OREF EASTERN REGION
RESIDENT RESEARCH SYMPOSIUM
Friday, September 16, 2022

Atrium Health and Wake Forest University School of Medicine
Sheraton Greensboro at Four Seasons
Koury Convention Center
Registration and Lunch in Gilford “D”
Scientific Program in Auditorium 2
3121 W. Gate City Boulevard
Greensboro, NC 27407

Co-Hosted by:

L. Andrew Koman, MD
Professor and Chair
Department of Orthopaedic Surgery and Rehabilitation
Executive Director,
Atrium Health Musculoskeletal Institute

Claude T. Moorman III, MD
Edward N. Hanley, Jr., MD Professor & Chair
Department of Orthopaedic Surgery
President,
Atrium Health Musculoskeletal Institute

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About OREF:
The Orthopaedic Research and Education Foundation (OREF) was founded in 1955 to ensure an expanding base of knowledge and effective, evidence-based treatment protocols for orthopaedic surgeons to continually improve patient care. Since its founding, OREF has funded more than $147 million in research and educational grants and awards that benefit all of orthopaedics. For more information about OREF grants and awards, please visit www.oref.org. Follow OREF on its Facebook page (OREFtoday) and on Twitter (@OREFtoday).

OREF EASTERN REGION
RESIDENT RESEARCH SYMPOSIUM
SUMMARY AGENDA
Friday, September 16, 2022

12:00 noon – 1:00 p.m.	**Lunch and Registration** **Atrium Health and Wake Forest University School of Medicine** Sheraton Greensboro at Four Seasons Koury Convention Center, Room Gilford "D" 3121 W. Gate City Boulevard Greensboro, North Carolina
1:00 p.m. – 1:05 p.m.	**Welcome and Introductions** L. Andrew Koman, MD Professor and Chair, Department of Orthopaedic Surgery and Rehabilitation, Wake Forest University School of Medicine Executive Director, Atrium Health Musculoskeletal Institute
1:05 p.m. – 1:10 p.m.	Claude T. Moorman III, MD Edward N. Hanley, Jr., MD Professor & Chair Department of Orthopaedic Surgery President, Atrium Health Musculoskeletal Institute
1:10 p.m. – 1:15 p.m.	**OREF Welcome** Mr. Lee Grossman Chief Executive Officer Orthopaedic Research and Education Foundation
1:15 p.m. – 2:05 p.m.	**Keynote Address** *The Pearl – Innovation and Strategy in Action* Rasu B. Shrestha, MD, MBA Atrium Enterprise EVP and Chief Strategy and Transformation Officer Atrium Health
2:05 p.m. – 2:30 p.m.	Session I – Resident Research Presentations & Discussion
	Break
2:35 p.m. – 3:05 p.m.	Session II – Resident Research Presentations & Discussion
3:05 p.m. – 3:35 p.m..	Session III – Resident Research Presentations & Discussion
3:35 p.m. – 4:05 p.m.	Session IV – Resident Research Presentations & Discussion
	Break
4:10 p.m. – 4:35 p.m.	Session V – Resident Research Presentations & Discussion
4:35 p.m. – 5:00 p.m.	Session VI – Resident Research Presentations & Discussion
5:00 p.m. – 6:00 p.m.	**Reception** Awards Presentation and Closing Remarks

KEYNOTE SPEAKER

Rasu B. Shrestha, MD, MBA

Atrium Enterprise Executive Vice President and
Chief Strategy and Transformation Officer
Atrium Health

Rasu B. Shrestha, MD, MBA, is executive vice president & chief strategy and transformation officer for Atrium Health, one of the largest non-profit and leading academic health systems in the United States. As a member of the executive leadership team, Shrestha is responsible for Atrium Health's enterprise strategy, including planning and tactical direction for the organization's current strategic roadmap and beyond. In addition, he spearheads a renewed focus on innovation, launching new healthcare inventions, discoveries and ideas to benefit our patients and the communities Atrium Health serves. He also provides executive leadership for corporate communications and marketing, as well as enterprise data and analytics.

With over 25 years of experience, Shrestha joined Atrium Health in February 2019. Prior to joining the organization, Shrestha served as chief innovation officer for the University of Pittsburgh Medical Center (UPMC), where he was responsible for driving UPMC's innovation strategy, serving as a catalyst in transforming the payer-provider organization into a more patient-focused and economically sustainable system. In addition to leading innovation at UPMC, Shrestha also served as executive vice president of UPMC Enterprises.

In addition, he serves on the Board of Directors of the Healthcare Information and Management Systems Society (HIMSS), the Society for Imaging Informatics in Medicine (SIIM), as well as Academy Health, and was the chairman of the HIMSS Innovation Committee, and co-chair of Health Datapalooza. Shrestha also serves on the Board of the Blumenthal Performing Arts.

Among his many achievements, Shrestha was recognized as "Executive of the Year" by *Healthcare Dive* and was acknowledged as one of the "Top 20 Health IT Leaders Driving Change" and as a "Top Healthcare Innovator" by *InformationWeek*.

Shrestha was the youngest student in his college in Malaysia and holds a Doctor of Medicine degree from CCS University in India. He has received training in radiology and has held a fellowship in informatics at the University of London. Shrestha also a holds a master's degree in business administration from the Marshall School of Business at the University of Southern California.

Judges

Cynthia Emory, MD
Atrium Health Wake Forest Baptist
Atrium Health Musculoskeletal Institute/

Joseph Hsu, MD
Atrium Health Carolinas Medical Center
Atrium Health Musculoskeletal Institute

L. Andrew Koman, MD
Atrium Health Wake Forest Baptist
Atrium Health Musculoskeletal Institute

Claude T. Moorman III, MD
Atrium Health Carolinas Medical Center
Atrium Health Musculoskeletal Institute

Susan Odum, PhD
Atrium Health Carolinas Medical Center
Atrium Health Musculoskeletal Institute

OREF Eastern Region Resident Research Symposium
DETAILED AGENDA
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2:10 p.m. – 2:15 p.m.	*Medical Optimization of Patients Undergoing Elective Total Hip Arthroplasty* Edwin Chaharbakhshi, MD, West Virginia University
2:15 p.m.- 2:20 p.m.	*Needle Aspiration and Intra-Articular Tobramycin Therapy for Native Septic Arthritis: Is It Effective?* Nathaniel Koutlas, MD, University of North Carolina, Chapel Hill
2:20 p.m. – 2:30 p.m.	Question and Discussions **Discussant: Claude T. Moorman III, MD**
	Break

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Benjamin Averkamp, MD, Atrium Health-Carolinas Medical Center

2:40 p.m. – 2:45 p.m. *Ballistic Versus Blunt Mechanism Open OTA/OA 43C Tibial Plafond Fractures: A Control Matched Study*
Corey Jones, MD, Emory University

2:45 p.m. – 2:50 p.m. *Tibial Nonunion Exchange Nailing Fails More Than One Third of the Time*
Julia Mastracci, MD, Atrium Health-Carolinas Medical Center

2:50 p.m. – 2:55 p.m. *The Prevalence of Depression and PTSD in Adults with Surgically Managed Traumatic Upper-Extremity Amputations*
Samuel Cohen-Tanugi, MD, Atrium Health-Carolinas Medical Center

2:55 p.m. – 3:05 p.m. Question and Discussions
Discussant: L. Andrew Koman, MD

Session III – Resident Research Presentations & Discussion

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Eoghan T. Hurley, MD, Duke University

3:10 p.m. – 3:15 p.m. *Outcomes of Humerus Nonunion Surgery in Patients Whose Initial Fracture Was Treated Nonoperatively*
Alexander Hysong, MD, Atrium Health-Carolinas Medical Center

3:15 p.m. – 3:20 p.m. *Treatment of Scaphoid Nonunion: Utilizing A Novel Random Flap Vascularized Capsular Bone Graft*
Benjamin Giertych, MD, West Virginia University

3:20 p.m. -- 3:25 p.m. *Staged Treatment is Superior to Single Stage Treatment for Infected Humerus Nonunions*
Patrick Pallitto, MD, University of North Carolina, Chapel Hill

3:25 p.m. – 3:35 p.m. Question and Discussions
Discussant: L. Andrew Koman, MD

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Session IV – Resident Research Presentations & Discussion

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3:40 p.m. – 3:45 p.m.	*Artificial Intelligence Automated Analysis of Scapula Dynamics Using Dynamic Digital Radiography: Initial Reliability Study* Zaamin B. Hussain, MD, Emory University
3:45 p.m. – 3:50 p.m.	*Outcomes After Use of the Induced Membrane Technique for Fractures of the Upper Extremity* Landon Bulloch, MD, Atrium Health-Carolinas Medical Center
3:50 p.m. – 3:55 p.m.	*Costs and Predictors of 90-Day Readmissions After Shoulder Arthroplasty with a Hospitalist Comanagement Model* Matthew Akelman, MD, Atrium Health-Wake Forest Baptist
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Session V – Resident Research Presentations & Discussion

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4:15 p.m. – 4:20 p.m.	*Association of Synovial Fluid and Plasma Tryptophan-Kynurenine Pathway Metabolites with Osteoarthritis Pain and Severity* Richard Danilkowicz, MD, Duke University
4:20 p.m. – 4:25 p.m.	*Health Literacy Awareness Amongst Orthopedic Surgery Residents* Elaine Shing, MD, PhD, Atrium Health-Carolinas Medical Center
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Session VI – Residents Research Presentations & Discussion

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4:40 p.m. – 4:45 p.m.	*Jones Fractures-Specific Screw vs. Intramedullary Screw or Plate Fixation for Fifth Metatarsal Fractures* Bryan Crook, MD, Duke University

4:45 p.m. – 4:50 p.m.	*Comparing the Validity of the International Spine Study Group and European Spine Study Group Sagittal Alignment Goals in an Asymptomatic Adult Population* Michael S. Schallmo, MD, Atrium Health-Carolinas Medical Center
4:50 p.m. – 5:00 p.m.	Question and Discussions **Discussant: Claude T. Moorman III, MD**
5:00 p.m. – 6:00 p.m.	**Reception** Awards Presentation and Closing Remarks

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Wireless in Ear Communication is Safe for Total Joints and Hoods

Samuel Rosas, MD
Atrium Health Wake Forest Baptist

Purpose: The null hypothesis was that in ear communication devices do not improve communication in a simulated TJA case.

Significance: Noise exposure during THA has been found to: 1) be significant and 2) create communication difficulties while performing TJA

Methodology: a prospective randomized simulation study was used to assess communication effectiveness in a simulated TKA. Subjects performed drilling and cutting of saw bones in simulated TJA case. Subjects were asked to repeat phrases said to them while drilling and cutting with and without in ear communication technology. Phrases those commonly employed during TJA. Subjects were randomized to the phrases. Effectiveness in communication was recorded as number of phrases correctly identified. Decibels were also measured and recorded as loudest seen. Objective outcomes were also obtained

Results: A significant difference in percent of correctly identified phrases was noted 80% vs 53%, $P<0.001$. Rating of effectiveness was also rated as significantly better for headphone use (mean 8.1 SD 2.25 vs 5.3, SD 2.1, $p<0.01$) as well as clarity (mean 8.1 SD 2.19 vs 4.2 SD 2.48, $p=0.001$). Mean Db exposure was similar when evaluated in the middle of the operators ($p=0.744$)

Conclusion: in ear technology appears to improve communication skills in a simulated TJA case.

Medical Optimization of Patients Undergoing Elective Total Hip Arthroplasty

Edwin Chaharbakhshi, MD
West Virginia University

Purpose: To report the timing and durability of medical optimization (MO) for elective total joint arthroplasty (TJA).

Significance: There is increased focus, yet a paucity of data, on MO of TJA patients.

Methods: Elective TJAs were reviewed between 2015-2019. Attempts at MO were made for body mass index (BMI), hemoglobin A1c (HbA1c), hemoglobin (Hb), smoking, and albumin. Data were collected at initial visit, pre-operatively, surgery, and one-year post-operatively. MO at each time point was graded (A=complete, B=partial, C=poor). MO improvement was defined as moving up at least one grade.

Results: A total of 877 patients were reviewed. Unoptimized parameters at initial visit were BMI(19%), HbA1c(13.5%), Hb(16%), albumin(19%), and smoking(9.5%). Mean time to MO for ≥1 parameter was 187.7 days (60.9-220; p=0.0003). BMI >40 at initial visit had a significantly higher risk of losing MO versus BMI <40 by time of surgery (7.6%, 0.1%; p=0.0001). Patients maintaining or improving MO from pre-operatively to surgery were as follows: BMI(95.7%), HbA1c(99.9%), albumin(93.5%), smoking(99.7%).

Conclusion: Most TJA patients have significant room for MO between initial visit and surgery. The mean time to MO of at least one parameter is six months. Patients with BMI >40 may have significantly increased BMI by day of surgery.

Needle Aspiration and Intra-Articular Tobramycin Therapy For Native Septic Arthritis: Is It Effective?

Nathaniel Koutlas, MD
University of North Carolina, Chapel Hill

Purpose: To evaluate the effectiveness of needle aspiration and intra-articular (IA) tobramycin therapy in treating native joint septic arthritis

Significance: Septic arthritis is a common condition, often among patients who are high-risk surgical candidates. To our knowledge, there are no prospective or retrospective studies evaluating the effectiveness of serial needle aspiration with IA antibiotics as treatment.

Methodology: Fifteen patients and fifteen joints met final criteria for inclusion. Records were reviewed for demographics, medical co-morbidities, illness severity, and aspiration characteristics. The primary outcome was need for surgical debridement, which was our surrogate for treatment success versus failure.

Results: Ten (66.7%) patients responded to IA tobramycin and avoided surgery while 5 (33.3%) failed treatment and underwent surgical debridement during the admission. There were no statistically significant differences between the treatment success and failure groups among the variables collected. The number of aspirations and injections was higher in the treatment success group (2.90 vs 1.40, $p = 0.134$).

Conclusion: Our retrospective study suggests that aspiration and IA antibiotics may be an effective alternative treatment to surgical debridement in patients who are high-risk surgical candidates. Further prospective study is underway to better understand and quantify the efficacy of treatment and assess longer-term clinical outcomes.

Femoral Nonunion Exchange Nailing: Are We Getting Better Results Now?

Benjamin Averkamp, MD
Atrium Health Carolinas Medical Center

Purpose: The goal of our study was to evaluate rates of osseous healing in femoral nonunions with contemporary exchange nailing.

Significance: While ~90% of femur fractures treated with intramedullary nail heal, ~10% of patients fail initial treatment and progress to nonunion. Exchange nailing remains a common treatment modality for femoral nonunions.

Methodology: We retrospectively reviewed patients (age≥18) from five academic Level 1 trauma centers who sustained femur fractures (AO/OTA 31, 32, 33) initially treated with intramedullary fixation that developed nonunion and were treated with exchange nailing for the index nonunion surgery.

Results: We identified ninety-nine femurs in ninety-nine patients which met inclusion criteria. 68 of 99 femurs (69%) achieved union following initial exchange nail procedure. Rates of osseous union were similar by AO/OTA classification (p=0.36), nonunion type (hypertrophic, oligotrophic, atrophic) (p=0.58), implant/biologic used (p=0.15), and time from initial procedure until exchange nail procedure (p=0.18). Fifty-nine patients had inflammatory labs (CRP, ESR) and cultures obtained at time of first non-union surgery with no significant differences in union (p=0.57) based on lab and culture results.

Conclusions: This large, multicenter study with modern implants, instruments, and techniques for exchange nailing femoral nonunions demonstrates disappointing rates of osseous healing (31% failure).

Ballistic Versus Blunt Mechanism Open OTA/OA 43C Tibial Plafond Fractures: A Control Matched Study

Corey Jones, MD
Emory University

Purpose: To compare complications between ballistic and blunt mechanism open tibial plafond fractures. We hypothesize both cohorts would have similar outcomes.

Significance: Despite the devastating nature of ballistic tibial plafond fractures, established treatment recommendations are limited to a small pool of retrospective case series.

Methods: Twenty-seven patients sustaining ballistic OTA/AO 43C tibial plafond fractures were treated operatively from 2011–2021. This cohort was compared to blunt open 43C pilon fractures 1:1 control-matched for fixation method and Gustilo-Anderson classification. The main outcome measures were infection, nonunion, post-traumatic osteoarthritis, soft tissue reconstruction, and need for additional fixation procedure.

Results: The ballistic and blunt open groups had similarly high rates of deep infection (18.5 vs. 25.9%, p=0.51), superficial infection (41% vs. 37%, p=0.78), nonunion (19% vs. 19%, p=1.00), post-traumatic arthritis (11% vs. 7%, p=1.00), soft tissue reconstruction (11% vs. 11%, p=1.00), and need for additional fixation procedure (19% vs. 11%, p=0.70).

Conclusion: Ballistic tibial plafond fractures are severe injuries that have similar outcomes to blunt open pilon fractures that occur with high energy axial-loading. While ballistic tibial plafond fractures are rare, our data reveals similarly high complication rates to blunt open pilon fractures and highlights the need for careful planning and soft tissue handling in treating these injuries.

Tibial Nonunion Exchange Nailing Fails More Than One Third of the Time

Julia Mastracci, MD
Atrium Health Carolinas Medical Center

Purpose: Evaluate rates of osseous healing in tibia nonunions treated with contemporary exchange intramedullary nailing.

Significance: Tibia fractures are often treated with intramedullary fixation. The literature reports 5 to 10% of tibia fractures progress to nonunion after intramedullary nailing. A common approach for treating tibial nonunions is through exchange intramedullary nailing.

Methodology: We retrospectively reviewed patients from five Level 1 academic trauma centers with tibia fracture nonunion that were treated with exchange intramedullary nailing. The primary outcome measure was osseous union. We further analyzed union rate by AO/OTA classification, nonunion type, implants used, time from initial procedure, and infection status.

Results: We identified sixty-six tibias which met inclusion criteria. Forty-three (65%) achieved osseous union after exchange intramedullary nail procedure. Rates of union were similar when comparing nonunion type, implant/biologic used, time from initial procedure to exchange nail, and evidence of infection including elevated inflammatory markers or positive surgical cultures. Complications included persistent non-union, re-operation, new infection and hardware failure.

Conclusion: This large, multicenter study with modern implants, instruments, and techniques for exchange nailing of tibial nonunions demonstrates disappointing rates of osseous healing (35% failure) consistent with the lower end of reported data in previous literature.

The Prevalence of Depression and PTSD in Adults with Surgically Managed Traumatic Upper Extremity Amputations

Samuel Cohen-Tanugi, MD
Atrium Health Carolinas Medical Center

Purpose & Significance: Despite advances in procedures and prostheses for upper limb amputees, it is critical to recognize psychosocial factors in these patients' care. Little is known about the prevalence of depression and PTSD in the civilian population after traumatic upper-extremity amputation.

Methods: In this retrospective observational single-center study, adult patients evaluated for traumatic upper limb amputations from 2016 to 2019 completed patient-reported (PRO) questionnaires and the Center for Epidemiologic Studies Depression Scale, and the Primary Care PTSD Screen during visits. All data underwent descriptive statistical analysis.

Results: Thirty-nine adults treated for upper-extremity traumatic amputation completed patient-reported outcomes (PROs) questionnaires. The median follow-up time was 17 months from amputation. Twenty patients (51%) screened positive for depression and 27 (69%) for PTSD. The median time from amputation to first positive screening was 6.5 months for depression and 10 months for PTSD. The physical component score of VR-12 was significantly worse for patients with depression. The Median DASH and mental component score of VR-12 were significantly worse for patients with PTSD.

Conclusion: Upper-extremity limb loss has a significant impact on mental health, which affects PROs. The high prevalence of depression and PTSD in traumatic upper-extremity amputees underscores the necessity for screening and multidisciplinary treatment.

Buccally Absorbed Cannabidiol Shows Promise in Treating Pain and Improving Satisfaction Immediately Following Arthroscopic Rotator Cuff Repair: A Placebo-Controlled, Double-Blinded, Randomized Trial

Eoghan T. Hurley, MD
Duke University

Purpose: The purpose of the study is to evaluate the effects of cannabidiol (CBD) on patients undergoing Arthroscopic rotator cuff repair (ARCR).

Significance: There is a paucity of literature to evaluate its effectiveness, safety, or ideal route of administration of CBD.

Methods: This is an FDA-sanctioned, multi-center, placebo-controlled, randomized, double-blinded trial conducted in 100 patients undergoing ARCR. The experimental group received an oral CBD tablet, while the control group received an identical placebo. Patients were followed-up on Day 1, 2, 7, and 14, and Visual Analog Scale (VAS) for pain, opioid consumption, and satisfaction with pain control were recorded.

Results: On Day 1, VAS pain score was significantly lower in those receiving CBD (4.4 ±3.1, 5.7 ±3.2, $p = 0.039$). On both Day 1 and Day 2, patient satisfaction with pain control was significantly higher in the CBD group (Day 1: 7.0 ±3.0, 5.6 ±3.7, $p = 0.040$ | Day 2: 7.3 ±2.5, 6.0 ±3.3, $p = 0.028$). There were no statistically significant differences in opioid consumption ($p > 0.05$).

Conclusion: Buccally absorbed CBD demonstrates an acceptable safety profile and shows significant promise in reduction of pain in the immediate peri-operative period following ARCR.

Outcomes of Humerus Nonunion Surgery in Patients Whose Initial Fracture Was Treated Nonoperatively

Alexander Hysong, MD
Atrium Health Carolinas Medical Center

Purpose: We aimed to describe generalizable union rates following nonunion surgery among patients with humerus nonunions whose initial fracture was treated nonoperatively and the risk factors for developing a recalcitrant nonunion.

Significance: Nonunions develop following non-operative management of humerus fractures in approximately 10-20% of fractures and remain challenging to treat.

Methodology: Nine medical centers retrospectively reviewed adult patients with a nonoperative humerus fracture who developed nonunions that were treated surgically (n=120). We measured union rates and used univariate regression to identify risk factors for recalcitrant nonunion.

Results: Following nonunion surgery, 95 (79.2%) achieved union, while 25 (20.8%) developed recalcitrant nonunion. Thirty-six (30.0%) experienced one or more complication(s), including 9 (7.5%) that developed an infection. Only current smoking status (p=0.0073) and having a complication (p=0.0001) were significantly associated with recalcitrant nonunion. Interestingly, nonunion type, addition/choice of bone graft, initial injury characteristics, BMI, and diabetes were not associated with recalcitrant nonunion.

Conclusion: Among patients with humeral nonunion whose initial fracture was managed nonoperatively, only 80% achieved union following nonunion surgery, and 30% experienced a complication. The success of nonunion repair should be discussed with the patient when considering nonoperative management. Further research is necessary to optimize treatment strategies for humerus nonunion.

Treatment of Scaphoid Nonunion: Utilizing a Novel Random Flap Vascularized Capsular Bone Graft

Benjamin Giertych, MD
West Virginia University

Purpose: Scaphoid fractures are complex injuries with high nonunion rates. We propose utilizing a vascularized capsular based random flap distal radius graft from the second compartment to simplify graft harvesting and versatility for scaphoid nonunion.

Significance: Vascularized bone grafts increase union rates; harvesting them can tedious with dissection of small vessels, microsurgical anastomoses, and pedicle rotation which jeopardizes graft viability.

Methods: Retrospective review of 9 patients with scaphoid non-union. The second extensor compartment release with 1cmx1cm corticocancellous graft harvest with osteotomes and longitudinal capsular incision to the dorsal lip of the radius (random flap bone graft). Graft placed into scaphoid defect and fixation achieved with headless screw over a guidewire.

Results: Mean follow up was 3.9 months radiographically (Range 2-10) and 4.3 clinically (Range 2-8). One patient was lost to follow up. Seven of remaining eight (87.5%) achieved radiographic union. The remaining patient declined radiographs and seen virtually due to Covid-19. He reported full painless range of motion and strength. Overall, one patient (11.1%) reported stiffness, one (11.1%) reported decreased wrist flexion, and one (11.1%) reported tingling in their dorsal hand.

Conclusion: This technique provides good early outcomes in scaphoid nonunion and eliminates technically demanding aspects of vascularized bone grafting.

Staged Treatment is Superior to Single Stage Treatment for Infected Humerus Nonunions

Patrick Pallitto, MD
University of North Carolina, Chapel Hill

Purpose: Humeral nonunions are challenging to treat and functional recovery may be limited. Debridement, irrigation, and antibiotics remain the cornerstone of treatment of infected nonunions but it is unclear what the overall union rate is following treatment.

Methods: Patients from seven Level 1 trauma centers with an infected humeral nonunion were retrospectively identified by the presence of a draining sinus or positive intraoperative cultures. Demographics, fracture characteristics, fixation, bone grafting, culture results, and complications were collected. The primary outcome was overall union rate.

Results: 33 patients were identified. Median age of index injury was 50 and trended younger in those that ultimately united ($p < 0.13$). Of initial injuries, 43.5% were open. A plate and screw construct was the initial fixation in 81% of patients. Cultures grew a single organism in 94.1% of patients. After revision operative treatment, 51% (n=17) went on to union. Staged treatment was associated with higher union (76.5%, $p<0.024$). Complications were seen in 53.1% of patients and were higher in the persistent nonunion group (68.8% $p<0.013$). Tobacco use, diabetes, BMI, and bone grafting did not appear to impact union.

Conclusions: This supports our hypothesis that infected humeral nonunions are challenging and at high risk for persistent nonunion. Staged treatment of infected nonunions was associated with a higher union rate.

Psychological Distress is a Stronger Driver of Shoulder Pain and Function Than Tear Severity in Patients Undergoing Rotator Cuff Repair

Chinedu Okafor, MD
Duke University

Purpose: We aimed to evaluate the association between psychological distress and shoulder pain and function in patients undergoing arthroscopic rotator cuff repair.

Significance: Psychological distress has been associated with declining shoulder function and quality of life yet literature exploring this is sparse.

Methodology: Patients that underwent arthroscopic rotator cuff repair and completed preoperative Optimal Screening for Prediction of Referral and Outcome (OSPRO) from 2019 to 2021 at a single academic institution were included. Patients were stratified into three groups: 1) partial-thickness, 2) small to medium full-thickness, and 3) large to massive full-thickness tears.

Results: Eighty-four patients were included. Regarding patient reported outcome (PRO) scores, there were no significant differences amongst the three cohorts of severity of rotator cuff tear. Higher scores within the OSPRO negative mood and coping domains correlated with lower PRO scores. Conversely, higher scores on the positive affect and coping domains were shown to strongly associate with PRO scores. These findings emphasize strong correlations between specific dimensions of preoperative psychological distress and postoperative pain and function.

Conclusion: These findings suggest that preoperative psychological distress is a stronger predictor of poor shoulder function and pain than rotator cuff tear severity in patients undergoing arthroscopic rotator cuff repairs.

Artificial Intelligence Automated Analysis of Scapula Dynamics Using Dynamic Digital Radiography: Initial Reliability Study

Zaamin B. Hussain, MD
Emory University

Purpose: Assess the reliability of an artificial intelligence (AI) automated image analysis software.

Significance: Dynamic Digital Radiography (DDR) is a novel technique that uses pulsed low-dose radiographs in the shoulder to allow dynamic non-invasive examination of glenohumeral and scapula kinematics. Manual measurement is the current gold standard to calculate the scapulohumeral rhythm (SHR) budis time consuming.

Methods: DDR was performed on 73 shoulders including normal controls and those diagnosed with rotator cuff tears, adhesive capsulitis, or glenohumeral osteoarthritis. Manual measurements of the angle between the humerus and the midline and the medial border of the scapula and midline were taken by two readers at 30, 60, and 90 degrees of shoulder abduction. Corresponding measurements were taken with a prototype automated AI algorithm to enable paired direct comparison and intra-class correlations (ICC) using a two-way random effects model.

Results: Total number of paired measurements was 219. Excellent inter-rater reliability - 0.87 (95% confidence interval 0.75 – 0.93) was found in the manual measurements. Moderate reliability - 0.58 (95% confidence interval 0.4-0.71) was found between the manual and AI measurements of SHR.

Conclusion: The prototype automated image analysis algorithm shows proof of concept, and early promise but requires further refinement before it can reliably replace manual measurement of SHR.

Outcomes After Use of The Induced Membrane Technique For Fractures of The Upper Extremity

Landon Bulloch, MD
Atrium Health Carolinas Medical Center

Purpose: The purpose of this study was to review outcomes from cases in which the induced membrane technique was used for segmental bone loss in the upper extremity.

Significance: Segmental bone loss remains a clinical challenge, and little data exists regarding outcomes after use of this technique.

Methods: An institutional database was used to identify patients with segmental bone defects from acute trauma, nonunions, and infections based on either diagnosis or procedure codes. Indications and outcomes were then reviewed.

Results: We identified 17 patients with traumatic segmental bone loss and 11 patients with chronic nonunions and/or infections. 18 cases involved bones of the forearm, 9 cases involved the metacarpals and 3 cases involved the phalanges. Radiographic union was demonstrated in 26/28 patients (92.9%) with a median time to union of 22 weeks (range 13-29 weeks). No differences were found between union and non-union groups based on BMI, sex, race/ethnicity, or age. 10 patients required unplanned reoperation. Four nonunions required repeat grafting procedures, one periprosthetic fracture required fixation, and one patient underwent amputation for infection after multiple procedures.

Conclusion: The induced membrane technique continues to represent an effective option for acute traumatic bone loss as well as chronic fracture nonunions.

Costs and Predictors of 90-Day Readmissions After Shoulder Arthroplasty with a Hospitalist Comanagement Model

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Purpose: To assess costs and predictors of 90-day readmission in patients undergoing shoulder arthroplasty with an orthopaedic hospitalist comanagement model (OHC). We hypothesized that patients comanaged under the orthopaedic hospitalist comanagement model would have higher 90-day costs and equivalent rates of readmissions.

Significance: OHC services have been implemented to improve the quality of care during the initial procedural admission and decrease readmissions, however there is a gap in the literature regarding cost-effectiveness and readmission rates in patients undergoing shoulder arthroplasty with an OHC service.

Methods: A single-center retrospective review identified patients undergoing shoulder arthroplasty between 2013-2017. Demographic, clinical characteristics and costs were reviewed.

Results: 325 patients met inclusion criteria. 57 patients were comanaged with OHC. 24 patients were readmitted within 90 days. Patients comanaged with OHC had significantly more comorbidities, including higher preoperative ASA and CCI ($p<0.039$) scores. OHC was not associated with increased readmission ($p=0.206$). Initial length of stay (OR 1.229, $p=.004$) was the strongest predictors of readmission. Length of stay (beta weight 0.294, $p<.001$), readmission (beta weight 0.26, $p<.001$), and OHC comanagement (beta weight 0.168, $p=.001$) were the strongest predictors of increased cost.

Conclusions: OHC may be an effective way to decrease readmission rates for more medically complex patients but is associated with increased cost.

Off-Label: The Results of Adjunctive Bone Morphogenic Protein for Challenging Femur Fractures: A Review of Two Cases

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Purpose: To present two cases with radiographs and consequences of the use of BMP, causing excessive HO formation in one patient and not in another.

Significance: Bone Morphogenic Proteins (BMP) was first approved for orthopaedic use in 2009, only FDA-approved for spine fusions and open tibial fractures. Any use outside these applications is considered off-label. The hope for off-label use is healing complex fractures and the concern is excessive heterotopic bone formation. Heterotopic ossification (HO) is ectopic formation of bone within soft tissues. BMP is a known inducer for bone growth and has been shown to be inherently present in injuries that result from trauma.

Methods: Review of patients, including operative reports, follow up appointments and imaging in conjunction with literature review.

Results: Patient cases and literature were reviewed. Use of BMP-7, specifically in the traumatic case of a femur fracture, can lead to increased HO formation.

Conclusion: BMP-7 is a key osteoinductive factor in injured bone and muscle that facilitates both bony healing and HO formation. Given the function of natural BMP-7, it is important to be aware of the effects of naturally occurring BMP in patients who have undergone trauma and the additive effect of BMP bone graft.

Association of Synovial Fluid and Plasma Tryptophan-Kynurenine Pathway Metabolites with Osteoarthritis Pain and Severity

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Purpose: To examine altered tryptophan (Trp) metabolism in osteoarthritis (OA) by analyzing the association of tryptophan metabolites with radiographic OA severity and knee joint pain.

Significance: OA has historically been understood on a structural basis, however recent work has begun to identify the role of low level, chronic inflammation in the pathogenies.

Methods: Knee synovial fluid (SF) and plasma samples from a previous study of participants with radiographic OA in at least one knee and self-reported knee pain were analyzed for Trp, kynurenine (Kyn), kynurenic acid (KynA), and indoleamine 2,3-dioxygenase (IDO) activity. SF and plasma concentrations were tested for an association with pain, severity and for correlation with one another.

Results: Higher mean SF concentrations of Kyn and IDO activity were positively associated with OA radiographic severity and pain. Compared with plasma, SF KynA and tryptophan were lower but IDO activity was higher. SF Kyn, KynA, Trp, and IDO activity were all significantly correlated with their corresponding plasma levels, and plasma Kyn was positively correlated with OA severity.

Conclusion: This exploratory study suggests that altered Trp metabolism in knee OA may have a direct pathogenic role in OA severity and pain and thus, the Trp pathway may be a target for OA therapy.

Health Literacy Awareness Amongst Orthopedic Surgery Residents

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Purpose/Significance: Musculoskeletal health literacy (HL) is an emerging concept in orthopedic healthcare. Patients have lower musculoskeletal HL than general HL. This study 1) establishes the state of HL awareness amongst orthopedic surgery trainees, 2) characterizes the state of orthopedic HL training, and 3) evaluates the desire for formalized HL training.

Methods: This study was endorsed by the Collaborative Orthopaedic Education Research Group (COERG) board. An 18-20 item questionnaire was administered anonymously to orthopedic residents in the 2020-2021 academic year.

Results: 192 residents (42%) from 19 orthopedic programs completed the survey. Most residents felt somewhat comfortable with HL concepts. Most residents reported no training in HL issues (77.5%). Of the 43 (22.3%) residents who received training, most felt that it was effective (N = 42, 97.7%). Residents felt it was somewhat important to receive HL training (Mdn = 4.0, IQR = 3.0-5.0). There was a modest desire for formalized training (39%).

Conclusion: This is the first study to qualify orthopedic resident perceptions of HL issues in practice and training. Residents were somewhat confident in their understanding of HL concepts. There is a lack of formal orthopedic training on HL issues. This may be an area for improvement in orthopedic training paradigms.

Mortality and Complications in Patients with Chronic Kidney Disease (CKD) and End Stage Renal Disease (ESRD) Following Lower Extremity Trauma

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Purpose: Assess mortality and postoperative complications amongst patients with CKD and ESRD following fixation of lower extremity fractures.

Significance: CKD is a known risk factor for fragility fractures, with increased postoperative morbidity and mortality. Current literature is largely limited to hip fractures.

Methods: Retrospective study of 356 patients with CKD/ESRD and surgical lower extremity fractures (pelvis to ankle) between 2008-2019 were stratified using the National Kidney Foundation guidelines: mild (stages 1-2), moderate-severe (stages 3-4), and ESRD (stage 5). Cohorts were compared and further analyzed using multivariable logistic regression.

Results: Mortality was significant between ESRD and mild CKD groups at 90 days (15.75% vs. 5.5% p=.033), 1 year (27.1% vs. 10.5% p=.005), and 2 years (47.1% vs. 17.0%; p<.0001). Complications were higher with increasing CKD severity (p<0.0001). A positive association between ESRD and mortality was seen at 90 days (OR 4.5, 95% CI 1.3, 15.1), 1 year (OR 2.7, 95% CI 1.1, 6.5) and 2 years (OR 5.2, 95% CI 2.3, 11.6). Moderate/severe CKD (OR 2.2, 95%CI 1.1, 4.3) and ESRD (OR 4.1, 95%CI 1.8, 9.4) had a positive association with post-operative complications.

Conclusion: Patients with moderate-to-severe and end-stage kidney disease have high postoperative morbidity and mortality with lower extremity fractures.

Jones Fracture-Specific Screw vs. Intramedullary Screw Or Plate Fixation for Fifth Metatarsal Fractures

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Purpose: The purpose of this study was to compare the Jones bolt to intramedullary screw and plate fixation with regard to complication rates and outcomes.

Significance: The Jones bolt is a novel surgical treatment for fractures of the proximal fifth metatarsal (Jones fracture) which aims for more anatomic fixation.

Methods: A retrospective single–surgeon case series was performed on all patients who underwent surgery with intramedullary screw fixation, Jones bolt, or plate fixation between 2010 and 2021 for Jones fractures. Univariate statistics were utilized for data analysis.

Results: A total of 85 procedures were performed, including intramedullary screw (60.0%), Jones bolt (14.1%), straight plate (18.8%), and hook plate (7.1%). The mean follow-up was 190.4 (±173.4) months. Most patients were female (70.6%) with a mean age of 49.0 (±16.3) years-old, and BMI of 29.0 (±6.8) Kg/m^2. For all fixation methods, the average visual analog scale (VAS) score improved from 5.4±2.6 preoperatively to 1.4±1.7 postoperatively ($p<0.0001$), while the average American Orthopedic Foot and Ankle (AOFAS) score improved from 59.0±13.2 preoperatively to 186.0±11.2 postoperatively ($p<0.0001$). There was no difference in final postoperative or overall change of VAS or AOFAS scores for Jones bolt versus all other types of fixation. No postoperative complications occurred.

Conclusion: The Jones bolt is a novel treatment for proximal fifth metatarsal fractures, with noninferior outcome scores and complication rates when compared with intramedullary screw or plate fixation.

Comparing the Validity of the International Spine Study Group and European Spine Study Group Sagittal Alignment Goals in an Asymptomatic Adult Population

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Purpose: Assess the correlation of calculated International Spine Study Group (ISSG) thresholds and distribution of European Spine Study Group (ESSG) Global Alignment and Proportion (GAP) Score in an asymptomatic population.

Significance: The ISSG formulae for age-specific realignment thresholds and the ESSG GAP Score are validated models for surgical adult spinal deformity patients. However, it is unknown whether these models are valid for asymptomatic patients.

Methods: Standing thirty-six-inch scoliosis radiographs obtained prospectively from a cohort of 149 asymptomatic volunteers were reviewed retrospectively. Spinopelvic parameters were measured for each patient and compared with values predicted by ISSG formulae. Patients were also categorized as proportioned, moderately disproportioned, or severely disproportioned based on GAP score.

Results: The strength of correlation between measured and predicted spinopelvic parameters based on ISSG formulae was poor: Pelvic Incidence-Lumbar Lordosis (r=0.24, *P*=0.032); Pelvic Tilt (r=0.11, *P*=0.18); Lumbar Lordosis-Thoracic Kyphosis (r=-0.36, *P*=<0.0001); Sagittal Vertical Axis (r=0.20, *P*=0.01); T1 Pelvic Angle (r=0.15, *P*=0.06). Based on GAP score, most patients were moderately (43.0%) or severely (28.9%) disproportioned (*P*=0.02).

Conclusion: In a cohort of asymptomatic adults, sagittal parameters predicted by ISSG methods correlated poorly with measured parameters. The GAP score demonstrated that most patients were either moderately or severely disproportioned.

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