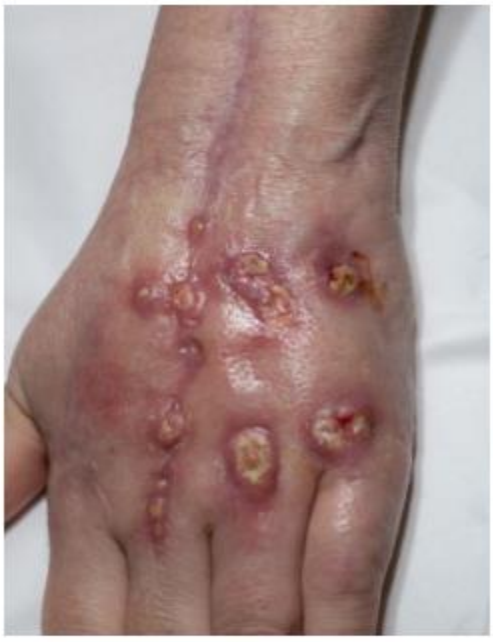


Figure 2. Photograph left dorsal hand after off of immunosuppression at 6 months

Disclosures

Program Committee

Maja Babic, MD: (This individual reported nothing to disclose); Submitted on: 05/30/2019

Laura Certain, MD, PhD: Submitted on: 06/03/2019 Musculoskeletal Infection Society: Board or committee member

Christopher J Gauland, DPM: Submitted on: 05/01/2019
Aedicell: Paid presenter or speaker
Austin Medical Ventures: Paid presenter or speaker

Carlos A Higuera Rueda, MD: Submitted on: 06/18/2019
American Association of Hip and Knee Surgeons: Board or committee member
American Journal of Orthopedics: Editorial or governing board
CD Diagnostics: Research support
Cymedica: Research support
Ferring Pharmaceuticals: Research support
Journal of Arthroplasty: Editorial or governing board
Journal of Hip Surgery: Editorial or governing board
Journal of Knee Surgery: Editorial or governing board
KCI: Paid consultant; Paid presenter or speaker; Research support
Mid-American Orthopaedic Association: Board or committee member
Musculoskeletal Infection Society: Board or committee member
OREF: Research support
Orthofix, Inc.: Research support
Orthogenics: Research support
PSI: Stock or stock Options
Stryker: Research support
Zimmer: Paid consultant; Research support

Brian A Klatt, MD: Submitted on: 04/30/2019
AAOS: Board or committee member
AAOSAAHKS Abstract Review Committee: Board or committee member
American Association of Hip and Knee Surgeons: Board or committee member
Clinical Orthopaedics and Related Research: Editorial or governing board
Journal of Arthroplasty: Editorial or governing board
Journal of the American Academy of Orthopaedic Surgeons: Editorial or governing board
MSIS: Board or committee member
SLACK Incorporated: Publishing royalties, financial or material support

Alexander C McLaren, MD: Submitted on: 06/06/2019
AAOS: Board or committee member
American Board of Orthopaedic Surgery, Inc.: Board or committee member
Musculoskeletal Infection Society: Board or committee member
Sonoran Biosciences: Stock or stock Options

Andy Miller, MD: (This individual reported nothing to disclose); Submitted on: 06/03/2019
Sandra Bliss Nelson, MD: Submitted on: 04/30/2019
Musculoskeletal Infection Society: Board or committee member

Thorsten M Seyler, MD, PhD: Submitted on: 04/30/2019
Advances in Orthopedics: Editorial or governing board
American Association of Hip and Knee Surgeons: Board or committee member
Biomet: Research support
Heraeus: Paid consultant
KCI: Research support
MedBlue Incubator Inc: Research support
Reflexion Health Inc.: Research support
Smith & Nephew: Paid consultant
Total Joint Orthopedics, Inc: IP royalties
Total Joint Orthopedics, Inc.: Paid consultant

Marcy Wilkinson: Staff (This individual reported nothing to disclose); Submitted on: 07/05/2019

FACULTY

A

Ahmed Abdel Aal, MD, PhD: Submitted on: 06/10/2019
Bard Peripheral Vascular: Research support
Boston Scientific: Research support
Medtronic: Research support

Matthew Philip Abdel, MD: Submitted on: 04/10/2019
American Association of Hip and Knee Surgeons: Board or committee member
International Congress for Joint Reconstruction: Board or committee member
Journal of Bone and Joint Surgery - British: Editorial or governing board
Minnesota Orthopaedic Society: Board or committee member
Stryker: Paid consultant

Joseph A Abboud, MD: Submitted on: 04/07/2019
Aevumed: Stock or stock Options
American Shoulder and Elbow Surgeons: Board or committee member
Arthrex, Inc: Research support
Curical Technologies LTD: Other financial or material support
Department of Defense: Research support
DePuy, A Johnson & Johnson Company: Research support
DJ Orthopaedics: IP royalties; Paid consultant
Dolevium: Other financial or material support; Stock or stock Options
Flexion Therapuetics: Paid consultant
Globus Medical: IP royalties; Paid consultant
Integra: Research support
Integra Life Sciences: IP royalties
Journal of Shoulder and Elbow Arthroplasty: Editorial or governing board
Journal of Shoulder and Elbow Surgery: Editorial or governing board
Marlin Medical Alliance, LLC: Stock or stock Options
Mid Atlantic Shoulder and Elbow Society: Board or committee member
Mininvasive: Other financial or material support
OBERD: Stock or stock Options
OREF: Research support
Orthopedics Today: Editorial or governing board
Orthospace: Research support
Parvizi Surgical Innovation LLC: Stock or stock Options
Shoulder JAM LLC: Stock or stock Options

(Joseph A Abboud, MD, continued)
SLACK Incorporated: Publishing royalties, financial or material support
Tornier: Paid presenter or speaker; Research support
Trice Medical: Other financial or material support
Wolters Kluwer Health - Lippincott Williams & Wilkins: Publishing royalties, financial or material support Zimmer: IP royalties; Paid consultant; Research support

Mohammad Salah Abdelaal, MD: (This individual reported nothing to disclose); Submitted on: 07/20/2019

Sean Aiken: Submitted on: 05/14/2019 Biocomposites Ltd: Employee
Hiba Anis, MD: (This individual reported nothing to disclose); Submitted on: 05/17/2019

Brielle Antonelli: (This individual reported nothing to disclose); Submitted on: 05/31/2019

Ibrahim S Alshaygy, MD: (This individual reported nothing to disclose); Submitted on: 04/22/2019

Nicholas Ryan Arnold, MD: Submitted on: 04/04/2019
Alkermes: Stock or stock Options
Celgene: Stock or stock Options
Gilead: Stock or stock Options
Johnson & Johnson: Stock or stock Options
Stryker: Stock or stock Options
William V Arnold, MD: Submitted on: 05/30/2019
AAOS: Board or committee member
Franklin Bioscience, Lannette Pharmaceuticals: Stock or stock Options
Journal of Arthroplasty: Editorial or governing board
Lannete Pharmaceuticals: Employee
Merck: Employee; Stock or stock Options
Norwich Pharmaceuticals: Stock or stock Options
Stryker: Research support
Zimmer: Research support

B

Maja Babic, MD: (This individual reported nothing to disclose); Submitted on: 05/30/2019

David Backstein, MD: Submitted on: 04/29/2019
Clinical Orthopaedics and Related Research: Editorial or governing board
Intellijoint Orthopaedics: Stock or stock Options
Journal of Arthroplasty: Editorial or governing board
Microport Orthopaedics: IP royalties; Paid consultant; Paid presenter or speaker
Surgical Services Inc: Research support
Zimmer: Paid consultant; Paid presenter or speaker

Faisal Bakaeen: (This individual reported nothing to disclose); Submitted on: 06/07/2019

Wael K Barsoum, MD: Submitted on: 06/20/2019
Beyond Limits: Stock or stock Options
Capsico Health: Stock or stock Options
Custom Orthopaedic Solutions: Stock or stock Options
DJO, Inc.: Research support
Editor in Chief- Journal of Hip Surgery: Editorial or governing board
Exactech, Inc: IP royalties
NIH: Research support
Orthosensor: Research support
Peerwell: Paid consultant; Stock or stock Options

(Wael K barsoum, MD continued)
Shukla Medical: IP royalties
Sight Medical: Stock or stock Options
Stryker: IP royalties; Paid consultant; Paid presenter or speaker; Research support
Thieme: Publishing royalties, financial or material support
Third Frontier: Research support
Zimmer: IP royalties; Research support

Thomas W Bauer, MD, PhD: Submitted on: 07/22/2019 Acumed, LLC: Paid consultant
Journal of Bone and Joint Surgery - American: Editorial or governing board
Journal of Orthopaedic Science: Editorial or governing board
Leica Biosystems: Paid consultant
Moximed, Inc: Paid consultant
Springer: Editorial or governing board

Christopher Paul Beauchamp, MD, FRCS (Ortho): Submitted on: 06/28/2019
Zimmer: Paid consultant

Karen Beenken, PhD: (This individual reported nothing to disclose); Submitted on: 07/22/2019

Elie Berbari, MD: Submitted on: 06/02/2019
Pfizer: Research support
UpToDate: Publishing royalties, financial or material support

Nicholas M Bernthal, MD: Submitted on: 06/07/2019
Biomet: Paid consultant
Bone Support: Paid consultant
Daiichi Sankyo: Paid consultant
Musculoskeletal Tumor Society: Board or committee member
Onkos: Paid consultant
Orthopaedic Research and Education Foundation: Board or committee member

Darci Block: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Thomas Bodmer, MD: (This individual reported nothing to disclose); Submitted on: 07/01/2019

Logan Boles, BS: Submitted on: 05/16/2018
Microport Orthopedics: Employee

Anthony J Boniello, MD: (This individual reported nothing to disclose); Submitted on: 05/31/2019

Bryant Bonner, MD: (This individual reported nothing to disclose); Submitted on: 06/01/2019

Christopher M Bono, MD: Submitted on: 05/01/2019
AAOS: Board or committee member
Elsevier: Publishing royalties, financial or material support
The Spine Journal: Editorial or governing board
United HealthCare: Other financial or material support
Wolters Kluwer Health - Lippincott Williams & Wilkins: Publishing royalties, financial or material support

Mathias P G Bostrom, MD: Submitted on: 04/17/2019
American Austrian Foundation: Board or committee member
Hip Society: Board or committee member
HSS Journal: Editorial or governing board
Ines Mandl Research Foundation: Research support
National Institutes of Health (NIAMS & NICHD): Research support
Smith & Nephew: IP royalties; Paid consultant; Research support

Barry D Brause, MD: Submitted on: 04/04/2019
Journal of Bone and Joint Infection: Editorial or governing board
Musculoskeletal Infection Society (MSIS): Board or committee member

James D Brodell Jr, BA: (This individual reported nothing to disclose); Submitted on: 04/03/2019

Jacob Robert Brooks: (This individual reported nothing to disclose); Submitted on: 10/06/2018

Madison Nicole Brown: (This individual reported nothing to disclose); Submitted on: 06/19/2019

Joshua Rory Buksbaum, BA, BS: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Zachary Burke, MD: (This individual reported nothing to disclose); Submitted on: 06/06/2019

Jessica Davis Burns, MD: (This individual reported nothing to disclose); Submitted on: 09/12/2018

Jack R. Brooks: (This individual reported nothing to disclose); Submitted on: 05/14/2019

Bryant Bonner, MD: (This individual reported nothing to disclose); Submitted on: 06/01/2019

Jan Brügger, MD: Submitted on: 06/04/2019
AstraZeneca: Paid presenter or speaker

Michael R Bubb, MD: Submitted on: 06/03/2019
GlaxoSmithKline: Paid consultant
Pfizer: Research support

Joshua Rory Buksbaum, BA, BS: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Joel David Bumgardner, PhD: Submitted on: 07/08/2019
American Institute of Medical and Biological Engineering: Board or committee member
Bionova Medical Inc: IP royalties
Elsevier: Publishing royalties, financial or material support
Journal of Biomedical Materials Research Part B: Editorial or governing board
Society for Biomaterials: Board or committee member
Triad Life Sciences: Research support

C

Flavio Andres Calderon II: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Stuart Adam Callary, PhD: Submitted on: 06/05/2019 Zimmer: Research support

Stephen Joseph Camer, ACNP-BC, ATC, BA, BOC, BOCO, BOCP, BS: (This individual reported nothing to disclos Submitted on: 07/03/2019

Alberto V Carli, MD, MSc, FRCSC: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Charles Spaulding Carrier, MD: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Claire Carter: (This individual reported nothing to disclose); Submitted on: 07/23/2019

Paulo Castaneda, BS: (This individual reported nothing to disclose); Submitted on: 04/03/2019

Jasmine Ann Arevalo Castillejos, BS: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Laura Certain, MD, PhD: Submitted on: 06/03/2019 Musculoskeletal Infection Society: Board or committee member

Gerard Chang, MD: (This individual reported nothing to disclose); Submitted on: 06/03/20

Antonia F Chen, MD, MBA: Submitted on: 04/16/2019 3M: Paid consultant
AAOS: Board or committee member
ACI: Paid consultant
AJRR: Board or committee member
American Association of Hip and Knee Surgeons: Board or committee member
American Medical Foundation: Paid consultant
Annals of Joint: Editorial or governing board
bOne: Paid consultant
Bone & Joint 360 Journal: Editorial or governing board
Clinical Orthopaedics and Related Research: Editorial or governing board

(Antonia Fl Chen, MD, MBA continued)
Convatec: Paid consultant
DJ Orthopaedics: Paid consultant
European Knee Association: Board or committee member
Graftworx: Stock or stock Options
Halyard: Research support
Haylard: Paid consultant
Healthcare Transformation: Editorial or governing board
Heraeus: Paid consultant
Hyalex: Stock or stock Options
International Congress for Joint Reconstruction: Board or committee member
Irrimax: Paid consultant; Research support
Joint Purification Systems: Stock or stock Options
Journal of Arthroplasty: Editorial or governing board
Journal of Bone & Joint Infection: Editorial or governing board
Knee Surgery, Sports Traumatology, Arthroscopy: Editorial or governing board
Musculoskeletal Infection Society: Board or committee member
Recro: Paid consultant
SLACK Incorporated: Publishing royalties, financial or material support
(Antonia F Chen, continued)
Smith & Nephew: Research support
Sonoran: Stock or stock Options
Stryker: Paid consultant
Zimmer: Paid consultant

Clark Jia-Long Chen, BS: (This individual reported nothing to disclose); Submitted on: 05/29/2019

Ji-Ying Chen Sr, MD, PhD: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Mukai Chimutengwende-Gordon, FRCS (Ortho), MBChB, PhD: (This individual reported nothing to disclose); Submitted on: 07/11/2019

Yu-Fen Chiu, MS: (This individual reported nothing to disclose); Submitted on: 05/21/2019

Madhav Chowdhry: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Matthew Christie, MD: (This individual reported nothing to disclose); Submitted on: 07/10/2019

Kyle Cichos, BS: (This individual reported nothing to disclose); Submitted on: 06/04/2019

Janet Donohue Conway, MD: Submitted on: 05/21/2019
Arthrex: Other financial or material support
Avitus Orthopaedics: Other financial or material support
Biocomposites: Other financial or material support
Biomet: Paid consultant
Cerament: Paid consultant
CyMedica Orthopedics: Other financial or material support
DePuy Synthes: Other financial or material support
Johnson Controls: Other financial or material support
Metro Prosthetics: Other financial or material support
MHE Coalition: Other financial or material support
Nuvasive: Other financial or material support
Orthofix, Inc.: Other financial or material support
OrthoPediatrics: Other financial or material support
Paragon 28: Other financial or material support
Smith & Nephew: Other financial or material support
Stryker: Other financial or material support
Supreme Orthopedic Systems: Other financial or material support
University of Florida: IP royalties
Vilex: Other financial or material support
Zimmer: Other financial or material support

Kerry Costi, BA: (This individual reported nothing to disclose); Submitted on: 01/15/2019

Philippe Cottagnoud Sr, MD: (This individual reported nothing to disclose); Submitted on: 07/23/2019

Paul Maxwell Courtney, MD: Submitted on: 04/26/2019 ConvaTec: Paid presenter or speaker
Hip Innovation Technology: Paid consultant
Journal of Bone and Joint Surgery - American: Publishing royalties, financial or material support

Lawrence S Crossett, MD: Submitted on: 06/03/2019
DePuy, A Johnson & Johnson Company: IP royalties; Paid consultant; Paid presenter or speaker
Johnson & Johnson: IP royalties; Research support

D

Omar Dahduli: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Ramez Dagher, MD: (This individual reported nothing to disclose); Submitted on: 07/21/2019

John L Daiss, PhD: Submitted on: 11/15/2018 MicroB-plex, Inc.: Employee

Nicholas David D'Antonio, BS: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Veronique Dartois, PhD: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Jerome Davidson, MD: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Iciar M Davila Castrodad, MD: (This individual reported nothing to disclose); Submitted on: 06/18/2019

Carl A Deirmengian, MD: Submitted on: 05/01/2019 Biomet: Paid consultant
Biostar Ventures: Paid consultant; Stock or stock Options Domain: Stock or stock Options
Trice: Stock or stock Options
Zimmer: Paid consultant; Paid presenter or speaker; Research support

Ronald Emilio Delanois, MD: Submitted on: 04/23/2019 Baltimore City Medical Society.: Board or committee member flexion Therapeutics: Research support
Orthofix, Inc.: Research support Stryker: Research support tissue Gene: Research support
united orthopedics: Research support

Craig P Delury, PhD: Submitted on: 05/14/2019 Biocomposites Ltd: Employee

Maxwell Detweiler, BS: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Matthew Dipane, BA: (This individual reported nothing to disclose); Submitted on: 05/30/2019

Malcolm Dombrowski, MD: (This individual reported nothing to disclose); Submitted on: 06/01/2019

Laura T Donlin, PhD: Submitted on: 06/03/2019
Karius, Inc.: Research support
Stryker: Paid consultant; Paid presenter or speaker

Evan Dugdale: (This individual reported nothing to disclose); Submitted on: 06/04/2019

Stephen Thomas Duncan, MD: Submitted on: 06/02/2019
Bone Support: Paid consultant
Heraeus: Paid consultant
Journal of Arthroplasty: Editorial or governing board
Journal of the American Academy of Orthopaedic Surgeons: Editorial or governing board Kentucky Orthopaedic Society: Board or committee member
Morph: Unpaid consultant
Smith & Nephew: Paid consultant; Research support
Stryker: Research support
Zimmer: Paid consultant; Research support

Devendra Hiraman Dusane, PhD: Submitted on: 05/14/2019 Biocomposites Limited: Paid consultant

E

John Eager, MD: (This individual reported nothing to disclose); Submitted on: 07/20/2019

Joseph Ehiorobo, BA: (This individual reported nothing to disclose); Submitted on: 04/04/2019
Shane C Eizember, MD: (This individual reported nothing to disclose); Submitted on: 06/01/2019

Daniel M Estok II, MD: (This individual reported nothing to disclose); Submitted on: 06/01/2019

F

Niklaus Fankhauser, PhD: (This individual reported nothing to disclose); Submitted on: 07/01/2019

Joseph Featherall, MD: (This individual reported nothing to disclose); Submitted on: 05/06/2019
Scott Patrick Feeley, BS: Submitted on: 06/05/2019 Zimmer: Employee

Vincent A Fischetti, PhD: Submitted on: 06/03/2019
Bioharmony: Unpaid consultant
ContraFect: IP royalties; Paid consultant; Research support
ContraFect and Bioharmony: Stock or stock Options

Carol Foltz, PhD: (This individual reported nothing to disclose); Submitted on: 05/28/2019

Austin Thomas Fragomen, MD: Submitted on: 07/20/2019
Limb Lengthening Research Society: Board or committee member
Nuvasive: Paid consultant; Paid presenter or speaker
Smith & Nephew: Paid consultant; Paid presenter or speaker
Synthes: Paid consultant; Paid presenter or speaker

Brianna Fram, MD: (This individual reported nothing to disclose); Submitted on: 04/03/2019

Kevin P. Francis: (This individual reported nothing to disclose); Submitted on: 06/02/2019

G

Samy S Gabriel: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Luke Garbarino, MD: (This individual reported nothing to disclose); Submitted on: 05/21/2019

Simon Garceau, MD: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Christopher J Gauland, DPM: Submitted on: 05/01/2019
Aedicell: Paid presenter or speaker
Austin Medical Ventures: Paid presenter or speaker

Kerryl Greenwood-Quaintance, MS: (This individual reported nothing to disclose); Submitted on: 07/22/2019

Jaiben George, MBBS: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Elie S Ghanem, MD: (This individual reported nothing to disclose); Submitted on: 04/14/2019

Kevin Gingrich, MD: (This individual reported nothing to disclose); Submitted on: 06/06/2019

Katherine Given, MBChB: (This individual reported nothing to disclose); Submitted on: 06/19/2019

Peter Aaron Gold, MD: (This individual reported nothing to disclose); Submitted on: 05/25/2019

Samuel W Golenbock, MSc: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Susan Goodman, MD: Submitted on: 05/30/2019
BMC Musculoskeletal Disorders: Editorial or governing board
Norvartis: Paid consultant; Research support
Pfizer: Paid consultant
Roche: Research support

Jaymeson Gordon: Submitted on: 06/21/2019 Enable Injections: Employee; Stock or stock Options

Steven M Gordon: (This individual reported nothing to disclose); Submitted on: 06/07/2019

Karan Goswami, MD: (This individual reported nothing to disclose); Submitted on: 05/28/2019

Jeffrey F Granger, MD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Eric J Greenberg, PharmD, CGP, BCPS: (This individual reported nothing to disclose); Submitted on: 05/31/2019

Danielle Greig, MD: (This individual reported nothing to disclose); Submitted on: 05/24/2018

Allan E Gross, MD, FRCSC, Prof: Submitted on: 04/09/2019
Intellijoint systtem - device for measuring length and offset after hip replacement: Stock or stock Options Journal of Arthroplasty: Editorial or governing board
Zimmer: IP royalties; Paid consultant; Paid presenter or speaker

Eric Grossman, MD: (This individual reported nothing to disclose); Submitted on: 05/30/2019

Kelly Guerin, PharmD: (This individual reported nothing to disclose); Submitted on: 05/03/2019

Douglas Guzior: (This individual reported nothing to disclose); Submitted on: 06/03/2019

H

Brian R Hamlin, MD: Submitted on: 05/14/2019 AAOS: Board or committee member
Bodycad: IP royalties; Paid consultant; Stock or stock Options Journal of Arthroplasty, Transfusion: Editorial or governing board
Smith & Nephew: Paid consultant

Mohammed Hammad: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Yazdi Hamid Reza, MD: (This individual reported nothing to disclose); Submitted on: 07/23/2019

Arlen D Hanssen, MD: Submitted on: 04/03/2019
Elsevier: Publishing royalties, financial or material support
International Congress for Joint Reconstruction (ICJR): Board or committee member
Stryker: IP royalties

Stephanie Hao, BA, BS: (This individual reported nothing to disclose); Submitted on: 01/07/2019

Michael D Harris, PhD: (This individual reported nothing to disclose); Submitted on: 06/04/2019

Mitchel B Harris, MD: (This individual reported nothing to disclose); Submitted on: 06/30/2019

Zoe Harrison, BS: Submitted on: 06/18/2019 Wright Medical Technology, Inc.: Employee

Alex Ryan Heatherly: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Christopher Hernandez, PhD: Submitted on: 07/23/2019 Orthopaedic Research Society: Board or committee member

Michael Henry, MD: (This individual reported nothing to disclose); Submitted on: 06/11/2019
Matthew Stewart Hepinstall, MD: Submitted on: 06/03/2019
AAOS: Board or committee member
Corin U.S.A.: Paid consultant
Cymedica: Research support
Exactech, Inc: Paid consultant
Flexion Therapeutics: Research support
KCI: Paid consultant
Stryker: Paid consultant; Paid presenter or speaker; Research support

Tanja Hermann: (This individual reported nothing to disclose); Submitted on: 07/01/2019

Angela Hewlett, MD, MS: Submitted on: 10/03/2018
Infectious Diseases Society of America: Board or committee member
LeafBio Inc: Research support
Musculoskeletal Infection Society: Board or committee member
Springer: Publishing royalties, financial or material support

Carlos A Higuera Rueda, MD: Submitted on: 06/18/2019
American Association of Hip and Knee Surgeons: Board or committee member
American Journal of Orthopedics: Editorial or governing board
CD Diagnostics: Research support
Cymedica: Research support
Ferring Pharmaceuticals: Research support
Journal of Arthroplasty: Editorial or governing board
Journal of Hip Surgery: Editorial or governing board
Journal of Knee Surgery: Editorial or governing board
KCI: Paid consultant; Paid presenter or speaker; Research support
Mid-American Orthopaedic Association: Board or committee member
Musculoskeletal Infection Society: Board or committee member
OREF: Research support
Orthofix, Inc.: Research support
Orthogenics: Research support
PSI: Stock or stock Options
Stryker: Research support
Zimmer: Paid consultant; Research support

Eldad Hod: (This individual reported nothing to disclose); Submitted on: 06/05/2019

David James Holland, MBChB, PhD: (This individual reported nothing to disclose); Submitted on: 06/27/2019

Brian Hollenbeck, MD: (This individual reported nothing to disclose); Submitted on: 05/30/2017
Chris Hopkins, MBBS: Submitted on: 06/19/2019
Australasian Society of Infectious Diseases - New Zealand Branch Committee: Board or committee member

Kellyn Hori, BS: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Matthew Howard, MD: (This individual reported nothing to disclose); Submitted on: 07/22/2019

Donald Howie, MD, PhD: Submitted on: 06/12/2019 Zimmer: Research support
Peter Paul Hsiue, MD: (This individual reported nothing to disclose); Submitted on: 05/24/2019

Paul M Huddleston, MD: Submitted on: 05/07/2019 Minnesota Orthopedic Society: Board or committee member

I

Daisuke Inoue, MD: (This individual reported nothing to disclose); Submitted on: 05/09/2019

Chad Ishmael, MD: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Morgan Ivy, BS: (This individual reported nothing to disclose); Submitted on: 07/22/2019

J

Anil Jagtiani, MD: (This individual reported nothing to disclose); Submitted on: 07/10/2017

Andre Jakoi, MD: Submitted on: 04/07/2019 Medicrea: Paid consultant

Jessica Amber Jennings, PhD: Submitted on: 06/18/2019
Abbott: Research support
Austin Medical Ventures: Research support
Elsevier: Publishing royalties, financial or material support

Tony R Joaquim, PhD: Submitted on: 06/04/2019
Zimmer: Employee; Research support; Stock or stock Options

Nathan A John, BS: (This individual reported nothing to disclose); Submitted on: 05/29/2019

Norman A Johanson, MD: (This individual reported nothing to disclose); Submitted on: 06/06/2019

Minseon Ju: (This individual reported nothing to disclose); Submitted on: 07/22/2019

Reuben Etienne Judd: (This individual reported nothing to disclose); Submitted on: 06/04/2019

K

Irene Kalbian, BA: (This individual reported nothing to disclose); Submitted on: 05/30/2019

Sujith Kallur, MS: Submitted on: 06/03/2019 Zimmer: Employee

Milan Kapadia: (This individual reported nothing to disclose); Submitted on: 05/07/2019

Christopher Karakasis, MD: (This individual reported nothing to disclose); Submitted on: 06/07/2019

Keith Kardos, PhD: Submitted on: 06/18/2019 Zimmer Biomet: Employee

Aditya Vishwas Karhade, BS: (This individual reported nothing to disclose); Submitted on: 05/01/2019

Jaret McGraw Karnuta, BS: (This individual reported nothing to disclose); Submitted on: 05/30/2019

Stephen L Kates, MD: Submitted on: 04/30/2019
AAOS: Board or committee member
American Orthopaedic Association: Board or committee member
Orthopaedic Trauma Association: Board or committee member
Sage Publications: Editorial or governing board; Publishing royalties, financial or material support

Ian Kaye, MD: (This individual reported nothing to disclose); Submitted on: 05/03/2019

Greg Kazarian, BA: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Benjamin Kelley, MD: (This individual reported nothing to disclose); Submitted on: 06/01/2019

Daniel Michael Kent: (This individual reported nothing to disclose); Submitted on: 07/22/2019

Suzanne E Kent, BS: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Yehuda E Kerbel, MD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Amrit Singh Khalsa, MD: Submitted on: 06/03/2019 Seaspine: Paid consultant

Gregory J Kirchner, MPH: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Brian A Klatt, MD: Submitted on: 04/30/2019
AAOS: Board or committee member
AAOSAAHKS Abstract Review Committee: Board or committee member
American Association of Hip and Knee Surgeons: Board or committee member
Clinical Orthopaedics and Related Research: Editorial or governing board
Journal of Arthroplasty: Editorial or governing board
Journal of the American Academy of Orthopaedic Surgeons: Editorial or governing board
MSIS: Board or committee member
SLACK Incorporated: Publishing royalties, financial or material support

Mitchell Robert Klement, MD: (This individual reported nothing to disclose); Submitted on: 05/31/2019

Alison K Klika, MS: (This individual reported nothing to disclose); Submitted on: 05/28/2019

Siran Koroukian, PhD: Submitted on: 06/07/2019
American Renal Associates: Other financial or material support
Celgene: Other financial or material support

James C Krieg, MD: Submitted on: 05/28/2019
Biostar Ventures: Stock or stock Options
Conventus: Stock or stock Options
Franklin Biosciences: Stock or stock Options
Journal of the American Academy of Orthopaedic Surgeons: Editorial or governing board
MDLive: Stock or stock Options
SAM Medical: IP royalties
Synthes: Paid consultant; Paid presenter or speaker
Synthes CMF: IP royalties
Trice Medical: Stock or stock Options
Paul Robert Kuzyk, MD, FRCSC, MSc: Submitted on: 06/02/2019
Avenir Medical Inc.: Paid consultant
Stryker: Research support
Zimmer: Research support

L

Aaron Lam, MD: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Regina Lamendella, PhD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Joshua Lawrenz, MD: (This individual reported nothing to disclose); Submitted on: 04/20/2019

Phillip A Laycock: Submitted on: 05/30/2018 Biocomposites Ltd: Employee

Bethany Lehman: (This individual reported nothing to disclose); Submitted on: 06/10/2019

Hannah Levy, BS: (This individual reported nothing to disclose); Submitted on: 05/31/2018

William T Li, BS: (This individual reported nothing to disclose); Submitted on: 05/06/2019

Alexander M Lieber, BA: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Paul Lichstein, MD: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Che Siu Lim: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Andreas Limacher, PhD: (This individual reported nothing to disclose); Submitted on: 07/02/2019

Frederic E Liss, MD: Submitted on: 06/03/2019
AAOS: Board or committee member
American Society for Surgery of the Hand: Board or committee member
Globus Medical: Paid presenter or speaker
Pacira Pharmaceuticals: Research support
Pennsylvania Orthopaedic Society: Board or committee member Physician Hospitals of America: Board or committee member

Theresa T Lu, MD, PhD: (This individual reported nothing to disclose); Submitted on: 07/23/2019

Christopher Luey, MBChB: (This individual reported nothing to disclose); Submitted on: 06/19/2019

M

Gerhard Emil Maale III, MD: Submitted on: 04/13/2019
Biocomposites: IP royalties
Smith & Nephew: IP royalties

Tad M Mabry, MD: (This individual reported nothing to disclose); Submitted on: 05/30/2019

John Madigan, MBA, MD: Submitted on: 06/05/2019 Zimmer: Employee; Stock or stock Options

James H. Maguire, MD: (This individual reported nothing to disclose); Submitted on: 06/01/2019

Bilal Mahmood, MD: Submitted on: 05/26/2019 Bristol-Myers Squibb: Stock or stock Options

Khalid Mahmoud: (This individual reported nothing to disclose); Submitted on: 06/11/2019

David C Markel, MD: Submitted on: 04/17/2019
rboretum Ventures: Stock or stock Options
Ascension Providence Hospital: Research support
Clinical Orthopaedics and Related Research: Editorial or governing board
Halyard: Paid presenter or speaker
Journal of Arthroplasty: Editorial or governing board
Journal of Bone and Joint Surgery - American: Editorial or governing board
Michigan Arthroplasty Registry Collaborative Quality Initiative: Board or committee member
Michigan Orthopaedic Society, aahks, mid america ortho assoc: Board or committee member
OREF: Research support
Osteoarthritis and Cartilage: Editorial or governing board
Stryker: IP royalties; Paid consultant; Paid presenter or speaker; Research support
The CORE institute: Stock or stock Options
US Veteran Administration: Research support

Kenneth McAlpine, MD: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Stephen Jack McBride, MBChB: Submitted on: 07/01/2019
Royal Australasian College of Physicians Infectious Diseases Advanced Training Committee: Board or committee member

Gerald McGwin, Jr PhD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Alexander C McLaren, MD: Submitted on: 06/06/2019
AAOS: Board or committee member
American Board of Orthopaedic Surgery, Inc.: Board or committee member
Musculoskeletal Infection Society: Board or committee member
Sonoran Biosciences: Stock or stock Options

Martin McNally, FRCS, FRCS (Ortho), MBChB, MD: Submitted on: 04/11/2019
Bonesupport AB: Paid presenter or speaker
British Orthopaedic Association: Board or committee member
European Bone and Joint Infection Society (President): Board or committee member
Girdlestone Orthopaedic Society (President): Board or committee member
Oxford Bone Infection Consultancy Ltd: Paid consultant
Oxford Handbook of Orthopaedic and Traumatology/ Oxford University Press: Publishing royalties, financial or material support

Edward J McPherson, MD: Submitted on: 05/02/2019
Atlanta Medical, Inc.: Paid presenter or speaker
Biocomposites: Paid presenter or speaker
Biomet: IP royalties; Paid consultant; Paid presenter or speaker; Research support Reconstructive Review: Editorial or governing board

Nathan Wesley Mesko, MD: Submitted on: 04/21/2019
Musculoskeletal Tumor Society: Board or committee member
Stryker: Paid consultant
Synthes: Paid presenter or speaker

Andy Miller, MD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Rebecca Minorini, BA: (This individual reported nothing to disclose); Submitted on: 06/04/2019

Dinshaw Mistry, FRACS: Submitted on: 07/11/2019 Medtronic: Paid presenter or speaker

Yushi Miyamae, MD, PhD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Nequesha Mohamed, MD: (This individual reported nothing to disclose); Submitted on: 04/25/2019

Daniel Kazemi Mohammadi: (This individual reported nothing to disclose); Submitted on: 04/17/2019

Robert M Molloy, MD: Submitted on: 04/08/2019
American Association of Hip and Knee Surgeons: Board or committee member
Stryker: Paid consultant; Paid presenter or speaker; Research support
Zimmer: Research support

Michael A Mont, MD: Submitted on: 04/15/2019
AAOS: Board or committee member
American Association of Hip and Knee Surgeons: Board or committee member
Cymedica: Paid consultant
DJ Orthopaedics: Paid consultant; Research support
Flexion Therapeutics: Paid consultant
Johnson & Johnson: Paid consultant; Research support
Journal of Arthroplasty: Editorial or governing board
Journal of Knee Surgery: Editorial or governing board Knee Society: Board or committee member
Medicus Works LLC: Publishing royalties, financial or material support
Microport: IP royalties
National Institutes of Health (NIAMS & NICHD): Research support
Ongoing Care Solutions: Paid consultant; Research support
Orthopedics: Editorial or governing board
Orthosensor: Paid consultant; Research support
Pacira: Paid consultant
Peerwell: Paid consultant; Stock or stock Options
Performance Dynamics: Paid consultant
Pfizer: Paid consultant
Skye Biologics: Paid consultant

(Michael A Mont, MD, continued)
Stryker: IP royalties; Paid consultant; Research support
Tissue Gene: Paid consultant
TissueGene: Research support
Up-to Date: Publishing royalties, financial or material support
USMI: Stock or stock Options
Wolters Kluwer Health - Lippincott Williams & Wilkins: Publishing royalties, financial or material support

William Kemp Montgomery, MD: (This individual reported nothing to disclose); Submitted on: 05/23/2019

Rex Corbin Moore: (This individual reported nothing to disclose); Submitted on: 07/23/2019

Vincent Michael Moretti, MD: (This individual reported nothing to disclose); Submitted on: 06/05/2019

Jessica Louise Mowbray, MBChB: (This individual reported nothing to disclose); Submitted on: 07/23/2019

Vishnu Priya Murali, MS: (This individual reported nothing to disclose); Submitted on: 07/22/2019

Gowrishankar Muthukrishnan, PhD: (This individual reported nothing to disclose); Submitted on: 07/21/2019

N

Arvind D Nana, FAOrthA, MBA, MD: Submitted on: 04/03/2019
AAOS: Board or committee member
International Geriatric Fracture Society: Board or committee member
Journal of Bone and Joint Surgery - American: Publishing royalties, financial or material support
Orthopaedic Trauma Association: Board or committee member

Monica Navarreto-Lugo, PhD: (This individual reported nothing to disclose); Submitted on: 07/22/2019

Sandra Bliss Nelson, MD: Submitted on: 04/30/2019
Musculoskeletal Infection Society: Board or committee member

Joseph Nguyen, MPH: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Elena Nikonova: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Mark Ninomiya, MS: Submitted on: 07/21/2019
AAOS: Board or committee member
Abbvie: Stock or stock Options
Amgen Co: Stock or stock Options
Astrazeneca: Stock or stock Options
Cytokinetics: Stock or stock Options
DePuy, A Johnson & Johnson Company: Stock or stock Options
Eisai: Stock or stock Options
Enzo: Stock or stock Options
Gilead: Stock or stock Options
Journal of Arthroplasty: Editorial or governing board
Journal of Bone and Joint Surgery - American: Editorial or governing board
Journal of Orthopaedic Research: Editorial or governing board
Medtronic Sofamor Danek: Stock or stock Options
Norvartis: Stock or stock Options
Zimmer: Stock or stock Options

Yingzhen Niu, MD: (This individual reported nothing to disclose); Submitted on: 06/17/2019
Allina A Nocon, MPH, PhD: (This individual reported nothing to disclose); Submitted on: 05/29/2019

Scott P Noel, MS: Submitted on: 06/13/2012
ExtraOrtho, Inc., Bionova Medical, Inc.: IP royalties; Other financial or material support
ExtraOrtho, Inc., Bionova Medical, Inc., Austin Medical Ventures: Employee
ExtraOrtho, Inc., Bionova Medical, Inc., SixFix, Inc.: Stock or stock Options

Hubert Noetzli: Submitted on: 06/28/2013
Zimmer: IP royalties; Paid consultant; Paid presenter or speaker

Lukas M Nystrom, MD: Submitted on: 07/15/2019
KCI: Paid consultant
Musculoskeletal Oncology Research Initiative: Board or committee member
Musculoskeletal Tumor Society: Board or committee member
Onkos Surgical, Inc.: Paid consultant

O

Irvin Oh, MD: Submitted on: 06/01/2019 Innomed: IP royalties

Adam S Olsen, MD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Michael O'Malley, MD: (This individual reported nothing to disclose); Submitted on: 04/30/2019

R Douglas Orr, MD: Submitted on: 06/10/2019
Agada Medical: Stock or stock Options
Lumbar Spine Research Society: Board or committee member
Stryker: Paid consultant
Tyber Medical: Stock or stock Options
Wolters Kluwer Health - Lippincott Williams & Wilkins
Journal of Spine disorders and Techniques: Editorial or governing board
World Spinal Column Society: Board or committee member

Douglas R Osmon, MD: (This individual reported nothing to disclose); Submitted on: 05/19/2019

Derek Overstreet: Submitted on: 10/02/2018
Sonoran Biosciences: Employee; Stock or stock Options

P

Leslie R Pace: Submitted on: 06/18/2019
MicroPort Orthopedics: Employee

Susan Pannach, PGDipHS, BSN: (This individual reported nothing to disclose); Submitted on: 05/31/2015

Howard Park, MD: (This individual reported nothing to disclose); Submitted on: 06/01/2019

Javad Parvizi, MD, FRCS: Submitted on: 04/26/2019
3M: Paid consultant
Alphaeon: Stock or stock Options
Ceribell: Stock or stock Options
Corentec: IP royalties; Paid consultant; Stock or stock Options
Datatrace: Publishing royalties, financial or material support
Eastern Orthopaedic Association: Board or committee member
Elsevier: Publishing royalties, financial or material support Ethicon: Paid consultant
Heraeus: Paid consultant
Hip Innovation Technology: Stock or stock Options
Intellijoint: Stock or stock Options

(Javad Parizi, MD, continued)
Jaypee Publishers: Publishing royalties, financial or material support
Joint Purification Systems: Stock or stock Options
Journal of Bone and Joint Surgery - American: Editorial or governing board
MDValuate: Stock or stock Options
MicroGenDx: Stock or stock Options
Muller Foundation: Board or committee member
NCI: Paid consultant
Parvizi Surgical Innovations: Stock or stock Options
Physician Recommended Nutriceuticals: Stock or stock Options
PRN-Veterinary: Stock or stock Options
SLACK Incorporated: Publishing royalties, financial or material support
Stryker: Paid consultant
Tenor: Paid consultant
TissueGene: Paid consultant
Wolters Kluwer Health - Lippincott Williams & Wilkins: Publishing royalties, financial or material support Zimmer: Paid consultant

Robin Patel, MD: Submitted on: 06/03/2019
Accelerate Diagnostics: Research support
Allergan: Research support
American Society of Microbiology: Board or committee member
BioFire: Research support
CD Diagnostics: Research support
Clinical Infectious Diseases: Editorial or governing board
Curetis: Research support
HBMS: Research support
Infectious Diseases Board Review (Faculty): Board or committee member
Journal of Clinical Microbiology: Editorial or governing board
Mayo Clinic, Rochester MN (my employer): Employee
Merck: Research support
Up-to-Date: Editorial or governing board
USMLE: Board or committee member

Taylor Paziuk, MD: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Sreeram Penna, MBBS, MRCSEd: Submitted on: 05/31/2019 Right Mechanics: Stock or stock Options
Veracuity LLC: Stock or stock Options

Matthew James Pestrak, PhD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Casey Peters: (This individual reported nothing to disclose); Submitted on: 05/24/2019

Nicolas Santiago Piuzzi, MD: Submitted on: 04/05/2019
Orthopaedic Research Society: Board or committee member

Hollis G Potter, MD: Submitted on: 04/04/2019
AOSSM - Imaging in Sports Health: Editorial or governing board Cartilage: Editorial or governing board
GE Healthcare: Research support
GE/NBA: Research support
Imagen: Stock or stock Options
Journal of Hip Preservation Surgery: Editorial or governing board
Journal of Orthopaedic Research: Editorial or governing board
National Institutes of Health (NIAMS & NICHD): Research support
Ortho RTI: Paid consultant
Osteoarthritis and Cartilage: Editorial or governing board

Brendan Prideaux: (This individual reported nothing to disclose); Submitted on: 07/23/2019

James J Purtill, MD: Submitted on: 05/24/2019 omega medical grants: Board or committee member

Q

Jonathan H Quade, MD: Submitted on: 06/11/2019 Smith & Nephew: Paid consultant

Deepak Ramanathan, MD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Weiping Ren, MD: (This individual reported nothing to disclose); Submitted on: 06/05/2019

Talha Riaz: (This individual reported nothing to disclose); Submitted on: 06/07/2018

Shawn Smith Richardson, MD: (This individual reported nothing to disclose); Submitted on: 06/02/2019

R

Frank F Rand, MD: Submitted on: 06/17/2019 Medtronic: Paid presenter or speaker
Scoliosis Research Society: Board or committee member

Talha Riaz: (This individual reported nothing to disclose); Submitted on: 06/07/2018

Lorenz Risch, MD, MPH, PhD: (This individual reported nothing to disclose); Submitted on: 07/02/2019

Martin William Roche, MD: Submitted on: 04/25/2019
CMO - Orthosensor: Employee
mako - stryker: Paid consultant
mako- stryker, Orthosensor: IP royalties
mako-stryker, Orthosensor: Paid presenter or speaker
makosurgical-stryker: Research support
Orthosensor: Stock or stock Options
Smith & Nephew: Research support

Felix Rohrer: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Alexander Rondon, MD: (This individual reported nothing to disclose); Submitted on: 05/24/2019

S Robert Rozbruch, MD: Submitted on: 05/04/2019
Informa: Publishing royalties, financial or material support
Limb Lengthening Reconstruction Society: Board or committee member
Nuvasive: Paid consultant; Paid presenter or speaker
Smith & Nephew: Paid consultant; Paid presenter or speaker
Springer: Publishing royalties, financial or material support
Stryker: IP royalties; Paid consultant; Paid presenter or speaker

S

Kordo Saeed, MBChB, MSc: (This individual reported nothing to disclose); Submitted on: 07/23/2019

Oleg Safir, MD: Submitted on: 06/03/2019
DePuy, A Johnson & Johnson Company: Research support
Zimmer: Paid consultant

Anna Cristina Samia, PhD: (This individual reported nothing to disclose); Submitted on: 06/28/2019

Ethan Sanders, BS: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Lee Sasala, MD: (This individual reported nothing to disclose); Submitted on: 05/06/2019

Joseph Hasbrouck Schwab, MD: Submitted on: 04/21/2019
Association of Bone and Joint Surgeons: Board or committee member
Musculoskeletal Tumor Society: Board or committee member
North American Spine Society: Board or committee member
Stryker: Paid presenter or speaker

Pierre-Emmanuel Schwab, MD: (This individual reported nothing to disclose); Submitted on: 05/20/2019

Giles R Scuderi, MD: Submitted on: 04/22/2019
Acelity: Paid consultant
Biomet: IP royalties; Paid consultant; Paid presenter or speaker
Convatec: Paid presenter or speaker
(Giles R Scuderi, MD, continued)
Force Therapeutics: Stock or stock Options
Medtronic: Paid consultant; Paid presenter or speaker
Operation Walk USA: Board or committee member
Pacira: Paid consultant; Paid presenter or speaker; Research support
SpringerElsevierThiemeWorld Scientific: Publishing royalties, financial or material support
Zimmer: IP royalties; Paid consultant; Paid presenter or speaker
Pierre-Emmanuel Schwab, MD: (This individual reported nothing to disclose); Submitted on: 05/20/2019

Edward M. Schwarz, PhD: Submitted on: 07/20/2019
Arthritis Research & Therapy: Editorial or governing board; Publishing royalties, financial or material support Asahi KASEI Pharma Corporation: Paid consultant; Paid presenter or speaker
DePuy, A Johnson & Johnson Company: Paid consultant; Research support
Eli Lilly: Research support
Journal of Orthopaedic Research: Editorial or governing board
MedImmune: Paid consultant
Musculoskeletal Transplant Foundation: Paid consultant
Orthopaedic Research Society: Board or committee member
Regeneron: Paid consultant
Telephus: Research support
Telephus Biosciences: Other financial or material support; Stock or stock Options

Oliver Scotting, MD: (This individual reported nothing to disclose); Submitted on: 05/23/2019

Peter Keyes Sculco, MD: Submitted on: 05/23/2019
EOS Imaging: Paid consultant
Intellijoint: Research support
Lima Corporate: Paid consultant

Parham Sendi, MD: Submitted on: 07/21/2019
Journal of Bone and Joint Infection: Editorial or governing board

Thorsten M Seyler, MD, PhD: Submitted on: 04/30/2019
Advances in Orthopedics: Editorial or governing board
American Association of Hip and Knee Surgeons: Board or committee member
Biomet: Research support
Heraeus: Paid consultant
KCI: Research support
MedBlue Incubator Inc: Research support
Reflexion Health Inc.: Research support

(Thorsten Seyler, MD, continued)
Smith & Nephew: Paid consultant
Total Joint Orthopedics, Inc: IP royalties
Total Joint Orthopedics, Inc.: Paid consultant

Amir Shahien, MD: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Akash Shah, MD: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Hongyi Shao, MD: (This individual reported nothing to disclose); Submitted on: 06/26/2019
Tong Shi: (This individual reported nothing to disclose); Submitted on: 07/23/2019

Alexander Shope, MEd, MHA, MMED (Ortho), MPH, MPT, MRCPCH: Submitted on: 06/28/2019
Aionx Antimicrobial Technologies, Inc: Paid consultant
Contamination Source Identification, LLC: Paid consultant

Irene G Sia, MD, MSc: (This individual reported nothing to disclose); Submitted on: 07/22/2019
Claus Simpfendorfer, MD: (This individual reported nothing to disclose); Submitted on: 05/31/2019

Devin Sindeldecker, BS: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Stephen Sizer, DO: (This individual reported nothing to disclose); Submitted on: 06/02/2019
Mark S Smeltzer, PhD: Submitted on: 06/01/2017
Biomet: Research support
Theravance: Research support

Eric Louis Smith, MD: Submitted on: 06/03/2019
American Orthopaedic Association: Board or committee member
Conformis: Paid consultant; Research support
DePuy, A Johnson & Johnson Company: Paid consultant; Research support

Keenan Sobol, BS: (This individual reported nothing to disclose); Submitted on: 06/05/2019

Nipun Sodhi, BA: (This individual reported nothing to disclose); Submitted on: 05/21/2019

Lucian B Solomon, FAOrthA, MD, PhD: Submitted on: 06/12/2019
Johnson & Johnson: Research support
Zimmer: Research support
Yang Song, MD: (This individual reported nothing to disclose); Submitted on: 06/26/2019

Branden Rafael Sosa: (This individual reported nothing to disclose); Submitted on: 06/07/2019

Clay A Spitler, MD: Submitted on: 06/03/2019 AAOS: Board or committee member
AO Trauma: Paid presenter or speaker
Orthopaedic Trauma Association: Board or committee member

Aniruth Srinivasaraghavan: (This individual reported nothing to disclose); Submitted on: 07/20/2019

Kwesi St. Louis, MD: (This individual reported nothing to disclose); Submitted on: 06/12/2019

ROUMEN Botev STAMENKOV, MD, MS: (This individual reported nothing to disclose); Submitted on: 07/14/2019

Kevin Staats, MD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

James Steckelberg, MD: (This individual reported nothing to disclose); Submitted on: 07/23/2019

Paul Stoodley, PhD: Submitted on: 05/12/2019
3M: Other financial or material support
Biocomposites: Paid consultant; Research support
Biocomposites Ltd: Paid presenter or speaker
Colgate-Palmolive: Research support
Journal of Orthopaedic Research: Editorial or governing board
MicroGen Dx: Other financial or material support
Novaflux: Other financial or material support
Philips Oral Healthcare: Research support

John T Strony, BS: Submitted on: 04/22/2019
Johnson & Johnson: Employee; IP royalties; Stock or stock Options

Vincentius J Suhardi, MD, PhD: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Kamolsak Sukhonthamarn, MD: (This individual reported nothing to disclose); Submitted on: 06/01/2019
Anne C Sullivan, MD: Submitted on: 06/05/2019 AAOS: Board or committee member
Aaos practice prep package: Editorial or governing board Biocomposites, Ltd.: Research support

T

Timothy Tan, MD: (This individual reported nothing to disclose); Submitted on: 05/24/2019

Aaron J. Tande, MD: (This individual reported nothing to disclose); Submitted on: 05/30/2018

Kathleen Turajane, BS: (This individual reported nothing to disclose); Submitted on: 06/03/2019

David J Tybor, MPH, PhD: (This individual reported nothing to disclose); Submitted on: 06/03/2019

U

Kenneth Urish, MD, PhD: Submitted on: 04/29/2019
AAOS: Board or committee member
ASTM: Board or committee member
BodyCad: Research support
Smith & Nephew: Paid consultant

Sam Ikenna Uweh Jr, BS: (This individual reported nothing to disclose); Submitted on: 06/05/2019

V

Rushabh Vakharia, MD: (This individual reported nothing to disclose); Submitted on: 05/29/2019

Nathan Varady: (This individual reported nothing to disclose); Submitted on: 05/19/2019

Cristina Villalpando: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Kelly Vince, MD: Submitted on: 11/18/2018
Zimmer: IP royalties; Paid consultant; Paid presenter or speaker

Anabelle Visperas, PhD: (This individual reported nothing to disclose); Submitted on: 05/17/2019

W

Karoline Wagner, PhD: (This individual reported nothing to disclose); Submitted on: 06/26/2019

Qiaojie Wang: (This individual reported nothing to disclose); Submitted on: 10/02/2018

Jared A Warren, ATC, DO: (This individual reported nothing to disclose); Submitted on: 04/03/2019

Yaniv Warschawski: (This individual reported nothing to disclose); Submitted on: 06/02/2019

Andrew Jonathan Wassef, MD: Submitted on: 06/29/2018
Biocomposites: Paid consultant
BoneSupport: Paid consultant; Paid presenter or speaker
Stryker: Paid consultant

Richard Wawrose, MD: (This individual reported nothing to disclose); Submitted on: 05/30/2019

Sameera Wickramasinghe: (This individual reported nothing to disclose); Submitted on: 06/18/2019

Christine Williams, BS, MS: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Alan Edward Wilson Jr, MD: (This individual reported nothing to disclose); Submitted on: 06/02/2019
Jesse Isaac Wolfstadt, MD: (This individual reported nothing to disclose); Submitted on: 04/04/2019
Xu Yang, MD: (This individual reported nothing to disclose); Submitted on: 06/30/2019

Justin Wright, BS: (This individual reported nothing to disclose); Submitted on: 07/21/2019

X

Chi Xu Jr, MD: (This individual reported nothing to disclose); Submitted on: 07/21/2019

Y

Michael Yayac, MD: (This individual reported nothing to disclose); Submitted on: 04/25/2019

Caleb Yeung, MD: (This individual reported nothing to disclose); Submitted on: 04/15/2019

Omar T Yunis: (This individual reported nothing to disclose); Submitted on: 07/08/2019

Z

Guangjin Zhou: (This individual reported nothing to disclose); Submitted on: 06/03/2019

Stephen Douglas Zoller, MD: (This individual reported nothing to disclose); Submitted on: 05/30/2019

Marcy Wilkinson: Staff (This individual reported nothing to disclose); Submitted on: 07/05/2019