

# Resident Research Day

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**Department of Orthopaedic Surgery & Sports Medicine**

Lewis Katz School of Medicine at Temple University

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Saturday April 13, 2019

Supported by the John Lachman Orthopaedic Research Fund

# Research Day Agenda

4/13/2019

Clancy Conference Room (MERB 342)

Moderator: Saqib Rehman, M.D.

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8:00-9:00am	<b>Grand Rounds Presentation</b> William DeLong, MD Professor and Chair of Orthopaedic Surgery St. Luke's University Health Network Lewis Katz School of Medicine	"Stem Cell Treatment of the Musculoskeletal System: 2019"
9:00-11:15	<b>Resident Research Presentations</b> Alexander Johnson, Nimit Lad, Dana Cruz, John Reynolds, Peter Eyvazzadeh, Courtney Quinn, Justin Kistler, Megan Reilly	10 minute presentations 5 minutes for questions
11:30	<b>Lunch and announcement of winners presented by Dr. DeLong and the John Lachman Orthopaedic Research Fund</b>	

## 9:00 Alexander Johnson – “Infection rates after gunshot-related tibia shaft fractures are comparable to rates after closed tibia shaft fractures”

Alexander Johnson, Bradley Wiekrykas, David Ebbot, Christopher Haydel, Saqib Rehman

**Introduction:** Diaphyseal fractures resulting from low energy firearm injuries (FI) are commonly seen in North American urban trauma centers and are not typically treated with formal surgical debridement. However, the tibia’s thin soft tissue envelope and higher propensity to develop infections with open fracture calls this practice into question. The purpose of this retrospective chart review is to compare infection rates of diaphyseal tibia fractures caused by firearm injuries with and without debridement, as well as compare against other open and closed mechanisms.

**Materials and Methods:** Retrospective chart review was conducted over a 10-year period at an urban level one trauma center. Included patients were 18 years and older treated operatively for an extra-articular tibia fracture (open or closed) via any mechanism with at least 3 months follow up. Patients treated non-operatively for an extra-articular FI tibia fracture were also included. All FI fractures and non-FI open fractures were classified using the Gustilo-Anderson system. Total infection rate and deep infection rate was calculated and compared for all FI fractures, non-FI fractures, and closed fractures treated operatively. Additional injury/treatment characteristics were analyzed for correlation to infection rates including compartment syndrome, vascular injury, muscle damage, bone visible within the wound, timing to antibiotics, decision to perform I&D, timing to I&D, use of aminoglycosides when indicated, and associated injuries.

**Results:** 223 cases (222 patients) met inclusion criteria. There was no significant difference between total infection and deep infection rates between FI

and non-FI fractures ( $P>0.05$ ). Type I FI fractures were indicated for I&D in 11 out of 35 cases; no type I FI fractures developed infection regardless of decision to perform I&D. All non-FI open fractures and all Type II and III FI fractures received urgent I&D. FI type I (0/35) had lower infection rates than FI type II (3/11,  $p = 0.005$ ), FI type III (2/4,  $p = 0.0005$ ), and non-FI type III fractures. There was no significant difference ( $p<0.05$ ) between deep infection rates in FI type I fractures, closed fractures (5/110), non-FI type I (0/16) and non-FI type II (0/23) fractures. None of the additional analyzed characteristics independently correlated to the rate of infections.

**Conclusion:** FI tibia shaft fractures lacking characteristics of type II and III open fractures can be safely treated without urgent I&D. FI type II and III fractures also have comparable or higher infection rates than their non-FI counterpart and we recommend treating them with urgent I&D.

## 9:15 Nimit Lad – “Orthopaedic Surgery Resident Financial Literacy: An Assessment of Perceptions and Participation in Disability Insurance”

Nimit Lad, William Justice, John Jennings, Saqib Rehman

**Background:** Residents report low levels of financial literacy and deficits in their financial preparedness. However, interest in financial education remains high as the average debt of graduating medical students in the U.S. is above \$200,000. Disability insurance provides one important form of protection against loss of income while carrying the high level of debt accrued in pursuing a career in medicine. In previous studies, a majority of residents have reported being uncomfortable with the topic of disability insurance, but indicate a strong desire to learn more about it. Furthermore, studies have not focused on specialties such as orthopaedics where earning potential could be adversely affected by physical impairment. This study aimed to gauge

perceptions and participation in disability insurance of U.S. orthopedic surgery residents, and their willingness to participate in formalized financial education.

**Methods:** 41 allopathic orthopedic surgery residents in the United States completed a 20 question anonymous online survey in 2018-2019. The survey assessed demographic data, self-assessed financial knowledge, amount of debt, participation in disability insurance, knowledge of current disability plans, and interest in participating in formal didactic education on disability insurance.

**Results:** A majority of respondents carry over \$200,000 in debt while 73% report having no formal financial literacy education in medical school or residency. Despite a majority of individuals indicating a lack of comfort with selecting plans, 76% of respondents are covered by disability insurance and 93% intend to obtain individual coverage as attendings. All respondents endorsed protecting their investment in their education and training to become a physician as their primary reason for having disability insurance. 44% reported low or no knowledge about disability insurance, plans, and companies, however 80.5% of respondents report moderate or high interest in learning about disability insurance and 73% are interested in participating in informational sessions.

**Conclusions:** Financial literacy education regarding disability insurance remains lacking in orthopaedic surgery training as many report a low level of knowledge regarding policies and comfort with selecting plans. However, orthopaedic residents identify disability insurance as an important protection for the significant investment in their education as 76% of respondents have a plan and 93% intend on obtaining a plan in the future. This study identifies obtaining disability insurance as a priority for orthopaedic residents, but also demonstrates an area of training that can be improved to help residents navigate their future financial situations.

## 9:30 Dana Cruz – “How “stable” are patients with isolated stable pelvic ring fractures?”

Cruz D, DiSanti N, Moar P

**Background:** Given the morbidity and mortality associated with pelvic ring injuries, it is the practice at our level 1 trauma center that all pelvic ring injuries are routinely admitted for observation. With increasing efforts to reduce healthcare costs however, hospital admissions and length of stay are coming under increased scrutiny. Previous studies have demonstrated increasing transfusion requirements and mortality associated with increasing instability of pelvic ring injuries. In contrast to patients with unstable pelvic ring injuries, of which an estimated 50% present with hemodynamic instability, low energy, isolated, stable pelvic ring injuries rarely develop these complications. The goal of this study was therefore to identify risk factors associated with hemodynamic instability amongst these mechanically stable patients.

**Methods:** Retrospective chart review was conducted at a single, urban, level 1 trauma center identifying patients whom sustained stable pelvic ring injuries, defined as APC1 or LC1 fractures, over a 6 year period. Age, gender, mechanism of injury, disposition, anticoagulant usage, hemoglobin on admission, comorbidities and concomitant injuries were compared between patients with and without hemodynamic instability.

**Results:** We identified 127 patients with orthopaedic injuries isolated to APC1 or LC1 fractures. 93 (73.2%) patients were female. 93 (73.2%) injuries resulted from a fall (down stairs, from height, seated or standing) while 31 (24.4%) were the result of a motor vehicle accident. 18 patients (14.2%) were taking anticoagulants at the time of admission. 15.7% of patients (20) demonstrated hemodynamic instability requiring angio-embolization or transfusion during their admission. When comparing

patients with (unstable) and without hemodynamic instability (stable), unstable patients were significantly older (mean 76.0 vs 61.5,  $p=0.004$ , range 19-97), with lower hemoglobin on admission (mean 10.4 vs 12.6,  $p=0.0002$ , range 6.9-16.2). Analysis by Fisher's exact testing demonstrated that amongst this sample, there was a statistically significant association between anticoagulant usage and hemodynamic instability ( $p=0.038$ ).

**Conclusions:** The incidence of hemodynamic instability amongst patients with stable pelvic ring injuries is low. Patient factors associated with hemodynamic instability include age, hemoglobin on admission and anticoagulant use.

### **9:45 John Reynolds – “Long-term Radiation Safety Profiles of X-rays After Undergoing Femoral Intramedullary Nailing”**

John Reynolds MD, Katharine D Harper MD, Michael Reynolds BS, Bin Wang MD, Shidong Li PhD, Sayed Ali MD, Christopher Haydel MD

**Introduction:** Ionizing radiation from medical imaging has come under increased scrutiny, as almost half of the radiation exposure experienced by the population in the United States is from medical imaging. As such, increased focus on decreasing the amount of exposure our patients received by modifying classic manual x-ray techniques. Automatic Exposure Control (AEC) is a technique that accomplishes this goal by allowing x-ray to reduce the required radiation dose and exposure while maintaining imaging consistency, regardless of the body habitus of the subject. The purpose of our study is to determine the effects of a femoral intramedullary implant on the amount of radiation the most radiosensitive organs are exposed to when compared to a native femur using both manual and AEC settings, in addition to fluoroscopy.

**Methods:** Calibration of ionizing chamber was performed in the days prior to the experiment. A mobile MOSFET system (BEST Medical) was calibrated with X-ray at kVp of 70, 80, 100, 120, and

138 kVp, phantom temperatures at 0, 21, and 43°C, and exposure ranges from 0.03 to 10 R. A fresh frozen cadaver had both MOSFETs and thermoluminescent dosimeter (TLD) probes placed at 5 locations to detect radiation (sigmoid colon (SC), right pelvic wall (RPW), left ovary (LO), pubic symphysis (PS), anterior pubic skin). X-rays centered at the left hip were taken using both Manual and AEC settings with probes recording the exposures at each location. X-rays were taken with the intramedullary implant in situ. Following this, the intramedullary implant was removed, and probes were confirmed to be placed in the same position. The previously performed protocol was repeated and values were recorded.

**Results:** By calibrating the chamber and accumulating exposures, we were able to achieve dose-measured accuracy of 6%. Manual results prior to implant placement were PS: 0.361mSv; LO: 0.170mSv; SC: 0.276mSv; RPW: 0.110mSv and skin: 0.364mSv. Manual results after placement of the implant were PS: 0.378mSv; LO: 0.150mSv; SC: 0.288mSv; RPW: 0.191mSv; and skin 0.469mSv. The relative risk of manual exposures are PS: 1.05; LO: 0.88; SC: 1.05; RPW: 1.74; skin: 1.29. AEC results prior to implant placement were PS: 0.063mSv; LO: 0.042mSv; SC: 0.063mSv; RPW: 0.038mSv and skin: 0.071mSv. AEC results after placement of implant were PS: 0.066mSv; LO: 0.035mSv; SC: 0.062mSv; RPW: 0.032mSv and skin: 0.068mSv. The relative risk of AEC exposures are: PS: 1.05; LO: 0.83; SC: 0.98; RPW: 0.84; skin: 0.96.

**Discussion:** The average background radiation exposure to a person in America is approximately 3mSv per year. Epidemiological studies have shown cancer risk associated with exposure follow a linear model when threshold levels below 90mSv of exposure were experienced. While this linear model has been confirmed in dose ranges between 10 – 90mSv, when exposures sit in the lower ranges (1-10mSv), there continues to be debate regarding increased risk and linear progression. Radiation exposure to the most radiosensitive pelvic and abdominal organs does not increase following

placement of a femoral intramedullary nail. These values also stay below the concerning threshold in both categories. This is in direct contrast to previous studies which demonstrated that radiation values increase up to 3x greater after placement of a total hip implant (to >1mSv per exposure). This is especially valuable information when considering patient's who receive a femoral intramedullary is commonly used in a trauma setting with younger patient populations. This points to the long-term safety of continued x-ray use in patients following the placement of a femoral intramedullary nail.

### **10:15 Peter Eyvazzadeh – “Opioid Prescribing Patterns in Shoulder Surgery Before and After Implementation of a Statewide Registry”**

Ahmed J, Lad N, Eyvazzadeh P, Ramsey F, Barnes L

**Introduction:** Opioid use has become a national epidemic in terms of its impact on both mortality and medical costs. The purpose of this study was to examine the effect of a statewide prescription drug monitoring program (PDMP) on opioid prescribing patterns within the context of elective shoulder surgery at an urban academic medical center.

**Methods:** A total of 425 patients who had undergone shoulder arthroscopy, rotator cuff repair, labral repair, and shoulder arthroplasty between January 1, 2015 and July 31, 2017 were included. Data was collected on patient age, medical comorbidities, post-operative complications, insurance type, opioid naivety, and the amount and type of pain medication prescribed within six months post-operatively. Statistical analyses were performed to compare variables between patients before and in the first six months after statewide registry implementation.

**Results:** There was a total of 215 patients in the group prior to implementation of the statewide registry, and 181 patients in the group after

initiation of the registry. There was no significant difference in opioid prescription rates before and after implementation of the PDMP. Through statistical analyses, a number of factors correlated with greater amounts of opioid prescriptions as measured in morphine equivalents. Specifically, a greater number of medical comorbidities, specific post-operative complications, Medicaid as the insurance provider, and the prescriber type were associated with higher numbers of total morphine equivalents prescribed.

**Discussion:** Implementation of a statewide registry did not statistically change the amount of opioid prescriptions filled after shoulder surgery in this study. Other factors were identified as having more influence on the quantity and duration of opioid treatment. Future studies may examine this phenomenon at a broader level across the orthopaedic field, and how the associated factors demonstrated in our study, impact physician prescribing.

### **10:30 Courtney Quinn – “Can culture data be used to predict success of arthroscopic vs open treatment of native septic knee arthritis?”**

Courtney Quinn, Nimit Lad, Jaquelyn Kakalecik, Frederick Ramsey, Vishal Saxena

**Introduction:** Literature suggests that arthroscopic versus open surgical treatment of septic arthritis of the native knee are of comparable efficacy. However, limited investigation has been performed to determine if either surgical technique is more effective for treating certain infecting organisms than others. The primary aim of this study is to determine if aspirate culture data can be used to predict success of open or arthroscopic treatment of septic knee arthritis. A secondary aim is to identify patient risk factors for requiring more than one operative intervention to eradicate the infection.

**Methods:** A retrospective chart review of patient data over a 10-year period from a single urban hospital was performed, evaluating all adult patients diagnosed with native septic knee arthritis. The diagnosis of septic arthritis was made based on synovial aspirate cultures, or a combination of clinical factors highly suggestive of infection (history and physical exam, elevated serum inflammatory markers, synovial cytology  $>50,000$  WBC/mm<sup>3</sup>). Exclusion criteria included, among others, prosthetic joint infections, presence of intra- or peri-articular hardware, and contiguous bone or soft tissue infections. Success of treatment was defined as eradication of infection with only one surgical irrigation and debridement (I&D).

**Results:** 150 cases of native septic knee arthritis in 148 patients met final inclusion criteria. Patients with positive synovial fluid cultures were more likely to require more than 1 I&D when compared to patients with negative synovial cultures (33.9% vs 13.5%;  $p=0.017$ ). Overall (irrespective of culture data), there was no statistical difference in the failure rates of open vs arthroscopic treatment (26.2% vs 30.7%;  $p=0.55$ ). There was no statistical difference in the need for subsequent I&D using either surgical technique in the treatment of methicillin sensitive staphylococcal aureus (MSSA;  $p=0.55$ ), methicillin resistant staphylococcal aureus (MRSA;  $p=0.69$ ), or streptococcal ( $p=1$ ) infections. While patients with concomitant bacteremia (positive blood cultures) required more than 1 I&D more frequently than those with negative blood cultures (19/54 vs 19/79), this difference was not significant ( $p=0.106$ ).

**Discussion:** The bacterial species does not appear to impact the efficacy of open vs arthroscopic techniques in the treatment of native knee septic arthritis. Patients with negative synovial cultures were less likely to need subsequent surgical intervention, which may be due to a lower bacterial load or to overtreatment. Patients with blood cultures may be at slightly higher risk for needing multiple surgical irrigations to eradicate septic arthritis.

## 10:45 Justin Kistler – “MRSA incidence and antibiotic trends in urban hand infections: A ten-year longitudinal study”

Justin M. Kistler, Joseph J. Thoder, Asif M. Ilyas

**Background:** Methicillin-resistant *Staphylococcus aureus* (MRSA) has been the most reported pathogen in hand infections at urban medical centers throughout the country. Antibiotic sensitivity profiles are continually evolving, but trends are not well known. The purposes of this study were to examine the epidemiology and determine the drug resistance trends for MRSA infections of the hand and to provide recommendations for empiric antibiotic treatment based on sensitivity profiles.

**Methods:** A ten-year longitudinal and consecutive, retrospective chart review was performed on all culture-positive hand infections encountered at a single urban medical center from 2005 to 2014. The proportions of all organisms were calculated for each year and collectively. MRSA infections were additionally sub-analyzed for antibiotic sensitivity.

**Results:** A total of 815 culture-positive hand infections were identified. Overall, MRSA grew on culture in 46% of cases, with the highest annual incidence peaking in 2007 at 65%. However, during the ten-year study period there was a decrease in overall MRSA prevalence reaching a nadir of 27% in 2014. While there was a drop in MRSA infection incidence over the ten-year study period, there was a steady increase in polymicrobial infections during that same 10 years, starting at 7% in 2005 and eventually peaking at 39% in 2014. Relative to antibiotic sensitivity, MRSA hand infections were universally resistant to penicillin, oxacillin, and ampicillin. Clindamycin resistance increased steadily during the course of the study, starting at a nadir of 4% in 2008 but growing to 31% by 2014. Similarly, levofloxacin resistance also consistently increased throughout the study reaching its peak at 56% in 2014.

**Conclusion:** The annual incidence of MRSA in hand infections has declined overall, but with an alternative increase in the number of polymicrobial infections. In addition, MRSA resistance to clindamycin and levofloxacin has consistently increased over the past 10 years. These findings present a new challenge in treating hand infections. Empiric antibiotic therapy for hand infections should not only avoid penicillin and its synthetic alternatives, but based on this study's findings should also consider avoiding clindamycin and levofloxacin for empiric treatment.

### **11:00 Megan Reilly – “Plantar plate reconstruction for Stage IV plantar plate tear using flexor tendon tenodesis”**

Reilly M; Darvish K; Assari S; Cole JR; Wilps T; Gokcen E.

**Background:** Outcomes of the surgical treatment of dislocated lesser toes have improved significantly over the past few years due to the development of techniques to repair plantar plate tears through a dorsal incision. However, treatment of stage 4 tears with no reparable plantar plate can be challenging. The current treatment involves flexor to extensor tendon transfer, requiring multiple incisions and additional surgical time. An alternative approach is presented, using the same modern techniques of plantar plate repair, but reconstructing the plantar plate using a flexor tendon tenodesis to the plantar base of the proximal phalanx.

**Methods:** Four fresh frozen cadaver foot and ankle specimens were used to determine the stability of this new technique. A simulated Lachman's test was performed on the 2nd, 3rd, and 4<sup>th</sup> metatarsophalangeal joints utilizing a force measurement instrument with displacement control on specimens with an intact plantar plate, an excised plantar plate, and following a flexor tenodesis reconstruction.

**Results:** The intact plantar plate force was 9.0±2.6kN for 2mm displacement, and following excision of the plantar plate, the force reduced to 1.3±0.4kN. The flexor tenodesis reconstruction improved the force to 6.0±1.9kN.

**Conclusion:** Plantar plate reconstruction with a flexor tenodesis to the proximal phalanx resulted in stability equal to 53% of the intact plantar plate, for the shear displacements between 2 to 6 mm. This procedure may be an alternative treatment option in patients with Stage 4 irreparable plantar plate tears.