

Is Perioperative Opioid Exposure Associated with Increased Post-Operative Opioid Use in Opioid-Naïve Total Knee Arthroplasty Patients Who Received an Advanced Pain Management Protocol?

Clifton Daigle, BS¹; Robert Branstetter IV, BS¹; Leland Van Deventer, BS¹; Ravi Rajendra, MD² Claudia Leonardi, PhD²; Amy Bronstone, PhD²; Vinod Dasa, MD²

School of Medicine¹ Department of Orthopedic Surgery² - LSUHSC

Presenting Author E-mail: rbran5@lsuhsc.edu

Disclosures: Clifton Daigle (N), Robert Branstetter IV (N), Leland Van Deventer (N), Ravi Rajendra (N), Claudia Leonardi (N), Amy Bronstone (N), Vinod Dasa (Bioventus, Swiftpath, Pacira, SIGHT Medical, My Medical Images, CyMedica Orthopedics, GrandCare Health Service, MEND Technology, Goldfinch Health, SKK, Cartiheal, NIH, OREF)

INTRODUCTION: Following total knee arthroplasty (TKA), opioids are commonly prescribed, despite known negative effects such as increased postoperative complications, delayed rehabilitation, and potential for opioid dependence. Studies suggest that perioperative opioid exposure serves as a predisposing factor for increased postoperative opioid utilization after TKA. There is a paucity of data regarding the influence of intraoperative opioid exposure on postoperative opioid consumption among opioid-naïve TKA patients. Thus, our study seeks to evaluate the correlation between perioperative opioid exposure and postoperative opioid utilization.

METHODS: This retrospective study included opioid-naïve patients who had unilateral primary TKA between May 2020 and November 2023 performed by a single surgeon. Opioid-naïve was defined as having no opioid prescriptions filled during the 3 months prior to TKA. All patients were treated using the same advanced multimodal pain protocol which included preoperative cryoneurolysis. The perioperative period was defined as the time from hospital admission to release from the post-anesthesia care unit (PACU); time spent in the hospital after release from the PACU (for patients who were not discharged on the same day of surgery) was excluded. Patients had to request opioids to obtain a prescription. Preoperative opioid prescription data was collected from the Louisiana Board of Pharmacy's Prescription Monitoring Program (PMP) database. REDCap was used for data management and statistical analyses were performed using SAS version 9.4 (SAS Institute Inc, Cary, NC, USA). Opioid prescriptions during the 3 months following TKA were analyzed as a function of perioperative opioid exposure.

RESULTS: A total of 140 patients were included in the study. Most patients were discharged home on the same day as surgery (71.4%). During the perioperative period, 22.1% (31/140) of patients received intravenous (IV) Fentanyl, 9.3% (13/140) received IV hydromorphone, and 31.4% (44/140) received an oral opioid either intraoperatively or during the PACU stay. Opioid prescriptions at discharge were provided for 5.7% (8/140) of patients. The odds of filling an opioid prescription within three months post-discharge from total knee arthroplasty were 2.75 times higher in patients who received opioids in the PACU compared to patients who did not receive opioids in the PACU (odds ratio=OR=2.75, 95% confidence interval: 1.06–7.18, p = 0.039).

DISCUSSION: PACU opioid administration was significantly associated with increased postoperative opioid utilization. Further investigation is required to determine whether the pain management protocol used in the present study is effective in limiting opioid use following TKA.

SIGNIFICANCE/CLINICAL RELEVANCE: Identifying perioperative opioid exposure as a risk factor for postoperative opioid independence may raise awareness of the hazards associated with opioid administration, potentially leading to enhanced patient outcomes and implementation of alternative pain management protocols.

Targeting arthralgia in knee osteoarthritis via non-psychoactive cannabinoid mechanisms

Collin Toups¹, Grace Guillot¹, Sydney Jensen², Kaitlyn Redondo², Vinod Dasa², Luis Marrero²

¹School of Medicine ²Department of Orthopaedic Surgery, Louisiana State University Health Sciences Center –
New Orleans

First/Presenting Author E-mail: ctoup3@lsuhsc.edu

Disclosures: No disclosures

INTRODUCTION: Non-surgical management of painful knee osteoarthritis (KOA) involves NSAIDs, corticosteroids, and opioids, which provide short-term relief and may worsen disease progression. Hence, our overarching goal is to evaluate novel, targeted analgesics that also provide effective, longer lasting anti-inflammatory relief for KOA. Activation of the polymodal transient receptor potential vanilloid 1 (TRPV1) cation channel can cause nociceptive arthralgia. TRPV1 is expressed in articular sensory afferents and some neuroendocrine-like synoviocytes. External or endogenous ligands, such as capsaicin and hydroxyeicosatetraenoic acid derivatives, can bind TRPV1 to trigger the release of calcitonin gene-related peptide (CGRP) that contributes to neurogenic inflammation. Endocannabinoids anandamide (AEA) and 2-arachidonoylglycerol (2-AG), and exogenous cannabidiol (CBD) share chemical features that can activate and, after prolonged activity, desensitize TRPV1 by interacting with its capsaicin-binding pocket, as well as mildly trigger anti-inflammatory cascades through cross-interaction with the cannabinoid 2 receptor (CB2R). CBD analogs such as JWH133 have been developed to have a 200-fold higher binding affinity for CB2R than conventional CBD. Before testing the analgesic and anti-inflammatory effects of such analogs in KOA-attributable arthralgia and inflammation, it is crucial to identify responders to treatment from a diverse KOA patient population. This study aims to identify the differential distribution of CB2R and activated TRPV1 in the synovial tissues and fluid of KOA patients grouped by reported pain.

METHODS: Specimens were collected from 40 patients with end-stage KOA. The patients were divided into two groups of 20 individuals each based on their KOOS pain scores. The first group reported the lowest pain scores, while the second group reported the highest pain scores. Synovial tissue and fluid were collected during total knee arthroplasty, preserved, and banked. Formalin-fixed synovial tissues were processed for paraffin sectioning and staining by H&E and for detection of TRPV1 and CB2R by indirect immunofluorescence. H&E sections were evaluated microscopically for synovitis and scored. Distribution of TRPV1 and CB2R relative to synovial tissue layer and area were calculated using Slidebook™ (3i) software-assisted morphometry of confocal photomicrographs. Synovial fluid was cleared, digested, and analyzed for CGRP by sandwich ELISA (Cusabio®). Prism (Graphpad) software was used to compare groups or correlate by Student's t or Spearman rho with $\alpha=0.05$.

RESULTS: Compared to the low pain group, patients reporting high pain presented with higher inflammation based on synovitis scores ($p \leq 0.0002$) and a higher percentage of synovial TRPV1 ($p \leq 0.0004$) with correspondingly high concentrations of CGRP ($p=0.0547$) in synovial fluid. Patients reporting low pain had a significantly higher distribution of CB2R than the high pain group ($p \leq 0.0001$) and altogether, CB2R expression inversely correlated with synovitis severity ($R = -0.51$; $p \leq 0.0001$).

DISCUSSION: Increased TRPV1 expression in the synovium of patients reporting high pain could be used to predict patient responsiveness to intra-articular supplementation with CB2R-specific analogs like JWH133 in the modulation of arthralgia and inflammation. The lower expression of CB2R in patients reporting high pain may indicate internalization due to ligand deficiency or tolerance following chronic upregulation. It can be predicted that a more significant expression of CB2R may indicate higher endocannabinoid production, which would allow for increased TRPV1 crosstalk and, thus, greater desensitization in the patients reporting low pain.

SIGNIFICANCE/CLINICAL RELEVANCE: Patient-centric co-targeting of CB2R and TRPV1 by local delivery of higher affinity CBD analogs can provide a safe but potent alternative to alleviate painful inflammatory arthropathy.

Chronic Osteomyelitis Predictors with Pattern of Care and Health Services

Thuc Truong, Angella Chang, Renee Breaux, Charlotte Pearson, Dr. Jessica Rivera
LSUHSC School of Medicine New Orleans, LSUHSC Department of Orthopedics
First/Presenting Author E-mail: ttruo2@lsuhsc.edu

Disclosures: Thuc Truong (N), Angella Chang (N), Renee Breaux (N), Charlotte Pearson (N), Dr. Jessica Rivera (N)

INTRODUCTION: Chronic osteomyelitis is an infection of the bone presenting at a point in time after an acute injury or trauma. The infection may occur due to a multitude of reasons, but a couple would be open wounds or biofilms created by pathogens on implanted hardware. Commensal staphylococci are the most common cause of osteomyelitis. Management of chronic osteomyelitis can either be surgical with irrigation and debridement, a course of antibiotics ranging from four to six weeks, or a combination of both. Chronic osteomyelitis can complicate the healing process, but also place a burden on the patient if there is a need for multiple operations and daily antibiotic treatments. The study aims to look at varying comorbidities, treatment plans, and social determinants of health for associations with chronic infection. Doing so will help improve the care and management of bone infection cases.

METHODS: (IRB #5170) This is a retrospective cohort study of patients that have been diagnosed with chronic osteomyelitis. The study covers 27 electronic medical records, from Epic, of patients at University Medical Center in New Orleans. The study includes patients that are aged 18 or over, have chronic osteomyelitis of the extremity long bone, hind foot, or bony pelvis diagnosis, and diagnoses between 2016 and 2022. Data being abstracted from the charts include, but not limited to, social determinants of health and outcomes of medical and surgical treatments.

RESULTS: The average age of abstracted from the charts is 44.5 years old with charts being 2/3 male and 1/3 female. 55.56% of the charts indicated were African American and the other 44.44% were White. Most of the charts, 85%, had antibiotics and surgery treatment, while the rest were only treated with antibiotics. 3 of the 4 charts receiving only antibiotic treatment, the orthopedic team did not see a need for surgical treatment and noted that antibiotic treatment yielded good progress. Only 6 of 27 charts were not prescribed long term IV antibiotics. There were 4 charts indicating IV drug use with 1 not prescribed long term IV treatment. The other 5 not on IV responded well to initial oral antibiotics and infectious disease consult not recommending IV treatment. There were 6 charts with a recurrence of chronic osteomyelitis. However, 83.33% of the patients who had a recurrence of chronic osteomyelitis were prescribed long term IV antibiotics. Additionally, the patients with recurrence, 33% only had antibiotics and no surgery as treatment.

DISCUSSION: From the charts abstracted, the most common method in treating chronic osteomyelitis was to have a combination of antibiotic and surgical treatment. Additionally, observed was the common practice of a prolonged course of antibiotic treatment through IV. However, it was interesting to note that most of the recurrence had been prescribed with 6 weeks of antibiotics. When increasing the number of charts abstracted, it may be of merit to see the percentage of patients not prescribed a course of IV antibiotics developing a recurrence of chronic osteomyelitis. The data collection is still ongoing and a definitive conclusion cannot be made at this time.

SIGNIFICANCE/CLINICAL RELEVANCE: If the aims of the project are reached, a new approach to managing osteomyelitis may allow to better treat and manage patients without relying on an extended period of antibiotics.

Abstract Title: Not an uncommon fungal arthritis: Sporotrichosis arthritis

Anthony Yeh, DO¹; Ashaur Azhar, MD²

^{1,2}LSU School of Medicine, ¹Department of Internal Medicine, Lafayette, LA, ²Department of Medicine, Section of Infectious Diseases, New Orleans, LA

First/Presenting Author E-mail: ayeh3@lsuhsc.edu

Disclosures: Anthony Yeh, DO (None), Ashaur Azhar, MD (None)

INTRODUCTION: Early treatment and diagnosis of septic arthritis is important to prevent disseminated disease and joint disability. Fungal joint infections can be slow to present, which can delay diagnosis, leading to severe disease. We present a case of *Sporothrix schenckii* joint infection.

CASE: 83 y Vietnamese male, retired fisherman and gardener with history of tobacco use, was referred to our facility for bilateral wrist pain, with significant swelling and drainage from his right wrist. Previously, he underwent unsuccessful debridement and medical therapy, which limited functionality. MRI showed an expanding mass in the radial and ulnar bursae within the carpal tunnel. He was taken to the OR for irrigation and debridement with tenosynovectomy of the flexor tendons and neurolysis of the median nerve. Tissue was sent for cultures and sensitivities and he was referred to infectious diseases for culture directed therapy.

RESULTS: Bacterial and Acid Fast Bacilli cultures were negative, but fungal cultures were positive for *Sporothrix schenckii* complex. Patient was started on itraconazole oral capsules. The wrist healed with proper wound closure, which resulted in improved functionality of his wrist.

DISCUSSION: *Sporothrix schenckii* complex joint infections are not uncommon. Without early diagnosis and appropriate treatment, it can lead to life-long disability of the joint and limb. Literature review shows knees and wrists are most commonly involved. In immunocompromised hosts, it can cause disseminated disease. Mainstay of treatment is surgical debridement, and a long course of itraconazole. Amphotericin B can be used in serious disease but can be nephrotoxic. The patient has been following at our facility for the last 9 months with significant clinical improvement, with a goal duration of treatment of 12 months.

SIGNIFICANCE/CLINICAL RELEVANCE: Sporotrichosis joint infections should be considered in the differential diagnosis of septic arthritis. Unlike bacterial septic joints, fungal joint infections can be indolent and misleading, which can delay treatment.

ACKNOWLEDGEMENTS: We acknowledge LSUHSC Orthopedics-oncology team for assisting in treatment of this case.

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IMAGES: (Left to Right). A=Wrist before and B= Wrist after surgery. C, D= MRI



Bromelain as a Source of Debridement for Infected Orthopaedic Implants

Matthew Bratton BS¹, Jaclyn Murphy BS¹, Jessica Rivera MD,PhD²

¹LSU School of Medicine, ²Department of Orthopaedics,

Mbrat1@lsuhsc.edu

Disclosures: Matthew Bratton (N), Jaclyn Murphy (N), Jessica Rivera (AAOS: Board or committee member, AAOS Now: Editorial or governing board, Limb Lengthening and Reconstruction Society: Board or committee member, Orthopaedic Research Society: Board or committee member)

INTRODUCTION: The growth of biofilms on orthopedic implants is of major surgical concern, with infection rates estimated to be up to 2 percent for all orthopedic procedures. Currently, manual scrubbing accompanied with a saline wash is the most common method of eradication. However, enzymatic debridement has emerged as an alternative option. Bromelain is an enzyme derived from pineapple stem and has been previously used in several studies as a method of biofilm dissolution. In addition to its intrinsic antimicrobial properties, bromelain is capable of hydrolyzing the complex carbohydrate shell of EPS and destabilizing the biofilm. As a result, we hypothesized that bromelain may be used for the debridement of infected orthopaedic implants.

METHODS: In our study, 10mm x 3.5mm surgical grade cortical bone screws were incubated in methicillin resistant *Staphylococcus aureus* (MRSA) inoculated broth for 120 hours with 10% fetal bovine serum (FBS). Treatment groups were exposed to low dose bromelain solution (200 µg/mL), high dose bromelain solution (1mg/mL), or bromelain powder (3 U/mg) for 20 minutes. The screws were then either rinsed with 1X phosphate buffer saline (PBS) or briefly scrubbed for thirty seconds prior to rinsing. The screws were then stained with 0.25% crystal violet (CV) dye for 25 minutes to determine the amount of biofilm remaining. The stained biofilm was removed from the screws using 33% acetic acid. Resultant effluents were analyzed by optical density (OD) read at 600nm. Optical density means were compared between each treatment group and respective controls with Students t-test. The percent of biofilm dissolution was determined using absolute OD values in the following formula: % BD = [OD Control – OD Treated/OD Control] × 100.¹

RESULTS SECTION: Six screws were used for each group. The average optical densities of the low dose bromelain solution (0.104±0.047) was no different compared to controls (p=0.345). The average optical densities of low dose + scrub bromelain solution (0.068±0.020) and high dose + scrub solution (0.045±0.014) were significantly different from their respective controls (p=0.012; p= 0.001). The average optical densities for screws in the high dose treatment group (0.056± 0.012), powder (0.041±0.010), and powder + scrub (0.032±0.005) were also significantly different than their respective controls (p=0.003; p=0.001; p < 0.0001). The powder + scrub treatment resulted in 91% biofilm dissolution.

DISCUSSION: Based on our work, bromelain is a promising alternative option for the debridement of infected orthopedic implants. However, an increased sample size is needed to more accurately assess the reliability of our results. In addition, further investigation is required to assess how different concentrations and exposure times may affect the percent biofilm dissolution. In the future, this experiment should be replicated in vivo to determine if treating infected implants with high dose bromelain yields any toxic side effects to the surrounding tissue.

SIGNIFICANCE/CLINICAL RELEVANCE: Bromelain enzymatic debridement has the potential to be used as an alternative option to effectively treat infected orthopaedic implants and reduce the risk of further revision surgeries.

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Methods to Measure Bone Healing in Distraction Osteogenesis

Matthew Bratton BS¹, Jaclyn Murphy BS¹, Thuc Troung BA², Jessica Rivera MD,PhD²
¹LSU School of Medicine, ²Department of Orthopaedics,
Mbrat1@lsuhsc.edu

Disclosures: Matthew Bratton (N), Jaclyn Murphy (N), Thuc Troung (N), Jessica Rivera (AAOS: Board or committee member, AAOS Now: Editorial or governing board, Limb Lengthening and Reconstruction Society: Board or committee member, Orthopaedic Research Society: Board or committee member)

INTRODUCTION: Distraction osteogenesis is a method by which new bone is formed by slowly distracting at an osteotomy site via the bone's response to mechanical stress. Distraction osteogenesis can be used to replace bone that has been lost for various clinical reasons including trauma, tumor, and infection. The newly grown bone is formed via endochondral ossification which then gradually ossifies until it reaches the point where it can bear the load of an intact bone. Currently, orthopaedic surgeons must use clinical judgement and radiographs to determine if the bone is healed enough to bear normal loads. This study involves performing distraction osteogenesis in a mouse model to gradually lengthen the femur and measuring the rate of healing.

METHODS: In our experiment, three mice underwent a surgical approach to the lateral thigh to expose the femur. An external fixator (RISystems) that has the ability to longitudinally distract bone was placed on the left femur. The femur was then cut using a Gigli saw and the mice were then closed with two sutures. For group 1 animals, the fixator was used to stabilize the bone. Group 2 animals underwent the same fixator placement but starting post-surgical day 2 underwent 16 days of distraction of the bone at 0.25 mm increments once per day for a total of 4 mm total distraction. Group 3 mice underwent the same osteotomy and fixator placement. However, prior to stabilizing the bone by connecting fixator pines to the bar, the intramedullary space was infected with 0.2 µl of Methicillin Resistant *Staphylococcus Aureus* (MRSA) broth.

RESULTS: Two of the three external fixators fell off the mice during the distraction period. We did observe new bone growth in the femurs of the remaining distracted mouse through the use of a pediatric x-ray device. However, the micro indentation device that was used to detect bone healing was too powerful for the femur and resulted in additional fracture when applied.

DISCUSSION: Continued work is needed to show that the use of the micro-indentation device will accurately measure the properties of bone healing. Future work will include rat models, which have larger femurs and may better support the distraction devices. Ultimately, we hope to give orthopaedic surgeons another tool to determine the distracted bone's properties compared to intact bone.

SIGNIFICANCE/CLINICAL RELEVANCE: This study hopes to give surgeons who preform distraction osteogenesis a tool to objectively determine if new bone grown is ossified enough to bear the load of intact bone

IMAGES AND TABLES:



Characterizing the Spectrum of Scoliosis in Autism Spectrum Disorder

Matthew Bratton BS¹, Ravi Rajendra MD², Claudia Leonardi PhD², Carter Clement MD, MBA^{2,3}
¹LSU School of Medicine, ²LSU Department of Orthopaedics, Children's Hospital New Orleans³
Mbrat1@lsushc.edu

Disclosures: Matthew Bratton (N), Ravi Rajendra (N), Claudia Leonardi (N), Carter Clement (N)

INTRODUCTION: Currently, no data exists on whether children with both ASD and adolescent idiopathic scoliosis (AIS) have distinct scoliosis curve types or varying surgical managements compared to neurotypical children. Our retrospective chart review at a single high volume scoliosis center spanning 5 years describes patterns of adolescent idiopathic scoliosis in children with ASD.

METHODS: Using ICD-10 codes, we constructed an electronic database of adolescents with a diagnoses of both AIS and ASD. We confirmed the diagnosis of ASD through a thorough review of clinician notes. To avoid confounding with syndromic conditions, adolescents with a syndrome independently associated with scoliosis were excluded. All participants were diagnosed with scoliosis between the ages of 10 to 18 consistent with AIS. We excluded other types of scoliosis including neuromuscular and congenital cases. All individuals included had radiographs available for independent interpretation by two fellowship trained pediatric orthopaedic surgeons.

RESULTS: In our study, we describe Lenke curve types, demographics, and radiographic characteristics of 35 patients with both AIS and ASD treated at a single center over a five-year period. An atypical number of patients (17/35 patients; 49%) had sagittal plane abnormalities on radiograph. Fifteen of the 35 patients (41%) had a maximum thoracic kyphosis equal to or greater than 40 degrees. Five of the 35 patients (14%) exhibited thoracolumbar junctional kyphosis. Of our 35 patients, 11 (31%) were treated surgically. For these patients, we calculated the length between initial appointment and definitive surgery, which ranged from 11 days to 3 years. Social and behavioral barriers limited 3 patients (9%) who were indicated for surgery from receiving surgical treatment.

DISCUSSION: Sagittal plane abnormalities, especially hyperkyphosis, are more common in ASD patients diagnosed with AIS than expected based on published AIS norms. These results suggest that scoliosis in ASD should potentially be considered a form of syndromic scoliosis rather than true AIS

SIGNIFICANCE/CLINICAL RELEVANCE: We hope to provide evidence that patients with autism display unique curve characteristics compared to neurotypical children and show that patients with autism may experience unique psychosocial issues such as anxiety, skin picking, and behavioral issues in the postoperative period.

IMAGES AND TABLES:

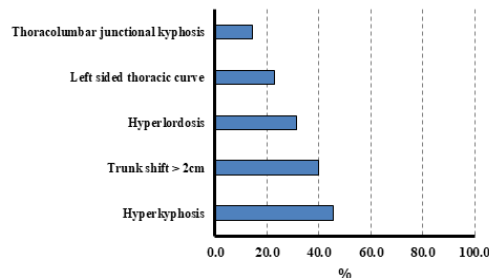


Figure 2. Sagittal plane measurements for patients with ASD diagnosed with AIS (n=35).

Evaluating limb regenerating capabilities of osteoprogenitor cells

Authors: Joshua P. Broussard, BS¹, Sylvia Culpepper, MS¹, Jennifer Simkin, PhD¹

¹Dept. Orthopedic Surgery, Louisiana State University Health – New Orleans

Email: jbro52@lsuhsc.edu

Disclosures: Authors have no disclosures to declare

INTRODUCTION: Osteoprogenitor cells are essential in bone healing but sometimes fail to fully regenerate necessary structures. This disparity in healing is exemplified in the mouse model where the distal ½ of the digit tip (P3) can fully regenerate while amputating proximal to this point of the phalanx (P2) results in regenerative failure. It is not yet clear why one injury regenerates and the other forms a scar. Previous studies, in other tissues, suggest regenerative cells overcome stress-induced cellular senescence better than non-regenerative counterparts. However, this stress resistance has yet to be tested in osteoprogenitor cells of the regenerating digit. We hypothesize that osteoprogenitor cells from regenerative P3 will have a greater ability to proliferate and greater resistance to stress-induced cellular senescence compared to osteoprogenitor cells from a non-regenerative P2.

METHODS: Osteoprogenitor cells were isolated from P3 and P2 bones in mice and then cultured in T-25 cell culture flasks. To calculate population doubling time, an initial starting concentration of 100,000 P3 or P2 osteoprogenitor cells were each seeded into 3 T-25 flasks. Cells were grown to 80% confluency, and then cells were counted using a hemacytometer. Population doubling was graphed using Population Doublings (PDs) = $\log [(number\ of\ cells\ harvested)/(number\ of\ cells\ seeded)]/\log 2$. To measure levels of senescence in P3 and P2 cell populations with each passage, cells were stained with Senescence-Associated β -Galactosidase (SA- β Gal) and then counted using brightfield microscopy. To measure stress resistance, P3 and P2 cells were placed in 24 well plates with varying concentrations of hydrogen peroxide (0 μ M, 75 μ M, 150 μ M, and 300 μ M hydrogen peroxide dilutions) for 2 hours. H₂O₂ was washed off and cells collected 24 hours later for SA- β Gal senescent staining.

RESULTS: P2 (non-regenerative) osteoprogenitor cells exhibit enhanced proliferative ability in vitro compared to P3 (regenerative) osteoprogenitor cells (n = 3). P3 cells show a higher level of senescence in vitro compared to P2 cells (p<0.05 n=3 per group. Student T test). P3 cells exhibit increased levels of senescence compared to P2 cells in response to H₂O₂ (p<0.05 n=4 per group. Fisher's LSD Post-hoc).

DISCUSSION: To determine the intrinsic capabilities of osteoprogenitor cells derived from distinct anatomical regions of the body, we first analyzed the proliferative potential and cellular senescence characteristics of P2 and P3 osteoprogenitor cells in vitro. Our findings shed light on the nuanced nature of these cells' behavior and provide insights into their regenerative capacities. Initially, we hypothesized that P3 osteoprogenitor cells would exhibit an inherent advantage in terms of proliferative ability and a reduced propensity for cellular senescence when compared to P2 osteoprogenitor cells due to the regenerative ability of the P3 phalangeal element. However, our observations revealed a contrasting pattern. Specifically, P3 (regenerative) cells displayed an accelerated onset of senescence, a decelerated rate of proliferation, and were more susceptible to stress induced cellular senescence compared to P2 (non-regenerative) cells. This suggests that P2 osteoprogenitor cells retain an intrinsic capability for proliferation, at least in vitro, and may be hindered by the in vivo environment. In future studies, we will assess the in vivo proliferative capabilities of P3 and P2, as well as their resistance to stress-induced cellular senescence. This aims to shed light on the pivotal role played by the wound's microenvironment in shaping the proliferative and stress-resistant capacities of P3 and P2.

SIGNIFICANCE/CLINICAL RELEVANCE: Enhancing our understanding of the mechanisms guiding osteoprogenitor cells, which dictate tissue regeneration and scar formation following injuries, can help refine clinical and surgical approaches as well as the development of therapeutic interventions for bone fractures and wound healing.

The Use of Botox-A as Management for African Americans with Keloid Scars

Chontel Carter Frank¹; Jennifer Simkin²

¹School of Nursing, LSUHSC ²Department of Orthopedic Surgery, School of Medicine, LSUHSC
ccarte@lsuhsc.edu

Disclosures: Authors have no competing interests to declare

INTRODUCTION: Keloids are tumor-like scars that are very difficult to manage. They are associated with a significant morbidity that impacts one's quality of life and performance. Keloids cause pain, itchiness, disfigurement, and are associated with negative mental self-perceptions. Keloids are more prevalent in African Americans, females, and individuals ages thirty and under (Olopoenia et al., 2024). Keloids are caused by invasive proliferative fibroblasts that accumulate collagen to grow after wound closure (Hao et al., 2018). Previous cellular studies have shown that cytokines like IL6 and fibrotic factors like Connective Tissue Generation Factor (CTGF) are significantly elevated in keloid tissues and are partly responsible for the increased collagen generation (Zhu et al., 2015). To reduce collagen production, intralesional injection of botulinum toxin type A (Botox-A) has been used in Asian populations with keloids and has shown promising clinical and histological improvement (Khateriy et al., 2022). However, there are no clinical trials to date with Botox-A and the treatment of African American patients with keloids in the United States. The efficacy of Botox-A for the treatment of hypertrophic and keloid scars is still debatable and further research is needed to clarify the mechanisms of action of Botox-A on the keloid fibroblast. To further understand the cellular mechanisms involved in keloids a framework is developed to visualize the human keloid fibroblast cell of an African American, treat these cells with Botox-A and evaluate the effect on CTGF and IL6 expression by keloid fibroblasts.

METHODS: A keloid fibroblast line was available for purchase from ATCC. This line was generated from an adult African American woman undergoing keloid biopsy. As a comparison, a dermal fibroblast line from an African American woman was also purchased from ATCC. Fibroblasts were cultured and stimulated with graded concentrations of botulinum toxin A (1U/ml, 2U/ml, and 4U/ml). Treated fibroblasts were compared to untreated fibroblast controls and each assay was repeated for a technical replicate of n=6. Media was collected after 48 hours of treatment; culture supernatant was collected for analysis of CTGF and IL6 secretion. The supernatant was assayed using the human IL6 and CTGF ELISA Kits.

RESULTS: Keloid fibroblasts showed reduced concentrations of CTGF in response to 2U/ml of botulinum toxin A ($p < 0.05$, ANOVA). In contrast, healthy fibroblasts did not show any response to botulinum toxin A. Additionally, botulinum toxin A did not show an effect on IL6 expression from either fibroblast type.

DISCUSSION: Our findings support the hypothesis that Botulinum toxin A has the ability reduce expression of the key fibrotic factor, CTGF, in keloid fibroblasts of an African American woman. Manipulating the generation of CTGF and its profibrotic effect can have a profound effect on keloid formation. Botulinum toxin A has exhibited significant effects on the appearance and symptoms of keloids in Asian populations. This study suggests these findings may extend to African American populations and can be useful in future management of keloids in the United States. Limitations of the study include the use of a single patient cell line, which highlights the gap in resources available for keloid research in the US.

SIGNIFICANCE/CLINICAL RELEVANCE: This study provides valuable insight into the use of botulinum toxin A for the management of African Americans with keloid scars.

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Evaluation of the Hand Trauma Transfers at a Level-1 Trauma Center after Joining the ASSH Hand Trauma Center Network

William Delahoussaye¹, Madeline Gautreaux¹, Patrick Palines², Kelly Babineaux²

¹LSUHSC School of Medicine, ²LSUHSC Department of Surgery

wdelah@lsuhsc.edu

Disclosures: William Delahoussaye (N), Madeline Gautreaux (N), Patrick Palines (N), Kelly Babineaux (N)

INTRODUCTION: Hand trauma remains among the most prevalent and expensive injury types within the United States. However, there remains limited access to specialized hand surgical care throughout much of the country, particularly in rural areas. In 2007, the American Society for Surgery of the Hand (ASSH) and the American College of Surgeons (ACS) established the National Hand Trauma Center Network (NHTCN) to improve coordination and regionalization of hand trauma services. In 2019, our institution joined the NHTCN with the aim of expanding access to hand surgery while maximizing efficiency and resource allocation and optimization. The goals of this study are to evaluate how joining the NHTCN affected the volume, demographics, and severity of hand trauma transfers to our institution.

METHODS: Data for this study was collected retrospectively over a six-year period from 2016 to 2021 from our institutional trauma registry. Patients were selected based on the criteria of being transferred to our facility due to hand mono-trauma. Analysis of transfer rates, transfer distance, injury patterns, insurance type, path of care, and hospital charges prior to and after joining the NHTCN in January of 2019 was performed using two-sample t-tests for averages or two-sample proportion tests for percentages.

RESULTS: There was a total of 39 hand mono-trauma transfers over three years prior to joining the NHTCN, and 114 over three years after. The average number of hand transfers per year increased by 25 (95% CI: 24.21 to 25.79; $P < 0.0001$), with a significant increase in transfers from both in-state and out-of-state sending facilities. This included an increase in transfers of significant injuries including complete amputations (15 from 4), partial amputations (18 from 13), and open fractures (35 from 11). There were no significant changes in demographic make-up or insurance coverage of hand transfers, although total charges increased from \$931,515 to \$3,837,625. The average distance traveled by hand transfers increased by 22.58 miles (95% CI: 3.17 to 42.00; $P = 0.0229$) after joining the network. The percentage of closed fractures increased by 14.91% (95% CI: 8.37 to 21.45; $P = 0.0105$) and the percentage of partial amputations decreased by 17.54% (95% CI: -1.30 to -33.78; $P = 0.0186$). Admissions of transfers decreased by 27.26% (95% CI: -17.51 to -37.01; $P = 0.0005$) after joining the network. The percentage of out-of-state transfers requiring surgery increased significantly (95% CI: 6.20 to 99.36; $P = 0.0404$), whereas there was no change among in-state transfers requiring surgery (95% CI: -13.78 to 21.32; $P = 0.5950$).

DISCUSSION: Integration into the NHTCN increased our institution's volume of hand trauma transfers, with patients being transferred from farther sending facilities. These findings suggest that joining the NHTCN increased patient access to specialized hand surgical care at our institution. Although an overall increase in the quantity of severe injuries was observed, there were only modest shifts in the overall composition of transfers. Optimizing and avoiding unnecessary transfers remains a challenging proposition.

SIGNIFICANCE/CLINICAL RELEVANCE: This project will demonstrate how integration into the NHTCN affects patient access to care, resource allocation, and hospital charges.

Macrophage-Mediated Tissue Regeneration: Uncovering the Metabolic Differences in Regenerative and Fibrotic Macrophages

Aysha Evans, MS¹, Robert Towers PhD², Mimi Sammarco, PhD³, Jennifer Simkin, PhD¹

¹LSU New Orleans School of Medicine, Department of Orthopaedic Surgery, ²University of Texas Southwestern, Dallas, TX, ³Mayo Clinic, Rochester, MN

First/Presenting Author E-mail: aeva15@lsuhsc.edu

Disclosures: I nor the co-authors have any disclosures.

INTRODUCTION: In humans, injury to muscle and bone often results in regeneration of the structure and function of the injured organ. However, after traumatic multi-tissue injuries, like amputations, healing ends in scar formation and a loss of the original structure and function of the injured organ. What drives regeneration in one injury and scar formation in another is still under investigation. Importantly, macrophages are cells essential for tissue regeneration; their depletion leads to scar formation or complete healing failure¹. And yet, macrophages are also known to drive tissue fibrosis after injury¹⁻³. Thus, understanding the balance between pro-regenerative and pro-scar forming macrophages is essential to improve healing and promote regeneration after traumatic injury.

METHODS: To delve into macrophage roles after traumatic injury, we employ a mouse model system where amputation through the third phalangeal element results in complete rebuilding of bone, dermis, skin, nerves, and blood vessels. Conversely, amputation proximal to this site through the second phalangeal element, results in unpatterned bone callus formation and excessive collagen production, causing structural and functional loss in the injured tissue⁸. These two injury sites are mere millimeters apart and allow us to examine how the macrophage response within the same animal results in vastly different outcomes. In this comparative model, we use metabolomics, single cell and spatial transcriptomics⁵⁻⁶, and in vitro assays to compare macrophages in regenerating and scar-forming injuries.

RESULTS: Using metabolomics and transcriptomics, we observe that macrophages in regenerating injuries prefer fatty acid oxidation and express growth factors, rather than inflammatory cytokines. Additionally, spatial transcriptomics shows these macrophages talk specifically to surrounding osteoblasts through bone morphogenetic protein (BMP) signaling, potentially explaining patterned bone growth post-injury. In contrast, macrophages in scar-forming injuries favor glycolysis and express higher levels of fibrotic and inflammatory proteins compared to their regenerative counterparts. These macrophages are not observed interacting with surrounding osteoblasts through BMP signaling.

DISCUSSION: Findings from this study indicate macrophages play separate roles during musculoskeletal regeneration and scar formation – providing BMP signals during regeneration and pro-fibrotic signals during scar formation. Additionally, we find the metabolic state of macrophages separates injury outcome with fatty acid oxidation being high during regeneration and glycolysis high during scar formation. Previous studies have linked metabolic state to gene expression, specifically showing fatty acid oxidation can increase BMP signaling in cells⁷. Thus, it may be possible to manipulate the metabolic profile of a macrophage to increase pro-regenerative events after injury. Future studies will test the ability to create a “pro-regenerative” macrophage through manipulation of metabolic profiles and if these cells can promote regeneration over scar formation after traumatic injury.

SIGNIFICANCE/CLINICAL RELEVANCE: (1 sentence): These studies identify targetable cells and pathways to promote regeneration over scar-formation after traumatic injury.

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ACKNOWLEDGEMENTS: (Optional)

IMAGES AND TABLES: (Optional) Up to 3 images and/or tables, sized to fit and readable, at the bottom of the page.

Delivery of Dalbavancin from Cement Beads: Is it Toxic to Bone?

Keenan Hurst¹, Grant Lambert¹, Janet Conway³, Jessica Rivera (PI)²,

¹LSUHSC- NO School of Medicine, ²Department of Orthopaedic Surgery, ³Rubin Institute for Advanced Orthopaedics
Khurs1@lsuhsc.edu

Disclosures: Keenan Hurst (N), Grant Lambert (N), Janet Conway (Rubine Institute for Advanced Orthopaedics Baltimore, MD), Jessica Rivera (LSUHSC Orthopaedic Surgery). The authors have no competing interests.

INTRODUCTION: While local antibiotics can be helpful to mitigate or treat infection, the local application of drug which would typically be administered intravenously may have adverse effects on the local tissues. A new lipoglycoprotein antibiotic called dalbavancin has not been extensively studied in terms of safety and efficacy for local delivery. The purpose of this research is to determine if antibiotic beads made with dalbavancin result in a local milieu that adversely affects cultured human cells. Due to the nature of orthopaedic trauma, both bone and soft tissue must be considered for toxic effects. We aim to determine how dalbavancin antibiotic beads affect both cultured human osteoblasts and skeletal muscle cells.

METHODS: Polymethylmethacrylate Simplex[®]P cement was used to prepare cement beads with no antibiotic (control), 500mg of dalbavancin HCl/40g cement pack (1X dose), or 1000mg/40g cement pack (2X dose). Human osteoblasts (Cell Applications, Inc) were seeded at 2×10^4 cells/cm² on 6-well tissue culture plates in Osteoblast Growth Media at 37°C. Human skeletal muscle cells (Cell Applications, Inc) were similarly seeded on 6-well tissue culture plates in Skeletal Muscle Growth Media. Once confluent, culture media was changed and wells then exposed to no bead, a blank (control) bead, a 1X bead or 2X bead in triplicate for four additional days. On the final day, the media supernatant was collected and assayed for caspase-3 fluorescence activity (Sigma-Aldrich), as a measure of apoptosis.

RESULTS: Human osteoblasts in culture did not demonstrate differences in apoptotic activity when exposed to a blank bead ($p=0.3180$) or 1X dose bead ($p=0.9633$) compared to cells not exposed to a bead. However, the 2X bead dose did increase caspase activity compared to unexposed cells ($p=0.0471$). Skeletal muscle cells in culture were not affected by any of the bead exposures compared to unexposed cells.

DISCUSSION: Dalbavancin is a new antibiotic approved to treat gram-positive soft tissue infection and may be helpful in treating gram-positive osteomyelitis. The local delivery of antibiotic, including delivery of antibiotic from cement beads, can be a useful adjunct to treating bone infection. However, high doses of locally delivered antibiotic may be detrimental to the local tissues. This *in vitro* study suggests a high dose of dalbavancin may affect osteoblast apoptosis as measured by caspase activity. Additional studies can now determine if 1X beads result in an eluent that eliminates bacteria.

SIGNIFICANCE/CLINICAL RELEVANCE: If the aims of the project are achieved, dalbavancin infused cement beads may prove as a safe and effective method for prevention of bone/soft tissue related infections following orthopedic surgery.

Probability of Occult Ankle Fracture Based on Radiograph-Measured Swelling

Christian K. Kerut¹, Sri Mudiganty, MD^{1,2}, Ronald Horswell, PhD³, Reagan Williams⁴, Melanie Valencia⁴, Joseph Gonzales, MD^{1,2}

¹LSUHSC School of Medicine, ²Orthopedic Department, ³Pennington BioMedical Research Center, ⁴Mercer University School of Medicine

First/Presenting Author E-mail: ckerut@lsuhsc.edu

Disclosures: None

INTRODUCTION: Several children every year present to the emergency department (ED) with a traumatic ankle injury. It is our experience that about 1/2 of these patients have X-rays not showing a fracture. About 1/4 of those patients with a “normal” X-ray subsequently reveal a fracture on follow-up X-ray a few weeks later. Clinically, patients are assessed on initial ED visit as to weight bearing or non-weight bearing on the injured ankle. If non-weight bearing, physicians often likely presume an occult fracture and will cast the patient. Traditionally, ankle swelling has not been used clinically to predict occult fractures. We set out to compare the likelihood of an occult fracture using swelling, weight-bearing status, and the combination of both.

METHODS: The study was a retrospective chart review. After obtaining IRB approval (#5179), using Children’s Hospital New Orleans data base, ED presentations for suspected lateral malleolus injury were pulled from a 1-year span (2021-2022). Soft tissue ankle swelling measurements were measured, as well as whether the patient was weight bearing or non-weight bearing. Fisher’s Exact test was used to calculate the sensitivity and specificity of each parameter. A computer model (Exact Logistic Regression) used both clinical parameters as well as just ankle swelling to predict probability of an occult fracture.

RESULTS: 61 children presented with ankle injury, of which 32 had negative initial x-rays. Of these 32, 8 (25%) had an occult fracture on follow-up X-ray. Non-weight bearing had sensitivity (75%) and specificity (58%) for occult fracture detection ($p = 0.220$), and for ankle swelling ($p < 0.0001$) with sensitivity and specificity variable based on ankle mm.

DISCUSSION: From this small retrospective study, it appears that X-ray measurement of ankle swelling is highly predictive of an occult ankle fracture. The addition of patient weight bearing / non-weight bearing may add to its predictive power; however, our sample size was not large enough to determine its statistical significance.

SIGNIFICANCE/CLINICAL RELEVANCE: (1 sentence): Current practice uses weight-bearing status to predict occult fractures, often leading to unnecessary casting; our study demonstrates the significance of ankle swelling and should be utilized more often in a clinical setting to predict occult fractures.

IMAGES AND TABLES:

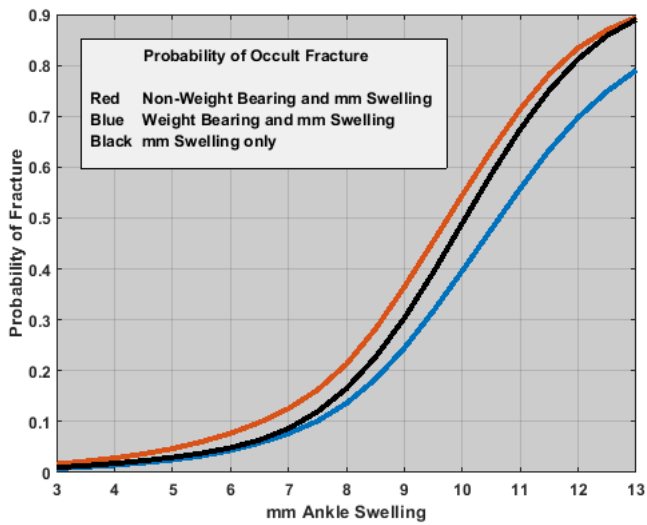


Figure 1. A computer model predicts the probability of an occult fracture based on the mm swelling. Addition of weight bearing / non-weight bearing added somewhat (non-statistically significant) to its predictive ability.

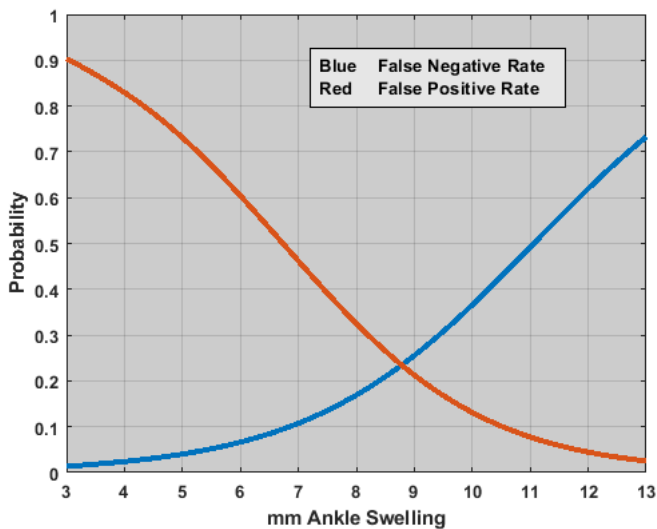


Figure 2. The false negative rate (FNR) (the fraction of all true fractures treated as a non-fracture) and the false positive rate (FPR) (the fraction of all non-fractures treated as a fracture) are shown. From this model, a patient diagnosed as having no fracture with 4 mm ankle swelling would have a FNR (probability of no fracture) of < 5%, but for a patient with 10 mm swelling the FNR would be ~ 35%.

The Impact of Knee Osteoarthritis Severity on Initial Treatment Choice: A Retrospective Analysis of Intra-Articular Injections

Christian K. Kerut¹, Connor Maginnis¹, Claudia Leonardi, PhD², Vinod Dasa, M.D.²

¹LSUHSC School of Medicine, ²Department of Orthopaedic Surgery

Presenting Author: ckerut@lsuhsc.edu

Disclosures: The authors of this study have zero disclosures.

Introduction:

Knee osteoarthritis (OA) poses a significant health burden, impacting over 9 million adults in the United States. Minimally invasive interventions, particularly intra-articular (IA) injections, are crucial in managing OA-related pain and functional limitations. Notably, IA Toradol has emerged as a promising alternative to corticosteroids, offering comparable analgesic effects at a reduced cost.

Methods

This retrospective study centers on OA diagnoses by a single surgeon between January 1, 2016, and December 31, 2019, encompassing 1330 patients. Comprehensive chart reviews included demographic details, Kellgren-Lawrence (KL) scores, and analyses of initial OA diagnosis injection treatments.

Results

A total of 1330 patients met the inclusion criteria. The study cohort was predominantly female, constituting 69% of the participants, with a mean age of 62 years. The breakdown of insurance types showed diversity, with 35.7% of patients being covered by private insurance. Both unilateral and bilateral OA were documented. Overall, the KL score was significantly associated with the 1st line of treatment ($p < 0.0001$). As the KL score increased, there was more utilization of steroids as well as Toradol, with a subsequent decrease in hyaluronic acid usage. This trend was observed in both unilateral and bilateral OA. For example, bilateral OA patients with a KL score between 0-2 received steroids 4.17% of the time, but those with a KL score of 4 received steroids 14.24% of the time.

Discussion

Our analysis explored the association between KL scores and the initial treatment administered to OA patients. Notably, as KL scores increased, there was a discernible trend: a higher percentage of patients received steroids and Toradol, while fewer received hyaluronic acid. This pattern suggests a correlation between disease severity, as indicated by KL scores, and the choice of first-line treatment. In summary, our findings strongly indicate that the severity of OA influences the selection of initial treatments.

Significance/Clinical Relevance:

This study illuminates the association between knee osteoarthritis severity, as indicated by Kellgren-Lawrence scores, and the initial treatment selection. The observed trend towards corticosteroids and Toradol injections for higher KL scores underscores the importance of personalized treatment strategies aligned with disease severity, potentially enhancing pain management and functional outcomes for patients. These insights are crucial for clinicians in optimizing knee OA management and improving patient quality of life.

Understanding Patient Questions Regarding Total Hip and Knee Arthroplasty Through Google Trends

Irfan A. Khan, MD, ATC¹, Jonathan Abraham, MD¹, Saad Siddiqui, BS², Andrew G. Chapple, PhD¹, Vinod Dasa, MD¹

¹LSU Health New Orleans Department of Orthopedics, ²Florida Internal University College of Medicine

First/Presenting Author E-mail: ikhan6@lsuhsc.edu

Disclosures: Irfan A. Khan, MD, ATC (N), Jonathan Abraham, MD (N), Saad Siddiqui, BS (N), Andrew G. Chapple, PhD (N), Vinod Dasa, MD (Bioventus, Swiftpath, Pacira, SIGHT Medical, My Medical Images, CyMedica Orthopedics, GrandCare Health Service, MEND Technology, Goldfinch Health, SKK, Carti heal, NIH, OREF)

INTRODUCTION: Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are being performed at increasing volumes annually. However, it is unknown what patients most commonly query online regarding THA/TKA. Google Trends provides the relative search volume [RSV] for Google search terms. Therefore, we conducted this study with Google Trends to identify THA/TKA search terms with the most patient interest.

METHODS: A retrospective longitudinal study on public interest in THA/TKA was conducted from January 2012 – December 2022 in the United States utilizing Google Trends. One arthroplasty fellowship-trained orthopedic surgeon and two orthopaedic residents identified questions that may arise perioperatively from patients considering TKA and included 50 Google search terms, for which the mean RSV was obtained and compared. Ranging from 0 – 100, the RSV represents interest in a keyword during at a specific point during the selected timeframe; 0 indicates minimal interest while 100 indicates peak interest. *Analysis of Variance Tests* were used to comparing means and statistical significance was set at a p-value less than 0.05.

RESULTS: Amongst 50 TKA search terms, “knee replacement pain” and “knee replacement recovery” had significantly higher mean RSVs than other terms, while “knee replacement cost”, “knee replacement therapy”, “knee replacement swelling”, “how long does knee replacement take”, “knee replacement infection”, “bilateral knee replacement”, “knee replacement scar”, and “robotic knee replacement” were among the ten highest mean RSV terms (67;66;21;19;11;8;8;7;5;4). The mean RSVs increased over time for “knee replacement pain” [2012: 45; 2022: 95] and “knee replacement recovery” [2012: 48; 2022: 83]. Amongst 50 THA search terms, “hip replacement pain” and “hip replacement recovery” had significantly higher mean RSVs than other terms, and the ten highest mean RSV terms included “hip replacement cost”, “hip replacement therapy”, “hip replacement precautions”, “hip replacement approach”, “how long does hip replacement take”, “hip replacement fracture”, “hip replacement infection”, and “hip replacement rehab” (65;61;20;15;14;12;11;11;10;8). The mean RSV increased over time for “hip replacement pain” [2013: 44; 2022: 88] and “hip replacement recovery” [2013: 50; 2022: 73].

DISCUSSION: Patients are interested in a wide range of topics regarding THA/TKA, with pain and recovery being the most frequently searched and growing topics. Additionally, topics such as cost, physical therapy, surgical length, complications, scars, and robotic assistance were also popular. Limitations of this study include utilizing Google Trends data to determine public interest in THA/TKA topics, which may differ from the interests of patients who use other search engines or do not utilize the internet to obtain information about THA/TKA.

SIGNIFICANCE/CLINICAL RELEVANCE: Patient education materials should include the aforementioned topics to provide patients with patient-centered information that addresses their questions and concerns regarding THA/TKA.

REFERENCES: None

ACKNOWLEDGEMENTS: None

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Bacterial Elimination with Dalbavancin Antibiotic Beads

Grant Lambert¹, Keenan Hurst¹, Janet Conway³, Jessica Rivera (PI)²

¹LSUHSC – NO School of Medicine, ²Department of Orthopaedic Surgery,

³Rubin Institute for Advanced Orthopaedics

First/Presenting Author E-mail: glamb5@lsuhsc.edu

Disclosures: Grant Lambert (N), Keenan Hurst (N), Janet Conway (Rubin Institute for Advanced Orthopaedics, Baltimore, MD), Jessica Rivera (LSUHSC Orthopaedic Surgery). The authors have no competing interests.

INTRODUCTION: Local administration of antibiotics via cement beads is a method currently employed in the management of traumatic wounds, fracture related infections, and hardware associated infections. However, not all antibiotics can be used with cement, and the elution characteristics of cement are not favorable for prolonged treatments. Dalbavancin, a lipoglycopeptide antibiotic with *Staphylococcus* coverage and an extended half-life, has been approved for the treatment of acute soft tissue infections caused by Gram-positive organisms and may be a novel option for delivering local antibiotic. This study aims to evaluate the elution capacity of dalbavancin from polymethylmethacrylate (PMMA) cement beads and its efficacy against *Staphylococcal* species in vitro.

METHODS: Polymethylmethacrylate Simplex[®]P cement was used to prepare cement beads with 500mg of dalbavancin HCl/40g cement pack. The beads were transferred into separate conical tubes containing 5 milliliters of phosphate-buffered saline (PBS) and subjected to agitation in a shaking incubator at 37°C. The PBS was sampled and replaced at intervals of 1, 2, 4, 16, 24, 48, 96, 116, and 144 hours. Methicillin-resistant *Staphylococcus aureus* (MRSA) Rosenbach (BAA-1683; ATCC) and Xen36 IVISbrite™ *Staphylococcus aureus* (#119243; PerkinElmer, Inc) were expanded separately in tryptic soy broth (TSB). The cultures were mixed with PBS for controls or PBS from the antibiotic elution timepoints followed by incubation. After 24 hours, the samples were evaluated for bacterial growth by measuring optical density (OD) at 600nm with a UV-Vis Spectrophotometer (Spectronic Genesys 10 Bio). The collected PBS samples were also analyzed via mass spectrometry at an outside institution with results currently pending.

RESULTS: The eluent from the dalbavancin antibiotic beads affected both the MRSA and Xen36 *Staph* culture densities. OD measurements from the MRSA and Xen36 strains plus blank PBS controls were 0.987 and 0.974, respectively. MRSA culture densities exposed to the dalbavancin antibiotic beads ranged from 0.029 to 0.015 resulting in a 96-99% decline in culture density compared to controls. Xen36 *Staph* culture densities exposed to the dalbavancin antibiotic beads ranged from 1.427 to 0.001. At one-hour, the eluent decreased culture density by 32%. Between 2- and 120- hours, eluent decreased culture density by 96-99%. At hour 144, the culture density rebounded to a 46% increase.

DISCUSSION: Dalbavancin is a novel lipoglycopeptide antibiotic with a long half-life and efficacy against bacterial pathogens commonly implicated in bone and hardware infections. Bone cement, such as PMMA, is commonly utilized as a vehicle for the local delivery of antibiotics; however, antibiotics infused into bone cement must be heat stable and should result in effective eluent from the beads. Dalbavancin has a notably longer half-life compared to antibiotics currently used in bone cement, which may be favorable if dalbavancin can effectively elute from cement. Preliminary results from the optical density measurements suggest that dalbavancin is capable of withstanding the temperatures produced by the PMMA reaction and retain activity against two different *Staph* isolate cultures in vitro for at least five days. Further analysis is required to determine the degree of dalbavancin elution from PMMA. Mass spectrometry evaluation of elution samples is currently in progress.

SIGNIFICANCE/CLINICAL RELEVANCE: The aim of this project is to determine whether the novel antibiotic dalbavancin is a viable option for local antibiotic delivery from bone cement, which may provide clinical benefit given its long half-life and extended spectrum of Gram-positive antimicrobial coverage.

Insights into the Health of the Quadriceps from the Articularis Genu of Patients with Osteoarthritis

Davis Martin¹, Jose Cruz¹, Ryan Schroeder¹, Mary Gatterer², Vinod Dasa², Luis Marrero²

¹School of Medicine, ²Department of Orthopaedic Surgery, LSU Health Sciences Center – New Orleans
First/Presenting Author E-mail: dmar19@lsuhsc.edu

Disclosures: Davis Martin (N), Jose Cruz(N), Ryan Schroeder (N), Mary Gatterer (N), Vinod Dasa (Bioventus, Swiftpath/Pacira; Bioventus, Myoscience; Myoscience, SIGHT Medical; SKK, Cartiheal, KCI.), Luis Marrero (N)

INTRODUCTION: Knee osteoarthritis (kOA) disability involves cartilage degeneration, painful inflammation, and stiffening fibrosis of the joint as a whole, resulting in debilitation of the articular musculature, such as the quadriceps femoris (QF). The vastus medialis oblique (VMO) of the QF is particularly sensitive to severe kOA and functional limitations. Another joint muscle, the articularis genu (AG), runs continuous to the vastus intermedius into the knee and can be sampled as part of the residual tissue excised during total knee arthroplasty (TKA). For this reason, the AG can be used to evaluate features of kOA-attributable myopenia relative to, for example, the muscle-derived paracrine secretome in synovial fluid (SF). Such a link could help develop SF analytics pre-TKA to inform individualized peri-operative strategies for muscular conditioning or rehabilitation. However, the AG must first be solidly confirmed as a surrogate for the disease status of the QF. Previous studies indicate similarities in myofiber type distribution and size between the AG and vastus lateralis relative to kOA-induced deficits in range of motion. This comparative study expands on the structural and gene expression changes related to the size, distribution, and specification of myofibers and endomysial fibrosis in AG and VMO sets of end-stage kOA patients.

METHODS: Sets of AG and VMO were collected from 19 kOA patients during TKA. Equivalent portions from each muscle were fixed or cryopreserved for histology or RNA isolation, respectively. Fixed muscles were processed for serial paraffin sectioning and stained by picosirius (PS) technique for collagen or indirect co-immunofluorescence (IIF) labeling of myosin heavy chain (MHC) 7, 2A, and 2X, corresponding to myofiber type (T) 1 (slow), 2a (fast), and 2a/x hybrids (super-fast/inefficient). Three 200x photomicrographs were captured per sample by confocal (Olympus) using excitation at 592nm for PS and 488, 592, and 633nm for myofiber IIF. Slidebook™ (3i) software-assisted morphometry of collagen and myofiber tags was used to segment and measure fibrosis or myofiber types and cross-sectional area (CSA). Samples were homogenized, RNA isolated, and cDNA synthesized (Superscript IV; Thermo) for qPCR array (Biorad) with a Lightcycler 480 (Roche) to measure gene expression related to T1 (*Myh7*, *Mef2c*) T2a (*Myh2*, *Pgc1α*), and T2x (*Myh1*) myofibers; hypertrophy (*Igf1*); atrophy (*Trim63*, *Fbxo32*); and fibrosis (*Ctgf*, *Tgfb1*). Prism 10.1.2 (GraphPad) was used for correlation analyses using Spearman's rho (R) with $\alpha=0.05$.

RESULTS: The AG and VMO displayed high association in the distribution of T1 or T2a (R=0.70; p=0.001) and T2a/x (R=0.89; p<0.0001) isoforms, validated by moderate correlations in genes driving specification and transition of T1: *Myh7* (R=0.86, p<0.0001) and *Mef2c* (R=0.50; p=0.070) T2a: *Myh2* (R=0.53, p=.042); and T2a/x: *Myh1* (R=0.52, p=0.048), all of which displayed an expression trend relative to fiber type percentages in both muscles. The size of T2a fibers was consistent between the muscles (R=0.78, p<0.0001) and significantly smaller than the CSA of T1 fibers. Higher *Igf1* values corresponded to larger CSA of T1 and T2a fibers and were associated between muscles (R=0.74; p=0.002). Conversely high expression of *Trim63* indicated severity of atrophy and correlated between the muscles (R=0.79, p=0.0003). Lastly, the severity of endomysial fibrosis was moderately comparable between muscles (R=0.51, p=0.030), in agreement with the number of *Tgfb1* transcripts (R=0.56, p=0.031).

DISCUSSION: This comparative study unveils a novel finding-AG myopenia from kOA mirrors measures that indicate disuse of the VMO. These include the presence of typically rare T2a/x hybrid myofibers, compensatory hypertrophy, preferential atrophy of fast twitch fibers, and abnormal thickening of the endomysium with fibrous deposits. This discovery paves the way for future assessment of structural changes in the otherwise discarded parts AG in relation to the levels of muscle-derived drivers of disuse-mediated myopenia of the QF in SF.

SIGNIFICANCE/CLINICAL RELEVANCE: Establishing the AG as a surrogate for the QF status in kOA marks a significant advancement in developing objective and individualized assessment tools for the condition of the articular musculature before TKA that will impact peri-operative physical therapy and further improve surgical outcomes.

Reducing Orthopaedic Waste at a Children's Hospital

Matthew Nguyen¹; Ravi Rajendra, MD¹; Srikanth Mudiganty, MD¹; Meredith Warner, MD¹; R. Carter Clement, MD¹

¹Louisiana State University Health-Sciences Center School of Medicine
First/Presenting Author E-mail: mngu22@lsuhsc.edu

Disclosures: Matthew Nguyen; Ravi Rajendra, MD; Srikanth Mudiganty, MD; Meredith Warner, MD; R. Carter Clement, MD

INTRODUCTION: The World Health Organization estimates climate change related to carbon emissions could result in 250,000 additional deaths yearly from 2030 to 2050 due to factors like food supply disruptions, changing patterns in vector-transmitted diseases, or heat stress from extreme weather events. Despite the projected impact of climate change on public health, the healthcare industry has not matched other industries working to both quantify and reduce carbon emissions. Our study aims to quantify the carbon emission yielded from surgical waste produced during posterior spinal fusion surgery at an academic children's hospital to determine whether individual surgeon efforts or institutional efforts more meaningfully influence carbon emissions.

METHODS: Over the span of one year, the waste bags produced after posterior spinal fusion cases at a children's hospital were weighed using a handheld scale to determine the average waste produced from a single posterior spinal fusion case and the mass of waste produced from all posterior spinal fusion cases within one year at the hospital. The total annual carbon footprint from incinerating this waste was then calculated using reported formulas in the literature.

RESULTS: The average amount of surgical waste produced after a single posterior spinal fusion case at the hospital weighed 21.43 kilograms (n=22, range=14.06 to 31.05 kilograms), which was then calculated to yield an annual carbon emission 1.1 Megagrams of carbon dioxide from incinerating waste from all scoliosis surgeries. In addition, twice weekly transportation of waste to the incinerator by diesel-powered truck results in an estimated emissions of 25.4 Megagrams of carbon dioxide annually, leading to a total annual carbon footprint of 26.5 Megagrams of carbon dioxide from posterior spinal fusion surgery at our hospital.

DISCUSSION: The annual carbon footprint produced from scoliosis surgery at our hospital is estimated to be 26.5 Megagrams of carbon dioxide. For reference, the average gas-powered passenger car emits about 2.5 Megagrams of carbon dioxide over the course of a year. The carbon footprint of transporting waste to the incinerator far outweighed the carbon footprint of incinerated waste at our institution, suggesting hospitals interested in carbon footprint mitigation should investigate protocols on sending waste outside of the facility for incineration. Future work will evaluate the direct carbon footprint from production of the implants and other supplies used in spine surgery along with the indirect carbon footprint from transportation of these implants and supplies to the operating room. Limitations of the study include potential inherent error in the weighing scaled used for measurement along with difference in preference of implant companies used by surgeons, which may influence accumulated waste from surgery cases

SIGNIFICANCE/CLINICAL RELEVANCE: Our study is the first to quantify the waste and carbon footprint associated with scoliosis surgery, while also providing a framework for institutions to calculate carbon footprint from surgical waste.

Charleston vs. Providence: Are all Scoliosis Bending Braces Created Equally?

Connor A. Nyborg¹, Laura Bartusiak¹, Ravi Rajendra, MD², Claudia Leonardi, PhD³, R. Carter Clement, MD, MBA²
¹Tulane University School of Medicine, ²LSU School of Medicine New Orleans, Department of Orthopaedics, ³LSU
School of Public Health, Behavior and Community Health
cnyborg@tulane.edu

Disclosures: Connoy Nyborg (N), Laura Bartusiak (N), Ravi Rajendra, MD (N), Claudia Leonardi, PhD (N), R. Carter Clement, MD, MBA (N)

INTRODUCTION: Providence and Charleston braces are alternative designs for nighttime bending braces to manage moderate idiopathic scoliosis. The Charleston brace applies asymmetric pressure to stretch and overcorrect the spinal curvature, while the Providence brace utilizes a three-point pressure system to rotate the spine in the opposite direction of the scoliosis curvature. There is minimal evidence comparing the effectiveness between these commonly used bracing options. We hypothesize the Providence brace provides superior in-brace correction compared to the Charleston brace.

METHODS: A retrospective chart review, which was approved by the institutional review board, was conducted on patients diagnosed with adolescent idiopathic scoliosis (AIS) and Juvenile Idiopathic Scoliosis (JIS) at an academic pediatric hospital between 01/01/2021 and 12/31/2022 who underwent treatment with a Charleston or Providence brace. Twenty-four Charleston and fifty-six Providence bracing patients were enrolled. The in-brace coronal curve magnitude and maximum curvature were compared between the two braces using mixed models, with pre-brace coronal curve magnitude considered as a covariate. Statistical significance was determined using a linear-mixed model with $p < 0.05$.

RESULTS: The Charleston brace showed a 62.1% immediate reduction in spinal curvature, and the Providence showed a 77.5% immediate reduction ($p=0.009$). Both the Charleston and Providence brace were utilized in patients with similar pre-bracing curvature ($p=0.288$). There was no difference in gender ($p=0.467$) or race ($p=0.202$); however, insurance type differed ($p=0.006$) with 45.8% of patients using the Charleston brace with Medicaid and only 12.5% of patients using the Providence brace with Medicaid. Furthermore, 50% of patients using the Charleston brace were self-pay, while 76.8% of patients using the Providence brace were self-pay. Although Providence patients went on to require definitive posterior spinal fusion at a lower rate of 7.5% compared to Charleston braces at 12.5%, this trend was not statistically significant ($p=0.423$).

DISCUSSION: The Providence brace provided better immediate spinal curvature correction in-brace. The difference in payer-mix highlights potential socioeconomic factors that may influence the choice of brace and access to treatment options. With our sample size, although Providence patients compared to Charleston patients required posterior spinal fusion at lower rates, this trend was not statistically significant. Further research is needed to determine if the trend seen in our study is similar in a study with a larger sample size. Additional research can also determine differences in patient compliance and satisfaction between the two braces. The data from our study will help pediatric orthopaedic surgeons discuss bracing options with parents with the Providence brace appearing to offer greater immediate reduction.

SIGNIFICANCE/CLINICAL RELEVANCE: Our project demonstrated superior in-brace immediate correction with the Providence brace compared to the Charleston brace in managing AIS and JIS.

Hand In Hand: A Retrospective Review of Traumatic Hand Injuries (THI) at a Level 1 Trauma Center

Mohammed S. Rais, BS¹, Harel G. Schwartzberg, MD², Kelly L. Babineaux, MD, FACS (PI)²

¹LSU New Orleans School of Medicine, ²LSU New Orleans Department of Surgery; Division of Plastic and Reconstructive Surgery
mrais1@lsuhsc.edu

Disclosures: Mohammed S. Rais, BS¹ (N), Harel G. Schwartzberg, MD² (N), Kelly L. Babineaux, MD, FACS (PI)² (N)

INTRODUCTION: In the past decade, hand injuries have affected millions of patients in the United States, with the associated detriments significantly altering a patient's quality of life. Despite hand injuries being such common presentations to Emergency Departments across the United States, research on hand trauma continues to remain limited. The objective of this study was to examine demographics and current practices associated with traumatic hand injuries (THI) in order to develop evidence-based guidelines and improve future clinical outcomes.

METHODS: A retrospective review of patients was conducted through a Level 1 trauma center's trauma registry database consisting of patients who presented with THI from January 2016 through February 2024. Variables collected included: Age, Gender, Race, Height, Weight, BMI, Transfer Status, Admit Status, Hospital Length of Stay (days), Operative Status, and Amputation Status. Descriptive analyses were performed.

RESULTS: Of the 2696 patients included in the study, 79% were male, 49% were black or African American, and averages of age and BMI were 40 years and 27.5, respectively. 22% of patients were transferred from a lower center of care to this Level 1 Trauma Center. Blunt injuries to the hand were most common at 61%. 66% of patients included were admitted, and the average hospital LOS was 5 days. Of these patients, 56% (n=1520) underwent surgical intervention for their THI, and roughly 7% required hand amputation.

DISCUSSION: Results from this study shows the breadth of hand injuries encountered and managed at a Level 1 trauma center over an eight-year period. Although this project is limited in its retrospective nature, it shows the following: Due to the complexity of THI, patients are transferred to higher level of care to receive appropriate treatment for such niche injuries. Along with this notion, over half of these patients requiring surgical treatment showcases the importance of training and staffing fellowship-trained hand surgeons to be equipped to appropriately treat such hand traumas. Future multi-center studies are needed to develop best practice guidelines for patients with traumatic hand injuries.

SIGNIFICANCE/CLINICAL RELEVANCE: If the aims of the project are achieved, THI will be better addressed, managed, and treated in clinical practice.

Comparing ACDF Outcomes by Cervical Spine Level: A Single Center Retrospective Cohort Study

Davis Martin¹, Ryan Schroeder¹, Collin Toups¹, Clifton Daigle¹, Matthew Spitchley¹, Claudia Leonardi^{2,3}, Berje Shammassian⁴, Amit K. Bhandutia²

Louisiana State University Health Sciences Center ¹School of Medicine, ²Department of Orthopedics,

³Department of Behavioral & Community Health, ⁴Department of Neurosurgery

First/Presenting Author E-mail: rschr1@lsuhsc.edu

Disclosures: Davis Martin (N), Ryan Schroeder (N), Collin Toups (N), Clifton Daigle (N), Matthew Spitchley (N), Claudia Leonardi, Berje Shammassian, Amit K. Bhandutia

INTRODUCTION: Anterior cervical discectomy and fusion (ACDF) is a common treatment for cervical radiculopathy and myelopathy associated with complications including postoperative dysphagia. Previous research has suggested a relationship between complications and level involvement, however there is limited direct comparison of post-operative outcomes in upper cervical spine fusions (UCF) versus middle to lower cervical spine fusions (MLCF). This study aims to compare the overall outcomes of UCF (defined as fusions involving C3-C4 disc space) with MLCF (defined as the remainder of the cervical spine). Due to the more complex anatomy and indirect data suggesting increased rates of dysphagia after UCF, the authors hypothesized increased rates of complications following UCF compared to MLCF.

METHODS: A retrospective chart review of 835 patients who underwent ACDF from 2012 to 2022 was conducted with patients classified as either upper cervical fusion (UCF), defined as inclusion of C3-4 disc-space, or middle-lower cervical fusion (MLCF), defined as lacking C3-4 disc-space. Demographic characteristics were compared using either χ^2 tests or Fisher exact tests. Clinical characteristics were compared in univariable analysis using either χ^2 tests, linear-mixed effects models, or generalized linear-mixed models depending on their distribution. Characteristics including demographics, number of levels fused, spinal cord signal change, and neurological diagnosis were included in the multivariable models to minimize confounding.

RESULTS: A total of 835 patients were included in the current analysis, comprising 562 in the MLCF group and 281 in the UCF group. The median follow-up time was 211 days for UCF and 200 days for MLCF. UCF led to a 1.5-day longer length of stay (LOS) compared to MLCF in both univariable (1.5 vs. 3.1, $p < 0.0001$) and multivariable analysis [2.3 days (95% CI: 1.8, 3.0) vs. 3.3 days (2.6, 4.2), $p < 0.0001$]. MLCF patients reported improvement or resolution in their symptoms more often than UCF patients [0.43 (95% CI: 0.30, 0.62) and 0.46 (95% CI: 0.30, 0.70)]. There was no significant difference observed in rates of major complications or revision surgeries. However, there was a significantly higher rate of minor complications, specifically dysphagia, in the UCF group both on univariate and multivariable analysis, respectively [1.72 (95% CI: 1.18, 2.49) and 1.66 (95% CI: 1.08, 2.56)].

DISCUSSION: To our knowledge this study is the first to directly investigate the link between cervical fusion level and post-operative outcomes. UCF patients had increased rates of post-operative dysphagia, longer LOS, and were less likely to report an improvement in neurological symptoms post-operatively when compared to MLCF patients both before and after controlling for demographic differences, number of levels fused, presence of spinal cord signal change on pre-operative radiographs, and type of neurological symptoms. Future prospective studies are needed to confirm these findings.

SIGNIFICANCE/CLINICAL RELEVANCE: UCF may be associated with increased likelihood of post-operative dysphagia, longer LOS, increased likelihood of non-home discharge from hospital and a lower likelihood of improvement in neurological symptoms compared to MLCF.

Fragility Fracture Treatment Factors in a Southern Hospital System

David St. Étienne Jr MS¹, Ikenna Ifearulundu MD, MPH², Andrew G. Chapple PhD (PI)^{1,3}, Lauren Leslie DO⁴, Deryk Jones MD⁴, Peter Krause MD, FACS³, Vinod Dasa MD, FACS³

¹ Louisiana State University School of Medicine – New Orleans, ²Louisiana State University Health Science Center, ³ Louisiana State University Orthopedic Department of Surgery, ⁴Ochsner Health System Department of Orthopedic Surgery

First/Presenting Author E-mail: dsteti@lsuhsc.edu

Disclosures: David St. Étienne Jr MS (N), Ikenna Ifearulundu MD, MPH (N), Andrew G. Chapple PhD (N), Lauren Leslie DO (N), Deryk Jones MD (N), Peter Krause MD, FACS (N), Vinod Dasa MD, FACS (Sanara, Bioventus, Pacira, Sanofi, Ferring, Medi post, Vertex, Carti heal, Avania, Nanochon, Anika, DOC SOCIAL, Goldfinch consulting, Motive, MEND, Grand Care, Doron Therapeutics, My Medical Images, J of ortho exp and innovation, NIH, OREF, JOEI)

INTRODUCTION: Disparities in receiving treatment are known to exist among patients with osteoporotic fractures. This study investigates factors related to the likelihood of treatment in a southern hospital system. We hypothesize that there will be a difference in fragility fracture treatment rates based on fracture history and location.

METHODS: A retrospective chart review of surgical patients with any indication or diagnosis of osteoporosis was conducted at a southern hospital region. Patients aged 60 or older with an osteoporotic fracture were included. Patients with less than one year of follow-up, missing insurances, or a BMI over 100 were excluded. The patients' initial fracture location was reviewed and grouped by the five most common anatomical locations. Our primary outcome was whether proper osteoporosis treatment occurred within one year of the first fragility fracture. Treatment rates were analyzed by patient demographics, medical history and fracture details using Fisher exact and Wilcoxon rank-sum tests. Multivariable logistic regression was performed to determine factors associated with treatment after adjustments. IRB approval was obtained (#1742).

RESULTS: 2,692 patients had an osteoporosis-related fracture. Of those fractures, less than half (44.4%, n=1,196) received osteoporosis-related treatment. Fracture locations were most often reported as unspecified (75.6%, n=2,035) followed by femur (17.6%, n=474) and arm (3%, n=81). Treatment rates for all fracture locations were between 20-40%. Before multivariable adjustment, osteoporosis treatment rates were significantly different across patient's age, smoking status, fracture location, number of fractures, inpatient status, length of first visit, the year the fracture occurred, and any history of prior treatment (p<0.05). Anatomical locations showed differences in treatment rates, specifically the femur, lower leg, and arm as well as the right side of these extremities (p<0.05). The regression showed treatment before fracture was most predictive of receiving treatment after fracture by 13.9% (p<0.05). Furthermore, older patients were less likely to be treated by -0.3% and patients were treated about .9% more often each year (p<0.05).

DISCUSSION: Our findings showed a discernable difference between treatment rates based on the location of the index fracture. The results also demonstrated that previous treatment for osteoporosis was associated with an increased probability of fragility fracture treatment compared to patients who had not previously received osteoporosis treatment. Limitations in the study include the categorization of fracture locations. The high volume of unspecified fracture location descriptors reduced the ability to further determine treatment disparities by location. The analysis demonstrates disparities in treatment rates within one year of a fracture and supports significant differences across patient factors.

SIGNIFICANCE/CLINICAL RELEVANCE: The disparities in treatment rates within one year of a fracture supports the need for more robust monitoring protocols to decrease subsequent fractures.