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Buttress Plating versus Anterior-to-Posterior Lag Screws for Fixation of the Posterior Malleolus: A Biomechanical Study

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Introduction

When compared to similar bimalleolar ankle fractures, outcomes of trimalleolar fractures are significantly worse^{3,4,5}

- Lower post-treatment functional scores
- Higher incidence of post traumatic arthritis

The posterior malleolus plays a significant role in tibiotalar load transfer^{7,8}

- Surface area of the plafond
- Geometric restraint to posterior talar subluxation
- Stabilizing the syndesmosis

Despite recognized clinical and biomechanical importance, operative indications and preferred method of

Objective

The purpose of this study is to compare the biomechanical performance of the two most common methods for fixation of the posterior malleolus²

- AP lag screws
- Posterior buttress plating

Materials & Methods

- Posterior malleolus fractures involving 30% of the distal tibial articular surface were created in seven pairs of fresh frozen human cadaveric ankles⁹
- One specimen in each pair was randomly assigned to fixation with either two anterior-to-posterior lag screws or a one-third tubular buttress plate without supplemental lag screws
- Each specimen was then subjected to cyclic

Outcome Measures

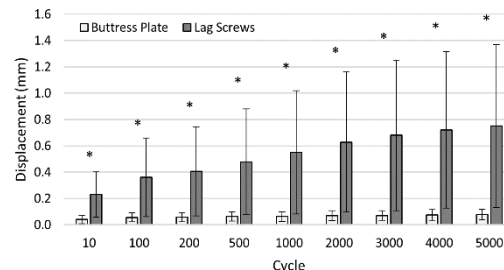
- Permanent axial displacement during each test cycle (axial displacement at no load)
- Peak axial displacement during each test cycle (axial displacement at 50% BW)
- Load at 1 mm axial displacement
- Ultimate load
- Axial displacement at

Conclusions

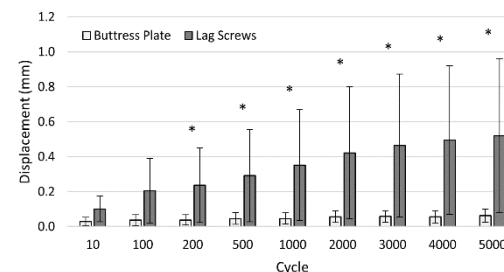
- Posterior malleolus fractures treated with posterior buttress plating showed significantly less axial displacement during cyclical loading compared to fractures fixed with AP lag screws
- There were no significant differences between the two groups during load to failure testing
- Ankle joint stability and articular reduction have been implicated in the development of post-traumatic arthritis
- Surgeons should consider these findings when selecting a fixation strategy for these common fractures

Results

Peak Axial Displacement



Permanent Axial Displacement



Ultimate Load Testing

Load at 1 mm axial displacement

- Buttress plate: 1211 ± 570 N
- lag screws: 802 ± 416 N
- p=0.319

Ultimate load

- Buttress plate: 1585 ± 683 N
- Lag screws: 1617 ± 422 N
- p=0.899

Axial displacement at ultimate load

- Buttress plate: 2.51 ± 0.41 mm
- Lag screws: 3.67 ± 1.56 mm
- p=0.122

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Preoperative Use of Chronic Opioids and its Perioperative Effects When Undergoing Shoulder Arthroplasty

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Background & Hypothesis

- Chronic opioid therapy has become an increasingly used modality for treatment of osteoarthritic joint pain.
- The purpose of this study was to evaluate the effects of preoperative opioid use on the perioperative outcomes of total shoulder arthroplasty and reverse total shoulder arthroplasty.
- We hypothesize that preoperative opioid use is associated with adverse perioperative outcomes after shoulder arthroplasty.

Methods

- Retrospective analysis of patients undergoing elective anatomic total shoulder arthroplasty (TSA) or reverse total shoulder arthroplasty (RTSA) at a single tertiary institution from 2012 to 2015.
- Patients stratified by preoperative opioid use into three groups: non-user (**control**), short-acting (**SA**- e.g. hydrocodone, oxycodone), and long-acting (**LA**- e.g. Oxycontin, MS-contin, methadone, fentanyl patch) (Table 1).
- Patients received a preoperative interscalene block and intraoperative general anesthesia, followed by postoperative as needed hydrocodone 10/325mg, oral oxycodone and IV hydromorphone for breakthrough pain. Preoperative long acting opioids were continued at the patients' home dose.
- Clinical outcomes: length of stay, total inpatient opioid use, distance walked postoperatively, complications within 90 days.
- Univariate and multivariate analysis was used to examine the association of opioid use and adverse outcomes.
- Post-hoc power analysis using a 0.1 non-inferiority margin revealed a power of $\beta=0.93$.

Results

- 262 patients were identified (170 RTSA, 92 TSA; mean age of 64, 53% female).
- Preoperative use of opioids was associated with increased VAS scores and opioid consumption (Table 2A/B)
- Use of preoperative opioids was not associated with increased perioperative complications (Table 3).



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Results

Table 1: Cohort Characteristics		
	Control	Opioid User
Sample (n)	124	138
Short Acting		113 (81.9%)
Long Acting		25 (18.1%)
Age Median (IQR)	70 (62.8,76)	64.5 (58,72)
Sex Female	63 (50.8%)	76 (55.1%)
Male	61 (49.2%)	62 (44.9%)
ASA Status		
1	8 (6.5%)	7 (5.1%)
2	81 (65.3%)	90 (65.2%)
3	34 (27.4%)	39 (28.3%)
4	1 (0.8%)	2 (1.4%)

Table 2A Average VAS, mean \pm SD				
	Control	SA	LA	P Value
Preop	3 \pm 2.9	3.3 \pm 3.1	4.4 \pm 3.6	0.148
POD 0	2.6 \pm 1.9	3.2 \pm 2.4	3.9 \pm 2.5	0.007
POD 1	4 \pm 1.8	4.9 \pm 1.9	6 \pm 1.5	< 0.001
POD 2	3 \pm 1.9	3.9 \pm 2.1	5.1 \pm 1.4	< 0.001
POD 3	3.2 \pm 2.1	4.4 \pm 2.2	4.4 \pm 2.9	0.22

Table 2 B Average Morphine Equivalents Consumed, mean \pm SD				
	Control	SA	LA	P Value
Total	66.9 \pm 41	111.4 \pm 127.3	208.3 \pm 135.3	< 0.001
POD 0	17.8 \pm 11.6	24.8 \pm 19.5	42.6 \pm 29.1	< 0.001
POD 1	33.4 \pm 20.9	55.2 \pm 71.7	103.4 \pm 89.7	< 0.001
POD 2	12.1 \pm 13.1	25.6 \pm 39.2	48.8 \pm 41.4	< 0.001
POD 3	2 \pm 5.9	4.1 \pm 14.5	5.4 \pm 11.9	★ P<0.05 0.194

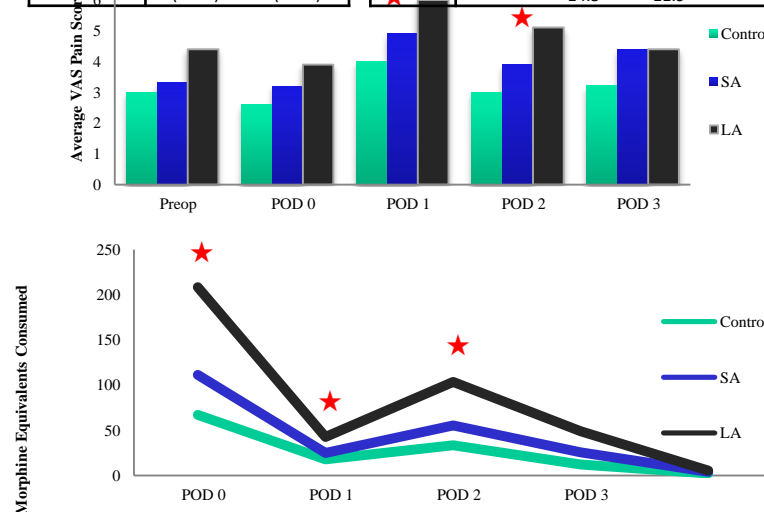


Table 3: Perioperative Outcomes Following Total Shoulder Arthroplasty			
	Control	Opioid User	P value
Sample (n)	124	138	
Distanced walked by POD1 (meters), mean \pm SD	200.1 \pm 196.1	191.5 \pm 167.3	0.651
Length of Stay, mean \pm SD	2.3 \pm 1.3	2.4 \pm 1.5	0.399
Disposition - Home	109 (87.9%)	126 (91.3%)	0.484
- Not Home (SNF)	15 (12.1%)	12 (8.7%)	
Readmission (90d)	4 (3.2%)	5 (3.6%)	1
Reoperation (90d)	1 (0.8%)	3 (2.2%)	0.624
Complication (90d)	9 (7.3%)	10 (7.2%)	1

Discussion

- Preoperative use of opioids is common in shoulder arthroplasty and associated with significantly increased postoperative pain and opioid requirements that are concerning for opioid tolerance.
- While previous literature has shown that preoperative opioid use is associated with opioid tolerance and poor analgesia that limits lower extremity arthroplasty rehabilitation and recovery, shoulder arthroplasty does not require mobilization and weight bearing of the operative upper extremity. It is not associated with surgical pain that reduces ambulation and rehabilitation.
- Preoperative opioid use was not associated with increased length of stay, disposition to an assisted care facility, perioperative medical complications, and readmission.

Conclusion

- Preoperative chronic opioid use was associated with increased pain scores and postoperative opioid usage, but without significant perioperative complications.

Reliability of Unilateral Clavicle Radiographs Versus Panoramic Shoulder Girdle Radiographs in Evaluating Midshaft Clavicle Fracture Shortening

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Introduction: A relative indication for surgical treatment of midshaft clavicle fractures is shortening of the fracture greater than 1.5-2.0cm. Previous studies suggest that this degree of shortening impairs shoulder function by decreasing muscular strength and endurance. Plain radiography is the primary modality used to assess shortening of clavicle fractures and make treatment decisions. The optimal radiographic projection for measuring clavicle shortening has not been established.

The purpose of this study was to compare the inter-observer and intra-observer reliability of measuring clavicle shortening on a standard unilateral clavicle series versus a panoramic shoulder girdle series (bilateral clavicles on the same cassette) (Fig. 1).

Materials / Methods: Statistical power analysis demonstrated a sample size of 30 would be sufficient for comparison. Inclusion criteria was patients with a midshaft clavicle fracture that were older than 18 years old, had no prior clavicle trauma or surgery, and had both unilateral and panoramic shoulder girdle series performed within 1 week of injury.

Two musculoskeletal radiologists, 2 fellowship-trained orthopaedic trauma surgeons, and 2 senior orthopaedic residents evaluated both a unilateral clavicle series and a panoramic shoulder girdle series for fracture shortening. Two weeks after initial evaluation, the same individuals reviewed the same films again to measure clavicle shortening.

An intra-class correlation coefficient and its confidence interval (CI) were calculated to determine inter-observer reliability. The average differences between the 2 time points with 95% CI was calculated to determine intra-observer reliability.

Results: Twenty of the thirty (67%) fractures were comminuted. Eighteen of the thirty (60%) clavicle fractures were left-sided. The majority of the clavicle fractures were either AO/OTA 15-B1 (10 fractures) or 15-B2 (16 fractures).

Overall, intraobserver reliability for measuring clavicle shortening was improved with the panoramic shoulder girdle films compared to the unilateral clavicle films ($p=0.02$). Individually, reliability for each observer improved with use of the panoramic shoulder girdle film. Four of the six (67%) evaluators demonstrated a statistically significant improvement.

Similarly, interobserver reliability was improved with shoulder panoramic radiographs. The ICC value for shoulder panoramic radiographs (ICC = 0.85) was significantly better ($p<0.001$) than unilateral clavicle radiographs (ICC = 0.57), indicating panoramic shoulder radiographs produced a more reliable measure of clavicle shortening.

Discussion: To our knowledge, no prior study has compared the reliability of measuring clavicle shortening in the acute setting on unilateral versus panoramic shoulder girdle films. Our study demonstrated a more reliable measure of shortening using the panoramic shoulder girdle films. This reliability was demonstrated in both inter and intra-observer measurements.

A standardized imaging protocol would be useful to accurately and reproducibly predict the risk of nonunion and malunion, as well as determine the need for operative intervention. When evaluating midshaft clavicle fracture shortening, clinicians should consider obtaining panoramic shoulder girdle films.

Introduction:

The impact of visual-spatial and psychomotor skills of medical students on their ability to become proficient in orthopaedic surgical procedures has not been reported. The progression of these same skills through orthopaedic training is not yet known

The primary goal of this study was to compare two novel orthopaedic specific psychomotor tests to three validated written visual-spatial tests. The secondary goal was to compare the performance of medical students, residents and staff orthopaedic surgeons on the two novel tests and the three written tests.

Materials / Methods:

Twenty-two fourth year medical students applying for orthopaedic residency, 10 orthopaedic residents, and 10 staff orthopaedic surgeons underwent testing. Testing consisted of the Cards Rotation Test, Map Planning Test, the Rey Complex Figure Test (RCFT), an arthroscopic simulator and a 3-dimensional psychomotor test (needle pass test). Results of the two novel orthopaedic tests were compared to the written visual-spatial tests.

Results:

There was no correlation between scores on the three written tests and the two psychomotor tests. Performance on the two psychomotor tests correlated to each other. Staff surgeons outperformed medical students on the 3-dimensional psychomotor test, both staff surgeons and residents outperformed medical students on the scope simulator.

TEST	Medical Students	Residents	Staff Surgeons
Rey Complex Figure Test	72.4	75.9	78.7
Cards Rotation Test	159.9	153.9	138.9
Map Planning Test	27.0	21.4	20.8
Scope Simulator (total number of beads correctly placed in 4 minutes)	37.7	74.3	78.1
Needle Pass Test (total mean distance in mm)	34.4	26.1	18.7

Table 1. Mean scores for each test by level of training

Discussion:

Psychomotor skills significantly improve with advanced orthopaedic training.

Our two novel orthopaedic specific tests did not correlate with written visual-spatial testing, however there was a clear progression of psychomotor skills with increased training and experience.

Closed Reduction of a Dislocated Hip Arthroplasty: Fracture Table Technique and Early Clinical Experience

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Introduction: Closed reduction of a dislocated hip arthroplasty can often be strenuous, exhausting and even impossible depending not only upon patient variables but also the surgeon's age and physical condition.

Methods: We describe a simple technique that allows orthopedic surgeons to perform closed reduction for a dislocated hip arthroplasty using a standard fracture table and fluoroscopy. We retrospectively evaluated all patients treated over the last 5 years by a single surgeon at a community hospital for a diagnosis of dislocated hip arthroplasty. Our cohort consisted of 6 consecutive patients treated using our described fracture table technique. These 6 patients all received a telephone call and answered questions regarding complications, re-dislocation and revision surgery.

Surgical Technique: Set-up supine on a fracture table, fluoroscope from 45° caudal and pre-reduction confirmatory imaging saved.

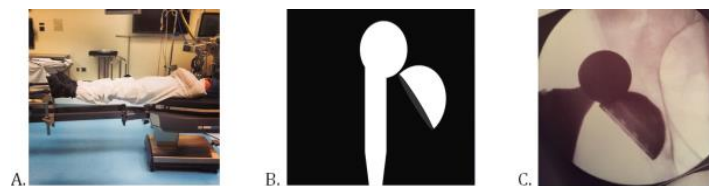


Figure 1: A. Demonstration with patient supine on fracture table under general anesthesia. B. Animation of dislocated THA. C. Dislocated THA fluoroscopic image.

Step 1: Unlock the components; IR for posterior and ER for anterior dislocations

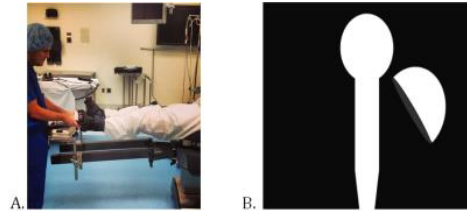


Figure 2: A. Leg is rotated to unlock the prosthesis. B. Animation of dislocated THA being rotated to disengage prosthesis.

Step 2: Macro longitudinal and lateral traction

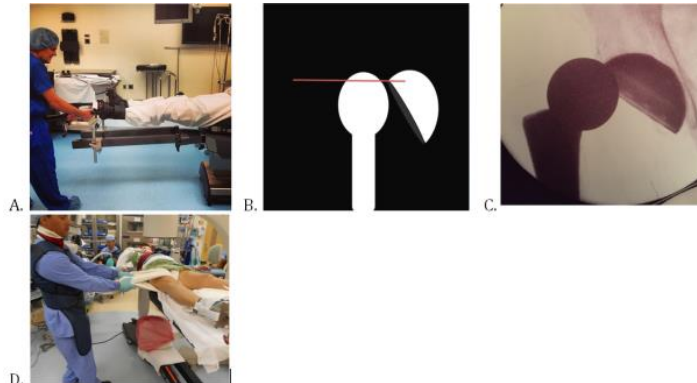


Figure 3: A. Large traction is applied to the affected extremity by operator directed force. B. Animation demonstrating the femoral component still perched on acetabular component. C. Fluoroscopic image of perched femoral component not yet at station. D. Example of lateral traction technique.

Step 3: Micro traction until just past station

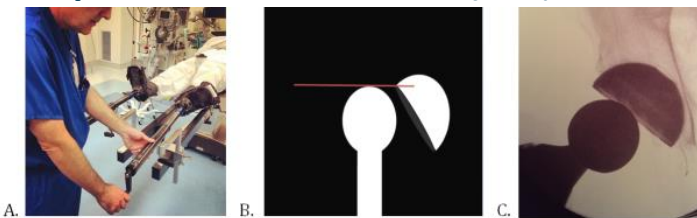


Figure 4: A. Small traction is applied to bring the prosthesis into position. B. Animation demonstrating the ability of precise traction to bring the prosthesis to its appropriate station. C. Fluoroscopic image of femoral component just past station.

Step 4: Reduction; opposite of step 1, ER for posterior and IR for anterior dislocations.

Step 5: Confirmation; traction released and image of concentric reduction saved

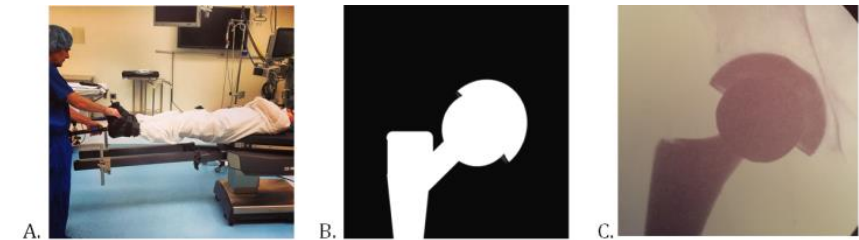


Figure 5: A. De-rotation of the affected extremity allows for reduction. B. Animation of reduced prosthesis after traction is released. C. Fluoroscopic image of reduced prosthesis after traction released.

Results: We present a retrospective, consecutive case series of 6 patients treated with mean follow-up of 13 months (6 weeks–30 months) and length of hospital stay of 26.7 hrs (5–72hrs). To date, this technique has not shown any increased risk of or unique complications and has yet to be unsuccessful requiring conversion to an open procedure. Of note were the presence of 2 greater trochanter non-unions and 1 non-displaced greater trochanter fracture pre-closed reduction.

Conclusion: Our described fracture table technique of hip arthroplasty closed reduction is safe, effective and reduces physical exertion required by the surgeon.

Introduction:

A substantial portion of Resident education occurs through teaching interactions amongst Residents. Optimizing teaching encounters for Intern and Intermediate Level residents is essential given the decreased work hours for Residents at this level due to work hour restrictions. There is a paucity of literature addressing the ability to optimize teaching ability of Residents.

Materials / Methods:

A teaching skills education program was established based on the One-Minute Preceptor model. Intermediate Residents tasked to manage an Acute Care Orthopaedic Surgery Clinic as an assigned rotation were randomized to receive the teaching skills program. Interns rotating through the Acute Care Clinic completed anonymous evaluations of the Intermediate Residents managing the clinic. Evaluation results of trained Intermediate Residents were compared to untrained Intermediate residents who rotated through the same rotation at different times.

Item Number	Item	Domain of One-Minute Preceptor Evaluated
1	The resident gave me direct feedback on the quality of my work.	Feedback
2	The resident provided me with feedback that was helpful.	Feedback
3	The resident asked me for my diagnosis and plan.	Commit & Probe
4	The resident explained the decision making process.	Feedback
5	The resident taught me clinically useful information.	General Rules
6	The resident provided suggestions to help me improve.	Feedback
7	The resident was an effective teacher.	Overall
8	The resident had an overall positive impact on my education. ("yes" or "no")#	Overall
9	I consider this resident to be a strong teacher. ("yes" or "no")	Overall
10	I feel that this resident has had formal education on teaching. ("yes" or "no")	Overall

Results:

There was no difference between the trained and untrained Intermediate Residents with regard to feedback given, quality of feedback given, useful clinical information taught and suggestions for improvement given. There was no difference in the percentage of each group described as an effective teacher or as having a positive impact on the education of the rotating interns. Untrained PGY3's were more likely to be considered a strong teacher than trained PGY2 residents. Finally, there was no difference with regard to the perceptions of whether or not the Intermediate Resident had received training in teaching.

Item Number	Item	Untrained PGY-2's	Trained PGY-2's	Untrained PGY-3's	P value
1	Feedback given	4.60	4.45	4.51	0.533
2	Feedback was helpful.	4.72	4.68	4.72	0.884
3	Asked for diagnosis and plan.	4.71	4.83	4.58	0.174
4	Explained decision making process.	4.69	4.67	4.78	0.648
5	Taught useful information.	4.74	4.78	4.82	0.744
6	Provided suggestions to help improve.	4.51	4.43	4.43	0.950
7	Effective teacher.	4.60	4.73	4.74	0.336
8	Overall positive impact. ("yes" or "no")#	97%	100%	100%	0.179
9	Strong teacher. ("yes" or "no")#	97%	93%	100%	0.019*
10	Resident has had formal education on teaching. ("yes" or "no")#	69%	77%	76%	0.632

Discussion:

The implementation of a formal teaching skills program directed at Intermediate Level Residents was unable to improve the teaching abilities of the residents trained. Time in training was most predictive of teaching ability.

Introduction:

Children who present to the emergency room with complaint of fever and new onset joint or extremity pain can be a diagnostic dilemma for many emergency and consulting physicians. Certain conditions, such as osteomyelitis and septic arthritis warrant admission, whereas other children with more benign conditions can be safely discharged home.

Given the limited time and resources, and the large differential in diagnoses for a child presenting with fever and extremity pain, the decision to perform additional studies in the emergency room, admit or discharge home is a difficult one.

The purpose of our study was to identify the etiologies of pediatric fever and extremity pain presenting to a tertiary care pediatric emergency department; and to isolate factors that predict the need for advanced imaging, admission, and surgical intervention.

Materials / Methods:

Our IRB approved this project. No outside funding was received.

Electronic medical records of children presenting to our institution's pediatric emergency department with fever and extremity pain were reviewed. Our search yielded 294 children. Of those children, 48 met our inclusion criteria.

The duration of symptoms, presence of either a measured fever in the emergency department and the corresponding recorded temperature or the history of a subjective fever and duration, and the number of presentations to any outpatient clinic or emergency department, were all recorded. The ability to bear weight, extremity involved, and if multiple extremities were involved were also documented. Radiographic and advanced imaging was also recorded when obtained for each child. The specific type of advanced imaging was also investigated and diagnostic result. Laboratory data results, in regards to serum white blood cell count (WBC), erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) were documented for each child.

Categorical data was analyzed utilizing chi-square test, or the alternative Fisher exact test if the assumptions of the chi-square were violated. Interval data (i.e. CRP, WBC, ESR) were analyzed utilizing ANOVA. Interval data were checked for normality and homogeneity of variances prior to application of parametric statistics. Alpha was set at $p < 0.05$ and SPSS v. 12 was utilized for all analyses (SPSS Inc., Chicago, IL).

Results:

The average age of children presenting to the emergency room with fever and extremity pain was 6.8 years (range: 0.3 to 17 years old). There were 21 females and 27 males. 20 of the 48 children (42%) had a measured fever in the emergency room. The initial emergency room diagnosis was consistent with the definitive diagnosis 42% of the time. The most common diagnoses were: Osteomyelitis (10 children), Oncological/chemotherapy induced (7 children), Rheumatological (7 children), and Septic Arthritis (4 children).

Multiple emergency room visits (two or more visits) were seen in 19 of the 48 children (40%). Magnetic resonance imaging (MRI) was ordered in 63% of children with multiple visits compared to 34% of children with a single visit ($p = 0.05$). Children who presented with the inability to bear weight on the affected limb were more likely to have a bacterial infection such as osteomyelitis, septic arthritis, or abscess. ($p = 0.016$)

Children with a definitive diagnosis of osteomyelitis or septic arthritis had a mean ESR of 50 mm/hr (range: 36 to 64 mm/hr) and a mean CRP of 98 mg/L (range: 60 to 138 mg/L). (Figure 1a and 1b). A statistical difference in ESR and CRP between children with a diagnosis of osteomyelitis or septic arthritis with those without a diagnosis of osteomyelitis and septic arthritis was found ($p = 0.043$, < 0.001). Children with a diagnosis of osteomyelitis or septic arthritis had a mean WBC of 11,700/mm³ (range: 5,600 to 23,900/mm³) compared to a mean WBC of 9,600/mm³ (range: 100 to 28,200/mm³) in children without osteomyelitis or septic arthritis. This was not statistically significant ($p = 0.774$)

Discussion:

Our study showed a cut-off for ESR as a marker for bacterial bone and joint infection that was similar to previous studies.^{1,2} An ESR > 36 mm/hr was found in all children diagnosed with osteomyelitis or septic arthritis. ($p = 0.043$) CRP in our study was found to have a higher cut-off than previous studies, a CRP of > 6.0 mg/dL (60 mg/L) was consistent with a definitive diagnosis of osteomyelitis or septic arthritis. ($p < 0.001$) Like previous studies, we also observed inability to bear weight as another predictor of osteomyelitis or septic arthritis. ($p = 0.016$)

In addition to obtaining inflammatory markers, our study showed that multiple diagnostic studies were routinely ordered in the emergency department for children presenting with fever and extremity pain. The most common diagnostic study obtained were radiographs, with 70.8% of children having one or more radiographs obtained. While not highly diagnostic, routine radiographs for children with fever and extremity pain are recommended as an initial study by several studies.^{3,4}

MRI is useful in distinguishing, amongst other diagnoses, transient synovitis from septic arthritis, which has been shown to not be easily distinguishable on ultrasound.^{5,6} MRI was also found to be helpful in diagnosing other bacterial infections, such as osteomyelitis and soft tissue abscess.^{7,8} In addition, MRI has been shown to be useful in differentiating infectious from non-infectious causes of fever and extremity pain, such as sickle cell crisis and acute lymphocytic leukemia.^{9,10}