

Resident Research Day



Department of Orthopaedic Surgery & Sports Medicine

Lewis Katz School of Medicine at Temple University

Saturday April 18, 2020

Supported by the John Lachman Orthopaedic Research Fund

Research Day Agenda

4/18/2020

Zoom Meeting online: <https://temple.zoom.us/j/533286399>

Moderator: Saqib Rehman, M.D.

8:00-9:00am

Grand Rounds Presentation

Jaimo Ahn, MD

Associate Professor of Orthopaedic
Surgery

Advisory Dean, Director of Student
Education, Associate Residency Director

Perelman School of Medicine

Hospital of the University of Pennsylvania

9:00-11:15

Resident Research Presentations

Colin Ackerman, Joshua Luginbuhl,
Akul Patel, Andrew Porter, Robert
Ames, Dayna Phillips, Colin
MacElroy Vroome, Jeffrey Wera

10 minute presentations

5 minutes for questions

11:30

**Lunch and announcement of
winners presented by Dr. Ahn and
the John Lachman Orthopaedic
Research Fund**

9:00 Colin Ackerman – “The New Era of Nicotine: Better for Patients?”

Colin Ackerman, Ofure O Asikhia, Douglas Brown, Christopher Haydel

Introduction: According to the Centers for Disease Control and Prevention, smoking is the leading cause of preventable death worldwide. With the advent of new smoking devices such as “e-cigarettes,” “vapes,” and “mods,” this problem continues to worsen as many people consider these alternatives “healthier” and having little to no adverse effects. This notion is perpetuated by the novel nature of these devices as well as their ability to market over the internet, a platform which prohibits the advertisement of cigarette. Furthermore, unbeknownst to many, these smoking alternatives contain similar chemicals to those found in cigarettes, namely anti-freeze, formaldehyde, nicotine, and tobacco. At present, smoking is known to cause cancer, heart disease, stroke, lung disease, diabetes, and chronic obstructive pulmonary disease, yet it also has known adverse effects within the realm of orthopaedics. Fracture healing, wound complications, and infections are all seen at higher rates in smokers as compared to nonsmokers. The aim of this study was to determine the prevalence of smoking alternative usage, to compare the perception of the impact of cigarette smoking versus smoking alternatives in regard to the impairment of bone fracture healing, and to assess willingness to quit smoking altogether if aware of the orthopaedic implications of nicotine.

Methods: A multiple-choice survey was randomly distributed to 231 patients, 18 years and older, who sustained an extremity fracture. All surveys were administered in an outpatient orthopaedic surgery clinic at a Level 1 urban trauma center.

Results: Of the respondents, 55.3% were male and 46.8% African American with a mean age of 46 years old. Use of either cigarettes or e-cigarettes represented 41.1% of respondents with 78.9% being daily consumers. When asked if patients felt

cigarettes impaired fracture healing, 30.3% of nonsmokers compared to 19.2% of smokers answered “definitely.” For the same question but concerning cigarettes, 22.7% of nonsmokers and 15.2% of smokers answered “definitely.” A larger portion of smokers (36.4% compared to 25.3%) answered that they felt e-cigarettes rather than traditional cigarettes affected bone fracture healing. Amongst smokers, 88.9% responded that they would be interested in cessation if told nicotine impaired fracture healing.

Discussion and Conclusion: This survey of orthopaedic patients identified a substantial discrepancy between the perceived harms of traditional cigarette versus e-cigarette usage. Therefore, these results may guide clinicians in further research as to the most effective methods of patient education regarding the effects of smoking, whether it be traditional or alternative use, on fracture healing.

9:15 Joshua Luginbuhl – “Cost of Operative Fixation of Ankle Fractures: Comparing Orthopaedics and Podiatry”

Alexa Deemer, Joshua Luginbuhl, Eric Gokcen

Introduction: Despite the increasing emphasis on value-based medical care in the United States, there are few cost-utility analyses focused on the treatment of ankle fractures. With an incidence of 168.7/100,000/year (14), ankle fractures are a common injury amongst the general population and an economic burden on the health care system. The cost of managing an ankle fracture both operatively and non-operatively is estimated to be between \$1908 and \$19,555 (9). Ankle fractures pose a unique situation as both podiatrists and orthopaedic foot and ankle surgeons are licensed to treat them. Despite this unique duality in potential management teams, there is currently a deficit in literature that examines the cost effectiveness of integrating both an orthopaedic surgery foot and ankle service and a podiatry team into clinical triage and subsequent

surgical management of ankle fractures. The goal of this study is to determine if it is more cost effective for an orthopaedic surgeon or podiatrist to manage patients with ankle fractures.

Methods: Data was obtained over a 1-year period at an academic level 1 trauma center. A total of 34 patients were treated for ankle fractures between July 2017 and June 2018. An indirect cost analysis was performed by analyzing the time spent in the operating room in procedure minutes (PR) and room minutes (RM) by both orthopaedic surgeons and podiatrists. The procedures performed by both the orthopaedic teams and podiatry teams were standardized using CPT codes. A statistical analysis was performed on the indirect cost data using a two-sample t test with equal variances. After organizing the data into “orthopaedic surgery” and “podiatry” categories depending on the provider seen, each variable was analyzed, including room minutes and procedure time.

Results: 25 patients were managed by an orthopaedic surgery team and 9 patients were managed by a podiatry service. For CPT code 27792 (Fracture and/or Dislocation Procedures on the Leg (Tibia and Fibula) and Ankle Joint) the average time in the room was 114 minutes for orthopaedic surgery and 140 minutes for podiatry ($p=0.007$). The average procedure time was 70 minutes and 86 minutes for orthopaedics and podiatry, respectively ($p=0.30$).

Conclusions: Orthopaedic surgeons and podiatrists are both licensed to treat ankle ankle fractures. Previous studies have shown that a risk factor for increased total post discharge costs included treatment by podiatry services. Furthermore, ankle fracture fixation performed by podiatrists was associated with higher malunion/nonunion rates amongst all types of ankle fractures, therefore requiring prolonged treatment. In this study, we demonstrate that the amount of OR time, an indirect measure of cost, needed to treat an ankle fracture was less for the orthopaedic surgery service.

9:30 Akul Patel – “Gender and Racial Bias in Letters of Recommendation for Orthopedic Surgery Residency Positions”

Akul Patel, Sohail Qazi, Mina Girgis, Xianing Lu, Daohai Yu, Bridget Slattery, J. Milo Sowards

Background: Orthopedic surgery continues to be a male and Caucasian dominated specialty. Although this has begun to change in recent years, females and minorities remain underrepresented in residency positions. While it is true that the largest demographic of the overall applicant pool for first year residency positions remains male and Caucasian, it is possible that there are biases within the recruitment process that increase the challenges faced by females and minorities wishing to enter the field. Letters of recommendation are one facet of the application process that could contain such bias. To our knowledge, in contrast to other fields such as urology and emergency medicine, studies that attempt to objectively analyze letters of recommendation for evidence of bias in orthopedic surgery are lacking. The primary purpose of this study was to retrospectively analyze all letters of recommendation received as part of the application process for first year residency positions at one ACGME accredited orthopedic residency program for the presence of bias. The secondary purpose was to determine if the presence of bias was influenced by the gender of the letter writer.

Methods: This was an institutional review board (IRB) approved study. All letters of recommendation received in the years 2016 and 2018 were deidentified and analyzed using the Linguistics Inquiry and Word Count (LIWC) 2015 software. This software uses prior published linguistic algorithms to calculate quantitative values between 0 and 100 for subjective qualities such as positive emotions and negative emotions and composite summary variables such as analytic, clout, authenticity, and emotional tone within a body of text. Independent variables in our analysis were applicant gender (male or female) and applicant race (Asian, Caucasian, or Other). Dependent variables included the aforementioned subjective qualities and composite variables.

Separate analyses were completed for male letter writers and female letter writers. Standardized letters of recommendation that did not contain a narrative portion, letters from international applicants, and ones that were a part of an incomplete application were excluded from analysis. Groups were compared using nonparametric tests, i.e., Wilcoxon for two groups and Kruskal-Wallis for 3 groups.

Results: A total of 5858 letters of recommendation from 1678 applicants were available for analysis. Of these, 5462 letters of recommendation from 1551 applicants were included in the final analysis (893 for female applicants, 4569 for male applicants, 3307 for Caucasian applicants, 858 for Asian applicants, and 1297 for other races). 5059 letters were written by male faculty and 403 by female faculty. Female and Asian applicants' letters were more likely to be longer in length ($p < 0.001$; median words F vs. M 310 vs. 293). Male applicants' letters were slightly more likely to have negative emotions ($p = 0.05$). When the letter writer was male, Asian applicants' letters were more likely to convey analytic and authentic qualities ($p = 0.013$ and 0.016). Other variables were similar between such groups, although there was a trend towards statistical significance of male applicants' letters containing more authentic qualities ($p = 0.059$).

Discussion and conclusion: Our study shows that letters of recommendation for orthopedic surgery residency positions are likely to contain some degree of bias. Faculty should ensure that they remain objective when analyzing the candidacy of future residents. Strengths of this study include its large sample size, utilization of software that is built on validated linguistic algorithms, and large inclusion criteria. Weaknesses include its retrospective nature, inclusion of only applicants to our institution, and inability to further divide races due to a low sample size of African American and Hispanic applicants. Further studies are required to fully characterize the degree and magnitude of bias in letters of recommendation and whether the findings of our study are significant enough to contribute to the

difference in socioeconomic demographics between orthopedic residents and society at large.

9:45 Akul Patel – “Causes for early readmission in AIS surgery”

Akul Patel, Joshua Pahys, Amer Samdani, Peter Newton, Suken Shah, Firoz Miyanji, Harms Study Group, Steven Hwang

Introduction: With increased attention on readmission, identifying risk factors associated with readmission may allow us to reduce the incidence.

Methods: We retrospectively reviewed a large dataset of prospectively collected AIS patients and divided patients into readmission < 90 days and > 90 days. Univariate analysis was performed and factors found to be $p < 0.10$ met criteria for entry into multivariate regression models. Separate models were created for < 90 readmit (RA) vs. no readmit (NO) and > 90 readmit (RA) vs. NO.

Results: 2049 patients were included of which 1957 (95.5%) were not readmitted. 27 were readmitted within 90 days (1.3%) and 65 were readmitted after 90 days (3.2%). Mean time to RA was 25.6 ± 17.6 days in the early group and 957.0 ± 642.3 days in the late group. The common reasons for RA were wound infections (33%), GI complications (30%), and instrumentation-related (15%). GI causes for RA included GI upset (N=3), SMA syndrome (N=3), 2 undescribed GI issues and were re-admitted 13.9 ± 4.2 days after surgery. Infection (23%) and instrumentation issues (22%) were the most common reasons for late RA. Lower pre-op SRS pain scores were consistently significant in both early and late readmission cohorts. (Table).

Discussion and conclusion: We reviewed risk factors associated with readmission in AIS patients from a large registry. GI complications were one of the most common reasons for early readmission (RA), representing a third of cases. Patients were readmitted an average of 2 weeks post-op due to SMA syndrome and GI upset. Overall a low pre-op SRS

pain score was most consistently associated with readmission risk. The readmission rate at 2 years for AIS patients was 4.5% with GI complications as a common reason within 90 days. The only consistent predictive factor for readmission was a low pre-op SRS pain score.

10:00 Andrew Porter – “Variable Force Distribution in the Femur During Broaching Through a Direct Anterior Approach”

Andrew S. Porter, Jason Brustein, Kurosh Darvish, Andrew M. Star, Danielle Y. Ponzio

Introduction: The direct anterior approach (DAA) has gained popularity as a true internervous and intermuscular approach because of the potential for less soft tissue insult, faster functional recovery, and reduced dislocation rates. However, a concern with the DAA is an associated technical learning curve with a difficult exposure accompanied by potential complications such as femoral fracture or femoral loosening. Previous retrospective analysis of these fractures found that the majority of fractures affected right-sided hips. This study evaluates mechanical force ratios transmitted by the surgeon to the bone while broaching for a right-sided hip compared to a left-sided hip via the DAA.

Methods: An experimental construct was adapted from a previous study by Greenhill et al. in which a 179-g size 10 broach was rigidly secured inside a hand-crafted metal casing with the distal tip resting on a 6-axis load cell. This construct was positioned to simulate the standard broaching position during the DAA. Forces were measured from twelve surgeons of varying experience levels, as well as the automated Kincise impactor, while broaching right vs. left hips, straight vs. offset broach handles, and Actis vs. Trilock broaches.

Results: In this experimental model it was shown that straight broach handles transmit greater force, both on and off axis, when compared with offset broach handles. On average, residents were found to transmit more force, again both on and off axis, when

compared to attendings. Most significantly, it was found that in left hips the moment—or twisting force applied to the broach—remained relatively constant with increasing force, whereas in right hips, the moment increased with greater broaching force.

Discussion: The increase in moment seen in right hips when compared to left hips may help to explain the higher incidence of right-sided fractures during the DAA. In addition, this study has reaffirmed that greater forces are seen when using a straight compared to an offset broach handle, but in an anatomical model. There was also shown to be a clear difference in force transmission from attendings to residents. The strengths of this study are the anatomical position of the construct, the large number of surgeons tested, and the numerous variables compared. Limitations are obviously that this is still an experimental model, as well as the fact that the all-metal construct is unable to imitate to physical properties of cortical bone. Moving forward there is the possibility that this model may be used as a training tool.

10:15 Robert Ames – “Prospective Follow-Up of Anterior Vertebral Body Tethering for Idiopathic Scoliosis: Interim Results from an FDA IDE Study”

Amer Samdani, Joshua Pahys, Robert Ames, Harsh Grewal, Glenn Pelletier, Steven Hwang, Randal Betz

Introduction: Anterior vertebral body tethering (AVBT) has emerged as a novel treatment option for patients with idiopathic scoliosis. We present the results from the first FDA IDE study on AVBT.

Methods: In this prospective review of a retrospective dataset, eligible patients underwent AVBT at a single center from August 2011 to July 2015. Inclusion criteria included skeletally immature patients with Lenke 1A or B curves between 30 and 65°. Clinical and radiographic parameters were collected until completion of the study (>18 years of age) contradicts average 17.1 ± 1.4 years of age at last

visit , with the latter measured by an independent reviewer.

Results: 57 patients (49 girls, 8 boys) were enrolled in the study with mean age of 12.4 ± 1.3 years (range 10.1–15.0). Patients underwent a mean number of 7.5 ± 0.6 levels tethered with a mean operative time of 223 ± 79 minutes and estimated blood loss of 106 ± 86 ml. Follow-up averaged 55.2 ± 12.5 months with mean Risser sign at follow-up of 4.2 ± 0.9 . The average preoperative main thoracic Cobb angle of $40.4 \pm 6.8^\circ$ corrected to $19.3 \pm 8.4^\circ$ at first erect. At most recent follow-up, the Cobb angle further improved to $18.7 \pm 13.4^\circ$. In the sagittal plane, T5-12 kyphosis measured 15.5 ± 10.0 pre-op, 17.0 ± 10.1 post-op, and 19.6 ± 12.7 at most recent follow-up. 80% of patients had curves $< 30^\circ$ at most recent follow-up. Pulmonary function remained stable. Most recent SRS scores averaged 4.5 ± 0.4 and self-image scores averaged 4.4 ± 0.6 . No major neurologic or pulmonary complications occurred. Revision surgery occurred in 7/57 patients (12.3%): 5 for overcorrection and 2 for adding on.

Discussion and conclusion: AVBT is a promising technique that has emerged as a treatment option for patients with immature idiopathic scoliosis. We present the results from the first FDA approved IDE study on AVBT. The findings affirm the safety and efficacy of this technique and suggest opportunities for improvement particularly with respect to reoperation rates.

10:30 Robert Ames – “Risk Stratification Algorithm For Orthopaedic Trauma Patients At Risk For Fat Embolism Syndrome”

Andrew Lowery, Vineet Naran, Robert Ames, Theresa Pazonis

Background: Fat embolism syndrome is commonly reported in the setting of long bone fractures (typically the femur or tibia) and fractures of the pelvis. The true etiology and pathogenesis are

unclear. FES can lead to dangerous clinical sequelae with pulmonary, neurologic, and/or dermatologic manifestations. To identify clinical characteristics and/or medical comorbidities that may place orthopaedic trauma patients at higher risk of developing FES. A secondary goal of our research is the design of a clinical algorithm for prediction of symptomatic FES.

Methods: We reviewed the electronic medical record of all orthopaedic trauma patients with a diagnosis of FES between the ages of 18-89 who presented to our institution between January 15th 2015 and November 15th, 2019. A 3:1 matched pair analysis was performed between patients who carried a diagnosis of FES and those with similar age, gender, and fracture type. Exclusion criteria included patients younger than 18, older than 89, pregnant women and prisoners.

Results: 18 patients with FES who met inclusion criteria were identified. Mean age was 41.16 ± 20.97 . Mean BMI was 27.80 ± 5.99 . 55.60% of patients had prior smoking/tobacco use history, 27.80% of patients carried a history of diabetes mellitus, 22.2% of patients had chronic inflammatory conditions, 5.60% of patients had history of DVT/PE and 5.60% had a history of TIA/stroke. 15 patients (83.30%) sustained a femur fractures, 6 patients (33.33%) sustained tibia/fibula fractures, 3 patients (16.70%) had pelvic fractures, and 2 (11.10%) patients had humerus fractures. 15.78% of fractures were open, 2 of which were femur fractures, and 1 humerus fracture. 100% of the patients had respiratory symptoms, neurologic symptoms in 61.1%, thrombocytopenia in 50.00%, fever in 38.90%, hypotension in 38.90%, coagulopathy in 33.30%, right heart failure in 16.70%, and shock in 5.60%. The following differences were noted between the FES and control groups: FES patients had higher pre-morbid rates of DM (27.8% vs. 18.5%), CAD/PAD (16.7% vs 7.4%), DVT/PE (5.6% vs. 1.9%), TIA/stroke (5.6% vs 3.7%). While they had similar rates of smoking/tobacco use (51.9% vs 55.6%) and similar mean BMI (27.8 vs. 27.3). Further statistical analysis is currently pending.

Conclusion: The clinical and laboratory findings in our data were often consistent with previously reported FES diagnostic criteria. A number of pre-morbid differences existed between the groups at baseline. We plan on expanding our dataset to more closely investigate the true incidence of FES at our institution, as well as trends in vital signs, renal function and inflammatory markers. We anticipate after further data mining and statistical analysis, we will be able to determine risk factors that predispose patients to development of FES, as well as develop a risk assessment algorithm to help clinicians manage this difficult clinical scenario.

10:45 Dayna Phillips – “Pediatric Train Injuries: The New Urban Lawnmower”

Dayna Phillips, Arianna Trionfo, Alexandre Arkader, Martin Herman

Background: Pediatric train injuries are rare, but potentially devastating injuries. The literature on train-related accidents is limited and primarily focuses on injuries occurring in the adult population. Despite current prevention and safety strategies, these injuries have remained relatively consistent over the past decade. The patterns of injury reported have varied depending upon the patient population and clinical setting.

The objective of this study is to report the patient demographics, mechanisms and patterns of injury, required interventions and morbidity caused by train-related injury in children at two level I pediatric trauma centers over an approximate 20-year period.

Methods: Retrospective chart review of all patients presenting to two Level I trauma centers (Children’s Hospital of Philadelphia and St Christopher’s Hospital for Children) from 1/1/2000 to 8/30/2017 who sustained train versus pedestrian injuries. Patients included in the study were males and females age 0-18 at the time of clinical presentation as well as in whom sufficient data could be collected. Individuals who were deceased upon arrival and involved in automobile versus train accidents were excluded from the study.

Results: A total of 13 cases were identified (3 female

and 10 male) with 0 deaths. Average age was 12 years upon presentation (14 years for females and 12.3 years for males; age range from 8-17). The majority of injuries (6 out of 10 with known injury location) occurred in South/Southwest Philadelphia. The injury was determined to have occurred while the child was walking/jumping on the train tracks in 8 cases (2 females and 6 males). The remainder were secondary to jumping onto train cars (3) and among other reasons (2). When assessing return to OR, 8 cases required multiple visits to the operating room prior to definitive treatment. These cases primarily were revision amputation cases, repeat irrigation and debridements, or for definitive fixation. A single case required revision of their amputation to a level proximal to the level they presented with. A total of 12 cases presented with orthopedic related injuries with 4 of the cases being amputations involving the upper and lower extremity.

Discussion and Conclusion: A majority of the pediatric patients who sustain train related injuries typically sustain musculoskeletal injuries, primarily involving the pelvis or the lower extremity. These injuries not only require multiple operating room visits, but also require the involvement of multiple surgical sub-specialties due to the complexity of these injuries. The results of this study brings light to the need for further improvement in limiting access to railroad areas and the incorporation of railroad safety initiatives/programs into schools.

11:00 Colin MacElroy Vroome – “Dorsal Hand Infection Admission Risk Factors”

Colin MacElroy Vroome

Background: Hand cellulitis lies on a spectrum of hand infections involving the dorsal aspect of the hand. These range from simple cellulitis to superficial and deep abscesses, as well as septic arthritis. First line treatment for cellulitis is typically a trial of oral (PO) antibiotics but the risk factors for failure of outpatient management have not been well identified. It is commonly described that delayed treatment of hand infections can result in stiffness and contractures so it would be of benefit to identify patients at risk for failure of PO therapy to expedite their proper treatment with admission and intravenous (IV) antibiotics.

Methods: A survey was created and distributed to attending and resident orthopedic surgeons to evaluate potential risk factors for failure of PO antibiotics in treatment of dorsal hand cellulitis. Risk factors assessed included patient compliance, diabetes, history of MRSA infection, intravenous drug use (IVDU), fever or elevated WBC on presentation, and size and location of the cellulitis as well as presence or absence of stiffness. Each of these were rated from 1 to 5 with 1 representing a non-factor and 5 representing a factor which is sufficient reason alone to admit a patient with dorsal hand cellulitis. A superficial abscess amenable to bedside decompression was assessed as a final risk factor for admission. Attending and resident surveys were separated and then within each group the rating for each risk factor were averaged to determine the highest rating risk factors with a score of 5 representing unanimous agreement that a patient with that factor should be admitted for antibiotics based on the presence of that factor alone.

Results: There were 12 and 15 returned surveys out of potential 16 faculty and 21 orthopedic residents, respectively. Highest scoring risk factors rated by faculty were failed PO therapy (4.75), fever or WBC count (4), diabetes (3.92), cellulitis extending to a joint with decreased motion (3.5), patient compliance (3.33), and IVDU (3.08). Highest scoring risk factors rated by orthopedic residents were failed PO therapy (4.73), diabetes (4), fever or WBC (3.93), cellulitis extending to a joint with decreased motion (3.73), MRSA history (3.73), compliance (3.6), contained cellulitis with joint stiffness (3.47).

Discussion and Conclusion: Orthopedic Surgery faculty and residents ranked risk factors for hand cellulitis requiring hospital admission to be similar. Both ranked failure of PO antibiotics highest. Both also ranked fever or elevated WBC and diabetes in the top 3 risk factors. Other risk factors may contribute and have a cumulative effect which is supported by the finding that no factors were rated unanimously as nonfactors (average score of 1). All patients presenting with dorsal hand cellulitis and infections should continue to be evaluated on an independent basis but these findings may help identify patients at risk for failure of oral antibiotic therapy in treatment of dorsal hand cellulitis.

11:15 Jeffrey Wera – “Repeat Drainage of Upper Extremity Infections: Do Repeat Cultures Change Antibiotic Treatment Regimens?”

Jeffrey Wera, Bradley Wiekrykas, G Rallis, Mark Solarz

Background: Polymicrobial infections and changing resistance patterns have made treating upper extremity infections difficult. Isolation of flora is essential to direct appropriate treatment. Some infections require multiple procedures. We sought to determine if repeat culture at time of repeat drainage changes treatment.

Methods: We queried our institutional coding database to identify patients admitted between October 2010 to August 2015 with an ICD-9 code associated with upper extremity infections. Patients were included if they had an upper extremity infection that required more than one procedure for drainage, and if repeat cultures were obtained. Data was grouped “same” if no new organisms resulted nor changes to sensitivities. Data grouped “different” was subdivided into “change” or “no change” depending on resultant organisms and sensitivities.

Results: 183 patients were included. Repeat culture resulted in antibiotic changes in 13 patients. Patients with HCV were more likely to require antibiotic change ($p=0.005$). Those with HIV approached statistical significance ($p=0.13$). Patients with history of IVDA did not result in significant changes to treatment ($p=0.23$).

Discussion and Conclusion: Repeat culture data resulted in a change in antibiotic regimen in 7.1% of patients (13/183). Patients without risk factors of HCV and HIV may not warrant repeat culture at time of repeat drainage.