Department of Orthopaedic Surgery

Wake Forest University
School of Medicine

35th Annual Gary Poehling, MD
Resident Research Day

6th Beth Smith, PhD and Tom Smith, PhD
Visiting Professor

Ned Amendola, MD

June 19, 2026

Atrium Health
Wake Forest Baptist

Wake Forest University
School of Medicine

The Department of Orthopaedic Surgery Resident Research Day and Visiting Professor is a yearly event where PGY5, PGY3, PGY2 Podiatry, and Physician Scientists highlight their research through podium presentations. Monetary awards are given to the top basic science, top clinical, and top podiatry research projects. Recipients are selected based on the overall evaluation of their research project and scored by the Visiting Professor.

The Visiting Professor highlights the event with presentations that provide insight on the technical aspects of their research and advising residents on how to transition from residency to fellowships to a faculty position. The Visiting Professor is an esteemed colleague in an orthopaedic specialty. This year's Visiting Professor is an expert in sports medicine / foot and ankle and invited by Dr. Albert Anastasio, Assistant Professor of Orthopaedic Surgery.

Annunziato (Ned) Amendola, MD

Ned Amendola, MD, is currently the Virginia Flowers Baker Distinguished Professor of Orthopaedic Surgery, Chief of the Sports Medicine Division, and Executive Director of the James R. Urbaniak Sports Sciences Institute at Duke University. In addition, he is the Head Team physician and Chief Medical Officer for Duke Athletics.

Dr Amendola earned his medical degree and completed his orthopedic residency at the Western University in London, Ontario. He completed post-graduate fellowships in Orthopaedic Sports Medicine, Foot and Ankle, and Hand Surgery. Dr Amendola is a Diplomate of the American Board of Orthopedic Surgery and the Royal College of Surgeons of Canada. He began his career on faculty where he trained at Western University in London Canada, where he became Chief of Orthopaedic Surgery at the University Hospital, moved to the University of Iowa in 2001 as Director of Sports Medicine, and was a tenured Professor of Orthopaedic Surgery until 2015. While at Iowa, Dr. Amendola received the Kim and John Callaghan Endowed Chair in Sports Medicine in 2009. He has been a tenured Professor of Orthopaedic surgery at Duke University since 2015.

Dr. Amendola has been involved as a member and a leader in many orthopedic and sports medicine organizations, currently President of the American Academy of Orthopedic surgeons (AAOS). He is Past President for the American Orthopedic Society for Sports Medicine. He has been a member of the Board of Directors of OREF, AAOS, ABOS, AOSSM, AANA, ISAKOS, and Past President of the Canadian Academy of Sport Medicine.

Throughout his career, Dr Amendola has focused on improving the quality of orthopedic care through clinical practice, education, and research. He has always appreciated teaching and learning from many students, residents, and fellows over his career. He has received numerous peer-reviewed grants, and published over 400 peer-reviewed articles, as well as authored an extensive number of book chapters and editor of 8 textbooks in sports medicine, foot and ankle, and arthroscopy. Dr. Amendola has earned numerous research related awards including Kappa Delta Award from the AAOS in 2012 and 2019 and Excellence in Research Award, Cabaud and O'Donohue awards from the AOSSM. He was inducted into the AOSSM Sports Medicine Hall of Fame in 2025, and Honorary member of ESSKA, SIAGASCOT and SIOT.

Gary G. Poehling, MD

Dr. Gary G. Poehling received a B.S. degree from Marquette University in 1964 and his M.D. degree from Marquette School of Medicine in 1968. He completed an internship and residency in general and thoracic surgery at Duke Medical Center from 1968-1970. He served in the United States Air Force from 1970-1972 at the 655th Tactical Hospital in Tachikawa, Japan. After fulfilling his military duty, Dr. Poehling completed his orthopaedic residency at Duke Medical Center from 1972-1976, serving as Chief Resident his final year. He subsequently joined the faculty of Bowman Gray School of Medicine, now Wake Forest University School of Medicine, and Department of Orthopaedic Surgery as an Assistant Professor. Dr. Poehling served as Interim Chair of the Department in January 1989 and was formally appointed as Chair in October 1989 and served in that capacity for 18 years and served as Editor in Chief for the Journal of Arthroscopy for 24 years.

Dr. Poehling has over 43 years of experience as an orthopaedic surgeon. He pioneered the use of arthroscopy and was influential in defining various procedures that can be performed arthroscopically. Together with James Roth, MD and Terry Whipple, MD, Dr. Poehling pioneered the use of wrist arthroscopy in 1985. Dr. Poehling also was one of the first orthopaedic surgeons to use arthroscopic operative techniques in the elbow. Dr. Poehling has also served as a proponent for the development and use of minimally invasive surgical techniques. As an academic surgeon he has promoted the application of computer technology for training residents and medical students. He has championed the importance of orthopaedic outcome studies and evidence-based medicine.

Beth Smith, PhD and Thomas Smith, PhD

Beth Smith earned her PhD in Toxicology from Texas A&M in 1974. She completed post-doctoral work at Wake Forest School of Medicine in 1978 with Richard St. Clair, PhD. Dr. Smith began her career at Wake Forest School of Medicine in 1987 in the Department of Orthopaedic Surgery as a Research Assistant. Her research interests were botulinum toxin to treat cerebral palsy. Her work using intramuscular toxin injections to manage muscle spasticity changed the management of pediatric patients with cerebral palsy worldwide. Dr. Smith published journal articles, book chapters, and books throughout her career. During her tenure, she was the Director of the Orthopaedic Research Lab, Coordinator of the Spasticity Management Workshops, served as Chair of the Division of Surgical Sciences Research Day from 1993-1997, and Chair of the Department of Orthopaedic Surgery Resident Research Day from 1991 until her retirement in 2018.

Thomas Smith earned his PhD in Physiology from Bowman Gray School of Medicine in 1979. He completed post-doctoral work at the University of Mississippi School of Medicine with Thomas Coleman, PhD and Arthur C. Guyton, PhD. Dr. Smith served as an Assistant Professor in the Department of Physiology and Biophysics at the University of Mississippi School of Medicine from 1980-1982. He began his career at Wake Forest School of Medicine as an Instructor in the Department of Physiology and Pharmacology in 1978, achieving the rank of Assistant Professor in 1982. Dr. Smith joined the Department of Orthopaedic Surgery in 1996 working diligently to improve orthopaedic research until his retirement in 2020. He is an expert in small animal models and microsurgery training. The models he developed are now a resource for the IACUC and multiple collaborators across the institution. His expertise in cardiovascular physiology and applications for orthopaedic research helped establish the Extremity Lab, advanced techniques for re-implantation, and assessment of compartment syndrome. He collaborated with Walt Curl, MD, and Nicole Deal to determine the action mechanism of cold therapy for treatment of contusions. Dr. Smith published journal articles, book chapters, and books throughout her career.

Beth Smith, PhD, and Tom Smith, PhD, have many collaborative accomplishments during their tenure in the Department of Orthopaedic Surgery at Wake Forest University. They were responsible for the growth of industry and grant funding for the lab. With this additional funding, the lab was able to grow the support personnel to facilitate the research interests of the department's faculty and residents. Current personnel comprise 4 research faculty, 3 management level staff, and 10 grants, lab, and project coordinator staff members. The Smiths were instrumental in the establishment and success of the Physician Scientists program starting in 1999. The program has resulted in patents, publications, Physician Scientist training, numerous awards, and the establishment of an orthopaedic research lab at Wake Forest School of Medicine that continues to thrive and grow.

- Patents: 3 awarded; 3 pending
- Book Chapters: 38
- Peer reviewed journal articles: 240
- Grant Funding (PI or Co-I): $19,150,068

Physician Scientists:

- 11 have completed their PhD at Wake Forest University; 12 currently serve as faculty at Medical Schools
- 5 Pending PhDs

Awards

- Koman L, Smith B, Li Z, Smith T. Kappa Delta Award for Clinical Research in Microvascular Physiology. Orthopaedic Research and Education Foundation. American Association of Orthopaedic Surgeons. 1999.
- Koman L, Smith B, Smith T. Kappa Delta Award for Clinical Research in Translational Uses of Botulinum Toxins. Orthopaedic Research and Education Foundation. American Association of Orthopaedic Surgeons. 2019
- Co-authors for 3rd, 4th, and 7th most frequently cited article from the Journal of Pediatric Orthopaedics
- Co-authors for top 100 classic papers of pediatric orthopaedic Surgery in JBJS (19th, 21st, and 30th most frequently cited)

Thirty-Fifth Annual Gary Poehling, M.D. Resident Research Day
June 19, 2026

Sixth Annual Beth Smith, PhD, and Tom Smith, PhD, Visiting Professor

Ned Amendola, Visiting Professor

8:00	Welcome Cynthia Emory, MD Professor and Chair of Orthopaedic Surgery
8:05	Visiting Professor Introduction Albert Anastasio, MD
8:10	***"Academic Success: It's a Team Sport"*** Ned Amendola, MD
Emcee:	Nequesha Mohamed, MD
	Physician Scientists:
9:00	Jeffrey Austin Foster, MD
9:07	Kaitlin A. Cruz, MD
9:14	Discussion
	PGY2 - Podiatry Residents:
9:30	Iyanna Damanze, DPM
9:37	Stephan Polacek, DPM
9:44	Taylor Woodward, DPM
9:51	Discussion
10:05	**BREAK**
	PGY3 – Orthopaedic Residents:
10:15	Tameka Dean, MD
10:22	Taha Elseaidy, MD
10:29	Mina Entessari, MD
10:36	Morgan Noel, MD
10:43	Abrianna Robles, MD
10:50	Discussion
11:05	***"Orthopaedic Surgery: Doing the Right Thing"*** Ned Amendola, MD
12:00	**Lunch**
	PGY5 – Orthopaedic Residents
12:45	Edward Beck, MD
12:52	Kyle Lynch, MD

12:59	Jeffery St. Jeor, MD
1:06	Robert Jack Teasdall, MD
1:13	Taylor Wood, MD
1:20	Discussion
1:35	Podiatry Award Winner Presentation
1:40	**CONCLUSION OF RESIDENT RESEARCH DAY**

Galunisertib versus Human Placental Extract for the Prevention of Radiation-Induced Bone Loss

Jeffrey A. Foster MD, Joseph Moore MS, Kaitlyn E. Reno PhD, Alicia Costa-Terryll, Leslie Kim, Martina Van Etten, Jessica R. Jones, Katherine L. Cook PhD, David R. Soto-Pantoja PhD, Scott A. Washburn MD, Michael B. Berger PhD, Kerry A. Danelson PhD, MBA, & Jeffrey S. Willey PhD

Faculty Research Mentor: Jeffrey S. Willey PhD

Introduction: Hypofractionated radiation therapy, such as stereotactic body radiotherapy (SBRT), has become a mainstay in treating localized tumors. While SBRT has led to improvements in tumor targeting, tumor control, and patient survival, a secondary consequence has been increased morbidity in the form of radiation-induced pain, bone loss, and subsequent fracture. In the setting of soft tissue sarcoma, radiation-induced fractures occur in up to 22% of patients who undergo surgery and radiotherapy. Even at relatively low total doses (i.e., 30 to 40 Gy), complications such as radiation-induced osteoporosis, insufficiency fractures, physeal arrest, and nonunion are common. Thus, preventing these radiation-related complications would greatly improve patient function, mobility, and quality of life. Preliminary *in vitro* work by our lab suggests that two investigational new drugs, galunisertib, a TGF-βR1 inhibitor, and human placental extract (HPE), may be efficacious in preventing radiation-induced pain and bone loss. Therefore, the objective of this *in vivo* study was to determine if galunisertib or HPE may prevent radiation-induced bone loss.

Methods: WT C57BL/6 female mice (N = 72) were randomly assigned to the following treatment groups: 1) DMSO; 2) DMSO+SBRT; 3) Galunisertib; 4) Galunisertib+SBRT; 5) HPE; and 6) HPE+SBRT. SBRT was administered to the intertrochanteric region of the left hindlimb via the X-Rad SmART+ image-guided small animal irradiator (Precision X-Ray, Inc., North Branford, CT, USA) using 220 kVP X-rays at a dose of 10 Gy X 1 fraction. DMSO and galunisertib were administered via drinking water at doses of 75 mg/kg/day, while HPE was administered via intraperitoneal injection at a dose of 16 mg/mL/week. Treatment groups were split into two cohorts and euthanized at 2-weeks or 2-months post-SBRT (n = 6). Bilateral hindlimbs were harvested and fixed for tissue analysis. Cortical and trabecular bone were analyzed via microcomputed tomography (vivaCT 80, Scanco Medical AG; Basserdorf, Switzerland) using a voxel size of 6 μm, voltage of 55 kV, intensity of 145 μA, and integration time of 300 ms. Two-way ANOVA with Tukey multiple comparisons test was performed to detect group differences (GraphPad Prism, GraphPad Software; Boston, MA, USA).

Results: For the 2-week cohort, there were no significant group differences or generalized trends observed in any of the cortical bone outcomes ($p > 0.18$). The Galunisertib+SBRT and HPE+SBRT groups experienced increased trabecular number ($p = 0.07$) and connectivity density ($p = 0.30$) compared to controls. For the 2-month cohort, the Galunisertib+SBRT group experienced greater bone mineral density ($p = 0.68$) and less cortical porosity ($p = 0.61$) versus other groups. There were no significant group differences or generalized trends observed in other cortical or trabecular bone outcomes ($p > 0.28$).

Conclusion: Galunisertib and HPE demonstrated marginal bone preserving properties following irradiation in this pilot animal study. While insignificant, this is likely limited by insufficient study power, as this study was powered using hindlimb swing as the primary outcome. Additional analyses are ongoing to determine if either intervention prevented radiation-induced pain in this model, which will be measured by comparing group differences in gait patterns. Future studies should consider translatability and clinical efficacy in patients undergoing SBRT for cancer treatment.

Investigating the Impact of Incretin Mimetic Induced Weight Loss on the Musculoskeletal System: An Experimental Proposal

Kaitlin Cruz, Stefan Kluzek

Faculty Research Mentor: Stefan Kluzek, MD PhD

Background: Glucagon-like peptide-1 (GLP-1 RAs) mimic the action of the endogenous incretin hormone, glucagon-like peptide-1 (GLP-1). These incretin mimetics function to delay gastric emptying, promote glucose homeostasis, and regulate appetite, resulting in them being effectual therapeutics for diabetes, obesity, and obesity related comorbidities. Over the past decade, glucagon-like peptide-1 receptor agonist (GLP-1 RAs) have skyrocketed in use for weight management, with recent data indicating use in at least 1 in 8 US adults. Evidence of the impact of GLP-1 RA use on musculoskeletal health is mixed. Some studies have reported significant structural and functional losses to the musculoskeletal system – while others report no significant changes. Most notably there also exists a discrepancy between clinical and preclinical research with some rodent models demonstrating no significant skeletal changes following GLP-1 RA use, which contrasts with findings of clinical trials. Preclinical skeletal muscle studies demonstrate loss of anaerobic muscle fibers and myogenic differentiation during GLP-1 RA induced weight loss, as well as loss of strength. Given these findings, our lab seeks to establish a rodent GLP-1 RA weight loss model where we can investigate hormonal fluctuations involved in orchestrating the remodeling of the musculoskeletal system during a 6-week period of weight loss. This model will provide key information regarding the influence of GLP-1 RA induced weight loss on hormonal pathways critical to musculoskeletal homeostasis. We hypothesize that GLP-1 RA induced weight loss produces a decrease in leptin which then impacts changes to key musculoskeletal hormonal pathways and results in suboptimal musculoskeletal functional and structural outcomes.

Approach: A GLP-1 RA induced weight loss model of a diet induced obesity (DIO) high-fat diet (HFD) C57BL/6 mouse will be compared to calorie restricted and control models, and musculoskeletal related hormones such as leptin, adiponectin, sex hormones, PTH, TSH, IGF-1, and myostatin will be longitudinally investigated by weekly electrochemiluminescence and ELISA. Structural musculoskeletal changes will be simultaneously tracked utilizing in vivo ultrasound, high-resolution X-Ray imaging, and body compositional analysis, with ex vivo micro-CT and muscle and bone histological analysis. Strength and functional changes will be evaluated utilizing longitudinal in vivo grip strength testing, terminal muscle force analysis, and ex vivo three-point bending mechanical testing.

Conclusion: Findings of this study are expected to better characterize key structural and functional changes of the musculoskeletal system under the influence of hormonal GLP-1 RA induced weight loss. Furthermore, this data allows us to determine potential supplemental interventions that might be added to GLP-1 RA weight loss regimens which can mitigate lean mass loss. Results of this study will better inform clinicians and patients about best practice use of GLP-1 RAs, allowing patients to utilize these therapeutics while preserving musculoskeletal tissue.

Is Inpatient Revascularization Beneficial In Long Term Outcomes of Amputations? Pilot Study Findings

Iyanna Damanze, DPM, PGY-II; Paula Gangopadhyay, DPM, FACFAS (PI); Taylor Woodward, DPM, PGY-II,

Faculty Research Mentor: Paula Gangopadhyay, DPM, FACFAS (PI)

Introduction: Current literature largely evaluates revascularization performed either prior to amputation in the outpatient setting or as a delayed, staged procedure following discharge. There is limited evidence specifically examining outcomes for patients who present with foot ulcers and undergo minor amputation with concurrent inpatient revascularization. This represents a significant gap in the management of ischemic foot ulcers and limb-threatening disease.

This study seeks to evaluate whether revascularization performed during the same inpatient admission as a minor amputation in patients presenting with foot ulcers is associated with improved clinical outcomes, including wound healing, limb salvage, and reduced rates of subsequent major amputation. Findings from this study may help guide multidisciplinary decision-making and optimize timing of revascularization in the care of patients with ischemic foot ulcers.

This is intended to be a pilot study.

Methods: This is a retrospective chart review conducted at an academic institution. Electronic medical records of patients who had an inpatient vascular procedure with a lower extremity amputation (partial ray vs. transmetatarsal) during the same inpatient stay from January 2021 until December 2024 were accessed and analyzed for the variables of interest. These patients were identified by using an I2B2 search in Epic with CPT codes for the procedures and diagnoses of interest. Partial ray amputation (28810), TMA (28805), Angiogram (75600–75774), Endovascular revascularization (37220–37235), and Fem-pop bypass (35556, 35583, 35656).

Results: The partial ray amputation group included 27 patients with a mean age of 70 years (range, 51–89). The majority were male (22 patients, 81%), with females comprising 19% (n = 5). Diabetes mellitus was present in 20 patients (74%), and all patients (100%) had peripheral vascular disease. Chronic kidney disease was identified in 16 patients (59%), while 5 patients (19%) had a history of prior amputation. The mean white blood cell count was 10.9 (range, 4.25–26.4). Regarding revascularization timing, most patients underwent the procedure prior to amputation (21 patients, 78%), while 2 patients (7%) underwent revascularization on the same day and 2 patients (7%) after amputation; timing was unknown in 2 cases (7%).

The transmetatarsal amputation group included 19 patients with a mean age of 64 years (range, 42–86). The majority were male (17 patients, 89%), with females comprising 11% (n = 2). Diabetes mellitus was present in 17 patients (89%), and all patients (100%) had peripheral vascular disease. Chronic kidney disease was identified in 13 patients (68%), while 5 patients (26%) had a history of prior amputation. The mean white blood cell count was 10.1 (range, 7.3–18.8). Regarding revascularization timing, most patients underwent the procedure prior to amputation (13 patients, 68%), while 3 patients (16%) underwent revascularization on the same day and 3 patients (16%) after amputation.

Conclusion: Future work will focus on expanding the inclusion criteria to better capture the full spectrum of patients undergoing minor amputations. This will include incorporating digit amputations, wounds left open for secondary healing, and patients with prior amputations on the ipsilateral limb. Outcome measures will be broadened to assess healing rates, mortality rates, revision procedures, and rates of subsequent major amputation, while also accounting for prior amputation status as a key variable. The statistical plan will be further developed to support these expanded analyses and allow for more robust evaluation of clinical outcomes.

Ulcer Healing rates with Underlying Osteomyelitis using Bioactive Split-Thickness Skin Allografts

Stephen Polacek, DPM

Faculty Research Mentor: Cody Blazek, DPM

Introduction: Cadaveric allografts have shown benefits in wound healing for foot and ankle surgery. Recently, the use of advanced skin substitutes like bioactive split-thickness skin allografts (BSA), a cryopreserved human allograft, have gained attention for enhancing healing compared with standard wound care alone and other skin substitutes. Chronic foot wounds with osteomyelitis (OM) pose significant challenges, as residual infection often impairs healing despite debridement and long-term antibiotic therapy. Traditionally, residual infection is considered a contraindication for grafting. BSA has shown promise in chronic wounds, but evidence in OM-complicated cases is limited. This study evaluates outcomes with BSA's in patients with and without residual OM compared with non-grafted controls.

Methods: We performed a retrospective comparative study of 67 patients who underwent open amputations or incision and drainage (I&D). Culture and/or pathology samples were taken of bone specimens providing a diagnosis of residual osteomyelitis. Surgeons determined intraoperatively whether wounds were suitable for BSA application. Patients were grouped as BSA without OM (n=13), BSA with OM (n=27), and controls with OM without BSA (n=27). Patients with OM received six weeks of antibiotics per infectious disease recommendations. Patient demographics, comorbidities and wound sizes were assessed. Primary outcomes included time to bone coverage (TTBC) and time to healing (TTH). TTH was followed up to one year. Non-parametric tests (Wilcoxon rank-sum and Fisher's exact) were used for comparisons, and Kaplan-Meier methods estimated time to bone coverage and healing. Cox regression models identified predictors of outcomes.

Results: Groups did not differ by demographic or procedural characteristics. Median TTBC was significantly shorter in BSA with OM (2.6 weeks) compared with controls (6.1 weeks, $p<0.0001$). No significant difference was noted when comparing TTBC in BSA without OM to BSA with OM. Healing rates at one year were comparable across groups (84.6% BSA without OM, 81.5% BSA with OM, 74.1% controls). Cox regression identified PVD as the only significant predictor of delayed bone coverage ($p=0.0056$). No variables were associated with delayed healing at one year.

Conclusion: Our findings suggest that BSA facilitates more rapid bone coverage in complex foot wounds, including those with underlying osteomyelitis. Importantly, the presence of osteomyelitis did not diminish graft effectiveness with similar TTBC and TTH supporting its role as an adjunctive therapy alongside antibiotics. While healing rates at one year were similar across groups, earlier TTBC in the BSA cohorts may contribute to reduced complication risk and a greater chance for limb salvage. Further studies should assess the role for skin substitutes with healing over complex wounds especially with residual osteomyelitis.

Mortality Rates of Diabetic Foot Infections Requiring Surgery

Taylor W Woodward, DPM, Brooke E Kiefer, DPM, Lyle Paukner, MS, Lindsay K Lesavage, DPM, Cody D Blazek, DPM, Nicholas S Powers, DPM, FACFAS

Faculty Research Mentor: Nicholas S Powers, DPM, FACFAS

Introduction: Diabetic foot ulcers affect up to 60 million people globally (1) with 60% experiencing diabetic foot infection (2) and 15-20% requiring amputation (3). The significant morbidity and mortality associated with diabetic foot infections and amputations has been well documented throughout the literature with reported five-year mortality rates ranging from 30% with ulcer alone to 80% for major amputation (4). Presence of peripheral arterial disease in diabetics undergoing minor amputations has been demonstrated as an independent predictor of mortality (5). The primary objective of this study was to evaluate the five-year mortality rate in patients undergoing surgical intervention for diabetic foot infections. The secondary objective of this study was to identify clinical and procedural factors associated with mortality.

Methods: A retrospective chart review was conducted to identify the mortality rate of patients admitted over a five-year period between 2015-2020 who underwent surgical intervention for diabetic foot infection. The study was conducted at a Level 1 academic trauma center. 146 patients were included in this study with a diagnosis of diabetic foot infection who underwent minor amputation of the foot during hospital admission. Minor amputation was defined as any level of amputation distal to the ankle joint. Other factors influencing mortality rates were also investigated, including age, peripheral arterial disease, and additional procedures (both minor and major amputations). Major amputations were defined as any amputation at the level of or proximal to the ankle joint.

Results: A total of 146 patients with a mean age of 61.8 (SD 12.5) were included in this study. The overall five-year mortality rate for diabetic foot infections requiring amputation was 49.3%. The overall survival rate for diabetic foot infections requiring amputation was 49.3%. 40% of patients had a diagnosis of both diabetes and peripheral arterial disease which did not yield any significant difference with regard to five-year mortality rate. Age and type of additional procedure were both found to be significant predictors of mortality. 82 patients underwent more than one procedure with 66 receiving distal and 16 receiving proximal amputation. The presence of additional procedures alone did not reach significance; however, the type of additional procedure did. Within the additional procedures group, the five-year mortality rate was 87.5% for proximal amputation and 25.4% for distal amputation. There was no statistically significant difference found between the five-year mortality rate of patients with peripheral arterial disease and those without.

Conclusion: This study seeks to add to the existing literature regarding mortality rates associated with diabetic foot ulcers and infections. Studies have demonstrated 30% five-year mortality rates in diabetic foot ulcers alone, 50% in patients requiring minor foot amputation and up to 80% in patients requiring major limb amputation (4, 6, 7). Our study found an overall 49.3% five-year mortality rate among patients who received any level of surgical treatment for diabetic foot infection, like that reported in the literature. Although the presence of additional procedures alone did not reach significance, the type of additional procedure did, demonstrating a 62% higher five-year survival rate in patients undergoing additional distal procedures compared with those receiving proximal limb amputation. The significant findings of this study add to the existing literature as well as demonstrate the importance of limb salvage and preventing proximal limb amputation.

Inhibition of Mitochondrial Redox Pathway as a Therapeutic Strategy Against Ischemia-Reperfusion Injury in Skeletal Muscle

Tameka Dean, Katlin Cruz, Xue Ma

Faculty Research Mentor: Stefan Kluzek

Introduction: Prolonged tourniquet application for extremity trauma in prehospital settings can lead to significant skeletal muscle damage due to ischemia-reperfusion (I/R) injury. Tourniquet use is often essential for limb salvage in lower-extremity trauma, but can induce significant I/R-mediated injury that poses a major barrier to full muscle recovery. Previous rodent studies suggest that I/R injury contributes to long-term deficits in muscle strength due to mitochondrial dysfunction and oxidative stress, resulting in inhibited satellite cell activation and delayed muscle fiber repair. In preliminary studies, we demonstrated that Ruboxistaurin (RBX), a selective inhibitor of PKCβII-mediated mitochondrial redox protein p66Shc activity, significantly decreases mitochondrial reactive oxygen species (ROS) in murine myoblasts in vitro. We hypothesized that RBX would attenuate ROS-mediated damage and restore muscle strength and function to pre-injury baseline following tourniquet-induced hindlimb I/R injury in mice.

Methods: All animal procedures were approved by the Institutional Animal Care and Use Committee (IACUC) of Wake Forest University Health Sciences. Hindlimb ischemia was induced using an orthodontic rubber band tourniquet applied to the left thigh of 6-month-old male (n=9) and female (n=9) C57BL/6J mice for 3h. Mice were randomly assigned to a 2-week or 9-week recovery cohort. RBX or saline was delivered via subcutaneously implanted osmotic pumps. Functional recovery of the ischemic hindlimb was assessed weekly using DigiGait software. At study endpoint, electrodes were placed into the gastrocnemius (GC) and tibialis anterior (TA) muscles of both experimental (left) and control (right) limbs to measure muscle force (mN*g) and contraction amplitude. Nerve conduction velocity on bilateral sciatic nerves was measured using electromyography. Consecutive compound muscle action potentials (CMAP) were calculated by averaging three consecutive stimulations. Left limb force, CMAP, and nerve conduction velocity (NCV) were normalized to the contralateral limb to account for inter-animal variability.

Results: RBX-treated mice in the 9-week cohort demonstrated significantly increased muscle force (mN*g) compared to 2-week cohort at 40 Hz (97 ± 7 vs 26 ± 12; p=0.01), 60 Hz (98 ± 15 vs 23 ± 8; p=0.01), and 80 Hz (111 ± 23 vs 20 ± 7; p=0.02). When normalized to the contralateral limb, RBX-treated mice in the 9-week cohort showed significant improvement in muscle force at 60 Hz (p=0.003), 80 Hz (p=0.047), and 100 Hz (p=0.007) compared with RBX-treated mice in the 2-week cohort. However, RBX mice were not statistically different from saline controls within each cohort. No significant increases in muscle force were observed between the 2-week and 9-week cohorts in saline-treated mice after normalization. EMG analysis demonstrated time-dependent recovery for both saline and RBX groups, with significant improvements in CMAP and NCV at 9 weeks compared with 2 weeks ($p<0.05$). However, when normalized to the contralateral limb, only RBX-treated mice retained significant increases in gastrocnemius CMAP amplitude at 9 weeks. RBX-treated mice exhibited significantly earlier recovery of gait parameters, characterized by earliest point of return to baseline in stance (day 28 vs 49), swing (day 49 vs 63), propulsion (day 42 vs 49), and brake duration (day 28 vs 49). Area-under-the-curve analysis further demonstrated significantly lower cumulative stance deficit burden in RBX-treated mice compared with saline controls (0.050 vs 0.402; p=0.007).

Conclusion: RBX-treated mice exhibited significantly greater muscle contractile force, CMAP, and nerve conduction at 9-weeks compared to 2-weeks post-tourniquet. Although both treatment groups demonstrated time-dependent recovery without intergroup differences, normalization to the contralateral limb revealed sustained improvement in the gastrocnemius CMAP amplitude of RBX-treated mice. RBX mice also demonstrated 1-3 weeks of earlier improvement in gait parameters compared with saline controls, accompanied with significantly reduced cumulative stance deficit burden. These data support earlier restoration of limb loading rather than uniform improvement across all gait domains. Findings suggest that RBX may enhance restoration of neuromuscular function following I/R injury, potentially through attenuation of mitochondrial oxidative stress and preservation of regenerative capacity. In future studies, histologic analysis of the tibialis anterior and gastrocnemius muscles from 2- and 9-week cohorts will be conducted to further characterize preservation of neuromuscular junction integrity and acceleration of myofiber regeneration as potential mechanisms of recovery.

Reducing Perioperative Transfusion Rates in Hip Fracture Patients Through Implementation of a Standardized Tranexamic Acid Protocol: Baseline Data from a Quality Improvement Initiative

Taha Elseaidy, MD, Ethan Cui, MD

Faculty Research Mentor: Jason Halvorson, MD

Introduction: Hip fracture patients are typically elderly, frail, and frequently anemic, placing them at high risk for perioperative blood loss and allogeneic transfusion. Tranexamic acid (TXA) has been shown to reduce transfusion requirements; however, its use remains inconsistent due to concerns regarding thromboembolic complications and lack of standardized protocols. This study evaluates baseline TXA utilization, transfusion rates, and hospital length of stay (LOS) to inform a protocol-driven quality improvement initiative.

Methods: A single-institution quality improvement study is being conducted including patients aged ≥55 years with radiographically confirmed intra- or extracapsular hip fractures presenting within 72 hours of injury. A standardized TXA protocol was defined as 1 g administered intravenously in the emergency department followed by 1 g IV infusion over 8 hours, and 1 g at induction. Baseline data were collected over a 6-month period (n=123). Primary outcomes included perioperative transfusion rate (hemoglobin ≤7 g/dL), TXA utilization, and LOS.

Results: The overall transfusion rate was 23.6%, with TXA administered in 38.2% of patients. Among those receiving TXA, 46% received two doses and 54% received a single dose, reflecting inconsistent use. Of 29 patients requiring transfusion, 65.5% received no TXA, and 10.3% received two doses. Transfusion rates decreased with increasing TXA exposure (25% no TXA vs. 13.6% two doses). Although not statistically significant (p=0.27), a dose-dependent reduction in transfusion risk was observed. Two-dose TXA was associated with lower odds of transfusion (OR 0.47, 95% CI 0.12–1.86), whereas any TXA exposure showed a smaller effect (OR 0.81, 95% CI 0.34–1.92).

Conclusion: Baseline data demonstrate underutilization and variability in TXA administration in hip fracture patients, with a relatively high transfusion rate. A clinically meaningful, dose-dependent reduction in transfusion risk was observed despite lack of statistical significance. These findings support the implementation of a standardized TXA protocol to improve adherence and optimize perioperative outcomes. Ongoing prospective data collection will assess the impact of protocol implementation.

Patient Factors Impacting Length of Stay after Total Shoulder Arthroplasty and Implications on Outpatient Surgery

Mina Entessari, MD; Jeffery D. St. Jeor, MD; James R. Black; Kyle A. Lynch, MD; Taylor R. Wood, MD; Jonathan D. Groothoff; Alan W. Reynolds, MD; Brian R. Waterman, MD; Nicholas A. Trasolini, MD

Faculty Research Mentor: Nicholas Trasolini, MD

Introduction: Orthopaedic surgeries have been transitioning to outpatient settings, leading to an increase in the use of ambulatory surgery centers (ASCs). While total shoulder arthroplasty (TSA) has traditionally been an inpatient procedure, recent advances in perioperative management and patient selection have decreased the hospital length of stay (LOS). However, who can safely undergo outpatient TSA in an ASC setting is important to distinguish.

Methods: A retrospective review was conducted. Patients who underwent TSA at a single institution were identified. LOS was determined by hours from surgery to discharge. Parameters of interest included type of surgery (i.e. anatomic TSA [aTSA], reverse TSA [rTSA], revision surgery, or aTSA converted to rTSA), body mass index (BMI), TSA on dominant hand, past medical history, age, gender, and race. All data analysis was completed with SAS Viya 3.5 (Cary, NC) via a linear regression; significance was alpha <0.05.

Results: 348 patients were evaluated with an average age of 67.5 (± 9.1) years, and an average hospital LOS of 37.3 (± 23.8) hours. When present, history of cardiac arrhythmia (e.g. atrial fibrillation, bundle branch block, etc.) and coagulopathy (e.g. Von Willebrand disease, hemophilia, etc.) prolonged LOS by 12.4 and 15.3 hours, respectively ($p=0.008$ and $p=0.048$). Female gender was associated with prolonged LOS of 6.1 hours ($p=0.014$). For every year increase in patient age there was a 0.4 hours increase in LOS ($p=0.003$). If surgery was performed on the side of hand dominance, there was a decrease of 5.0 hours in LOS ($p=0.044$). All other variables examined did not significantly impact LOS.

Conclusion: Outpatient TSA surgery can safely be performed for many patients. However, there are certain patient factors, including cardiac history, coagulopathy, age, and gender, that may predispose patients to increased LOS, reducing the likelihood of timely discharge in the outpatient setting.

Lateral Edge Angle, a New Parameter in Shoulder Instability After Arthroscopic Bankart Repair

Morgan Noel, MD

Faculty Research Mentor: Alan Reynolds, MD

Introduction: Arthroscopic bankart repair is a common surgical technique as a treatment for recurrent anterior shoulder instability given the overall low complication rates (fox). However, there is a risk of recurrent shoulder dislocations after bankart repair with a systemic review demonstrating a postoperative recurrence of 9.7% (Hurley).

Several radiographical factors have been investigated as risk factors for recurrent instability such as glenoid bone loss, Hill-Sachs lesions, on track and off track, as well as the distance to dislocation (DTD). Increased glenoid bone loss, longer Hill-Sachs lesions, and decreasing values of DTD (<10mm) were associated with recurrent anterior shoulder instability (LI, Barrow). More recently, two studies have assessed the craniocaudal aspect of a Hill Sach lesion through the lateral edge angle (LEA) with an angle >90° being associated with instability (Cong, Honoki). The purpose of this study is to assess the use of LEA in determining shoulder instability recurrence post arthroscopic bankart repair as well as examine the inter and intra-reliability of measuring LEA.

Methods: This was a retrospective review of patients who underwent arthroscopic bankart repair from 2018-2023. The patients were followed for at least two years post-operatively and evaluated for subjective and objective shoulder instability recurrence. The patients pre-operative MRIs were utilized to measure LEA, DTD, and glenoid bone loss by two orthopedic surgeons. LEA was measured twice by one individual to assess inter-reliability.

Results: Of the 73 patients included in the study, 13 patients had objective shoulder instability recurrence and 8 patients reported subjective shoulder instability with 52 patients reporting no recurrent instability. Of the objective recurrence group, 11/13 had LEA above 90 degrees while the subjective group had 2/8 and the no recurrence group had 11/52 patients with LEA >90°. Overall, the objective recurrence had a higher average LEA compared to no recurrence, 98.5° vs 93.9° ($p < 0.05$). The inter-reliability and intra-reliability were 0.94 and 0.93 respectively. The glenoid bone loss was 1.91mm for combine objective and subjective recurrence group and 0.92mm in the no recurrence group ($p = 0.03$). The DTD was 0.3mm and 8.2 mm in the objective and no recurrence groups respectively (0.004).

Conclusion: An increased LEA is associated with objective shoulder instability recurrence status post arthroscopic bankart repair. Increased glenoid bone loss and decreased distance to dislocation are associated with increased objective instability as well. LEA was found to be a reliable measurement as well. LEA can be utilized to assess for risk of dislocation after arthroscopic bankart repair.

The Sustainable OR: Optimizing tray efficiency and waste disposal in an effort to move towards a greener healthcare system

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Faculty Research Mentor: Maxwell Langfitt, MD

Introduction: Worldwide, the healthcare industry contributes somewhere between 4.6-8.5% of greenhouse gas (GHG) CO2 emissions overall. The U.S. contributes 27% of healthcare's carbon footprint globally, around double the carbon footprint of both China (17%) and the entire European Union (12%). Orthopaedic procedures are roughly 25% of the >17 million invasive procedures done annually. As one of the largest contributors to healthcare practice and revenue, orthopaedic surgeons should understand how small changes can make a great impact on GHG emissions and waste. Improving sustainability can lead to more cost-effective systems that function with faster turnovers and cheaper, more available implants, less waste of instruments and trays, and recycling or repurposing materials. Additionally, in 2024 Atrium Health made a pledge to be carbon neutral by 2030, which has raised the question of how to move closer to achieving this at the Wake Forest affiliated hospital locations. The purpose of this study was to evaluate total joint arthroplasty tray efficiency and to measure total waste in efforts to propose new recycling resources to improve institutional sustainability.

Methods: Efficiency – Tray Optimization
Operating room (OR) pick lists of three board certified arthroplasty surgeons for TKA and THA at a level 1 trauma center main hospital (MH) and a level 2 largely outpatient surgical center (OSC) were reviewed. The number of institutional and vendor trays were analyzed for consistency and accuracy. Differences in sterilization costs and GHG emissions were calculated using previously reported literature.
Sustainability – OR Waste
The average number of trash bags full of OR waste was calculated for both TKA and THA at the OSC. Subsequently, OR waste was then organized into three different receptacles: waste, recycling, and blue surgical wrap. Careful attention was paid to ensure no recycling material was contaminated with biohazard waste and that all blue wrap was collected prior to making incision. Blue wrap generated after incision (if any) was considered part of standard OR waste (trash).

Results:
Efficiency – Tray Optimization: For surgeon 1, 6 trays were used for THA at the OSC vs 9 trays at the MH. For TKA, 8 trays are used at both OSC and MH. For surgeon 2, 6 trays were used at the OSC vs 9 at the main hospital. For TKA, 4 trays were used at both OSC and MH. For surgeon 3, 8 trays were used for THA at both the OSC and MH. For TKA, 5 trays were used at the OSC vs 6 at the MH.
Number of trays were the same at both hospitals for TKA for 2 out of 3 surgeons. On average, 3 more trays were used for THA at the MH than at the OSC. (Table 1) Using existing literature, sterilizing 3 trays emits an extra 1656g CO2. At an average of 150 TKAs per surgeon per year this would emit an additional 745200g CO2 (745.2 kg). This is equivalent to 83.9 gallons of gasoline consumed, 828 pounds of coal burned, or 34.2 propane cylinders used for home barbeques.
Sustainability – OR Waste: An average of 4 bags of waste is accumulated for both TKA and THA amongst all 4 surgeons. When separating out recycling and blue wrap we found using above criteria we found that the waste was more appropriately designated as 1.5 trash bags of true waste, 2 bags of recycling, and 0.5 bag of blue wrap. This data suggests OR waste production could be cut by >50% with the implementation of a recycling program and partnership with blue wrap repurposing company.

Conclusion: Optimizing tray efficiency and restructuring OR waste disposal pathways are two ways orthopaedic surgery departments and surgical centers can easily contribute to global sustainability by significanlty reducing GHG emissions and inadvertendly cutting overall costs for hospital systems. Our study provides granular data to how these changes can help Atrium Health WFB move closer towards their pledge to net-zero carbon emissions by 2030.

Rates of Achieving Meaningful Outcomes and Predictors of Clinical Failure 5-Years After Undergoing Microfracture Augmented with Allograft Cartilage for Treatment of Hip Chondral Defects

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Introduction: Recently, a biologic scaffold combining micronized chondral allograft (BioCartilage®) and autologous platelet-rich plasma has been introduced to augment microfracture treatment of symptomatic chondral defects of the hip. The purpose of the study is to evaluate rates of achieving meaningful outcomes and clinical failure at 5-years after undergoing microfracture augmented with micronized chondral allograft and identify variables predictive of requiring clinical failure.

Methods: Data from a prospective series of consecutive patients with Outerbridge grade IV chondromalacia of the acetabulum or femoral head who underwent hip microfracture augmented with micronized chondral allograft between January 2017 and August 2019 was analyzed. Patient-reported outcomes were collected preoperatively and at minimum 5-year postoperatively. The Hip Outcome Score- Activity of Daily Living (HOS-ADL), -Sports Subscale (HOS-SS), modified Hip Harris Score (mHHS), and Non-Arthritic Hip Score (NAHS) thresholds for achieving the minimal clinically important difference (MCID), patient acceptable symptomatic state (PASS), and substantial clinical benefit (SCB) at 5-year after surgery were calculated. Regression analysis was perfomed to identify whether demographics and cartilage defect size was predictive of clinical failure.

Results: A total of 79 patients (84%) had 5-year follow up and were included in the final analysis. The combined mean age and BMI was 37.1±10.1 years and 27.1±4.5, respectively, with a mean follow-up time of 69.9±8.7 months. The average acetabular head and femoral chondromalacia area treated was 201.8±111.3mm^2 and 164±70.6mm^2, respectively. All functional score averages at 5-years demonstrated significant improvement ($p<0.05$). A total of 84.6%, 87.9%, and 77.3% reached at least one threshold for achieving MCID, PASS, or SCB respectively. Of the 79 hips analyzed, 12(15.2%) underwent conversion to total hip arthroplasty (THA) at an average of 31.3±21.7 months from hip arthroscopy. Older age was predictive of conversion to THA ($p=0.013$).

Conclusion: Patients undergoing microfracture with micronized chondral allograft augmentation for acetabular or femoral head chondromalacia demonstrated high rates of improvement in patient reported outcomes at 5-year follow-up regardless of chondromalacia defect size. While 15.2% required conversion to THA, most patients achieved clinical success indicating this novel technique provides good mid-term outcomes.

Does Simultaneous Periarterial Sympathectomy and Finger Ulcer Debridement Increase the Risk for Postoperative Infection?

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Faculty Research Mentor: Zhongyu Li

Introduction: Patients with chronic digital ischemia and Raynaud's phenomena often present with nonhealing digital ulcers or necrosis, requiring debridement in addition to periarterial sympathectomy (PAS). We hypothesize that simultaneous PAS and debridement does not increase the risk of postoperative infection.

Methods: Retrospective review of patients who presented with a nonhealing digital ulcer or necrosis who underwent PAS from 1997-2023 was performed. Postoperative infection was classified as an infection at the site of PAS incision or vascular graft donor site within 30 days. Demographics, surgical procedures and outcomes were collected. A multivariate logistic regression model was fitted to estimate adjusted odds ratios (aOR) and confidence interval (95% CI).

Results: 61 patients were identified. Autoimmune disease was present in 62% (N=38), tobacco abuse in 25% (N=16) and diabetes in 10% (N=6). Digital ulcers were present in 72% (N=44) and digital necrosis in 48% (N=29). Mean follow-up was 16.2±1.7 months (range 0.3-115 months). PAS with debridement was performed in 22 patients (36%) and 39 patients did not need debridement (61%). Of those 22 patients requiring debridement, 4 patients had infected ulcers and 4 patients had deep ulceration requiring bone debridement. The mean area of debridement was 1.5 cm2 (Figure 1). There was no association between simultaneous PAS and debridement and postoperative infection (aOR 0.12; 95% CI 0.12-1.14).

Conclusion: Our results suggest that simultaneous PAS and digital debridement can be performed safely without increased risk of postoperative infection.

Outcomes of 2.7 mm LC-DC Plate Fixation in Adult Diaphyseal Both-Bone Forearm Fractures: A Retrospective Analysis

Jeffery D. St. Jeor, MD

Faculty Research Mentor: Eben A. Carroll, MD

Introduction: Open reduction and internal fixation (ORIF) with plate constructs is the standard of care for adult diaphyseal both-bone forearm fractures, offering improved alignment, union rates, and functional outcomes compared to nonoperative management. However, traditional 3.5 mm and 4.5 mm plates are associated with hardware prominence, soft tissue irritation, and high rates of secondary procedures for implant removal. Smaller implants, such as 2.7 mm limited contact dynamic compression (LC-DC) plates, may reduce implant-related morbidity, but concerns remain regarding their mechanical strength and ability to maintain fracture stability. This study evaluates reoperation rates and causes for reoperation following fixation with 2.7 mm LC-DC plates.

Methods: A retrospective review was performed of adult patients treated operatively for diaphyseal both-bone forearm fractures at a level-one trauma center from 2011 to 2021. Inclusion criteria required fixation with 2.7 mm LC-DC plates and a minimum of 3-month follow-up. Patients with larger plates, dual plating constructs, intra-articular fractures, or age <18 were excluded. Demographics, injury characteristics, operative details, and postoperative outcomes were collected. Statistical analysis was performed using unpaired t-tests.

Results: Forty-four patients met inclusion criteria with a mean age of 43.1 ± 17.0 years and mean follow-up of 251 ± 376 days. High-energy mechanisms accounted for 91% of injuries, and 16% were open fractures. The overall reoperation rate was 18.2% (n=8). Nonunion requiring revision occurred in 9.1% (n=4), hardware-related complications in 2.3% (n=1), infection in 2.3% (n=1), heterotopic ossification requiring surgery in 2.3% (n=1), and peri-implant fracture in 2.3% (n=1). Length-unstable fracture patterns were significantly associated with increased reoperation risk ($p<0.001$), while demographic factors, fixation characteristics, and injury severity were not. Rates of hardware removal were lower compared to historical reports using larger plate constructs.

Conclusion: Fixation of diaphyseal both-bone forearm fractures with 2.7 mm LC-DC plates demonstrates acceptable union and complication rates comparable to traditional plating methods, with a potentially reduced need for hardware removal. These findings suggest that smaller plate constructs may be a viable option for select fracture patterns, particularly less complex injuries, though caution is warranted in length-unstable fractures. Further prospective studies with longer follow-up are needed to validate these results.

Ability of an institution wide preoperative antibiotic protocol to safely use cephalosporins in patients with penicillin allergies during primary total joint arthroplasty

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Faculty Research Mentor: John S. Shields, MD

Introduction: Perioperative cephalosporin antibiotic administration is proven to reduce surgical site infections, a morbid complication in total joint arthroplasty (TJA). Historically, patients with reported allergic reactions to other beta-lactam antibiotics (e.g. penicillin (PCN)) received alternate, less effective antibiotics due to potential cross-reactivity. New literature indicates patients with a PCN allergy, including anaphylaxis, are safe to receive cephalosporins without additional precautions or testing. We believe our institution wide protocol offers a safe and effective algorithm that will increase cefazolin usage in TJA.

Methods: This was a retrospective study that looked at patients who underwent primary TJA for osteoarthritis from 2022-2024. Institutional Review Board (IRB) approval was obtained for the study. Investigation was performed for demographics, type of surgery, antibiotic received, details on documented PCN allergy, adverse reaction from antibiotic received, and if the patient developed a prosthetic-joint infection (PJI).

Results: Our records identified a total of 3,910 patients who underwent TJA. Of the total patients, 667 (17%) had a documented allergy to PCN, and 67 (1.7%) had a documented anaphylactic reaction to PCN. Of the total number of patients, two (0.05%) had peri-operative non-anaphylactic adverse reactions, which included intermittent pruritus and facial swelling, but these could not be directly associated with the antibiotic received. And neither of these two patients had a prior history of PCN reaction.

Conclusion: Our institution wide protocol that administers cefazolin to patients with documented PCN allergy, including anaphylaxis proved to be safe and effective for our patients. There were only two adverse reactions in the total patient population, neither of which were anaphylaxis, nor could they be directly associated with the antibiotic received. Our data supports our institutional protocol that cephalosporins are safe in those with documented PCN allergy, including anaphylaxis.

Clinical and Surgical Outcomes Following Floating Knee Injuries

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Faculty Research Mentor: Jason Halvorson, MD

Introduction: Ipsilateral femur and tibia fractures, also known as “floating knee injuries,” represent a spectrum of extra-articular and intra-articular injuries associated with high energy mechanisms and therefore concurrent injuries. Because of the complex nature of these injuries, the optimal treatment remains controversial. Namely in the setting of intra-medullary nailing whether to use a single incision or separate incisions for certain fixation constructs. Further, clinical outcomes in the literature remain heterogenous likely owing to the diverse spectrum of these injuries. The aim of this study is to evaluate a retrospective series of patients who sustained floating knee injuries that underwent open treatment with either intramedullary nailing, open reduction with internal fixation, or combination of both constructs to treat floating knee injuries. We examined outcomes including union/malunion/nonunion rates, incidence of compartment syndrome, complications or infections leading to re-operation, and return to work status. Additionally, for Fraser type I floating knees (extra-articular tibial and femoral diaphyseal fractures), we examined if single (with retrograde femoral nail and antegrade tibial nail) versus multi-incision (antegrade femoral and tibial nails) techniques affected outcomes.

Methods: We performed a retrospective chart review of patients with floating knee injuries who underwent surgical treatment over the last 10 years (2012-2022) at our academic level 1 trauma center. Patients were identified by corresponding ICD-10 codes which were reviewed for accuracy using both injury and intervention imaging. Demographic data, concurrent injuries, treatment types, and outcomes were examined from the electronic medical record. Index consultation, operative and progress notes were used to identify surgical approach (dual versus single incision), implants used, compartment syndrome incidence, and subsequent clinical outcomes (union, malunion, infection, hardware failure, reoperation, return to work status). To evaluate the potential differences in outcomes between surgical procedures, a series of logistic regressions were performed. Results were reported as odds ratios (OR) with 95% confidence intervals (95% CI).

Results: A total of 104 patients were included. Average age was 39.4 years old. 66.3% were male. 66.3% of these patients had an open fracture. 1.9% had a concomitant vascular injury. 12.5% developed compartment syndrome. 72.1% of patients reached full union for both of their fractures initially. 4.8% and 20.2% went on to malunion and nonunion, respectively. 4.8% of patients eventually required amputation. 68.3% of patients returned to baseline ambulatory status with 51.9% documented as returning to work. There was a 7.7% mortality rate. 20.2% of patients suffered post operative infections requiring operative intervention. 57.7% of patients required return to the OR for various reasons. 32 patients had Fraser type I injuries, 19 of which were fixed using a single incision with retrograde femoral nail and antegrade tibial nail. Outcomes overall were not inferior with single incision fixation versus multiple incision fixation regarding union, nonunion, infection, return to baseline ambulatory status, and return to work with a trend toward significance for improved outcomes with single incision.

Conclusion: Floating knees are high-energy and complex injuries that are often difficult to treat, requiring multiple surgeries and subsequent complications. A high suspicion for compartment syndrome and vascular injury should be present when examining these patients on consultation. Additionally, nonunion rate and post-operative infection rate at our institution were 20.2% each. For simpler injuries, classified as Fraser type I, consider single-incision fixation techniques using retrograde femoral nail with antegrade tibial nail, as there was a trend toward improved outcomes.

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