

# 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 16, 2016

Supported by the John Lachman Orthopaedic Research Fund

# Research Day Agenda

4/16/2016

Clancy Conference Room (MERB 342)

Moderator: Saqib Rehman, M.D.

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8:00-9:00am	<b>Grand Rounds Presentation</b> Daniel Horwitz, M.D. Chief of Orthopaedic Trauma Geisinger Health System	“The Simple and Not So Simple Ankle Fracture”
9:00-10:15	<b>Resident Research Presentations</b> James Bennett, Katharine Harper, John Jennings, William Smith, Rupam Das	10 minute presentations 5 minutes for questions
10:15-10:20	Break	
10:20-11:35	<b>Resident Research Presentations</b> Kazimierz Komperda, Colin Mansfield, Mark Solarz, Dustin Greenhill	10 minute presentations 5 minutes for questions
11:40	<b>Lunch and announcement of winners presented by Dr. Horwitz and the John Lachman Orthopaedic Research Fund</b>	

## Resident Research Presentation Schedule:

- 9:00** James Bennett, M.D., PGY 3: "Significant intraoperative neuromonitoring alerts in patients undergoing fusion for adolescent idiopathic scoliosis: what are the outcomes of surgery?"
- 9:15** Katharine Harper, M.D., PGY 3: "Radiation exposure of the pelvis following total hip arthroplasty"
- 9:30** John Jennings, M.D., PGY 3: "How does physician attire influence patient perceptions in the outpatient orthopaedic surgery setting?"
- 9:45** William Smith, M.D., PGY 3: "Conjoined vs. isolated shoulder tendon transfers in brachial plexus birth palsy"
- 10:00** Rupam Das, M.D., PGY 5: "Does the Boston carpal tunnel questionnaire correlate with EMG findings?"
- 10:20** Kazimierz Komperda, M.D., PGY 5: "Anterior cruciate ligament reconstruction using quadriceps tendon autograft: retrospective review of outcomes and return to play"
- 10:35** Colin Mansfield, M.D., PGY 5: "Subscapularis tendon partial vs. full thickness tears: MRI and arthroscopic evaluation"
- 10:50** Mark Solarz, M.D., PGY 5: "Underinsured patients experience delays in treatment and higher rates of irreparable meniscal injury following anterior cruciate ligament rupture"
- 11:05** Dustin Greenhill, M.D., PGY 4: "Relationships between three classification systems in brachial plexus birth palsy"
- 11:20** James Lachman, M.D., PGY 4: "Interosseous fusion techniques in the foot: Does it really hurt less?"

## 9:00 James Bennett – “Significant intraoperative neuromonitoring alerts in patients undergoing fusion for adolescent idiopathic scoliosis: what are the outcomes of surgery?”

Amer F. Samdani, MD\*, James T. Bennett, MD, Robert J. Ames, MD, Jahangir K. Asghar, MD, Giuseppe Orlando, MD, Joshua M. Pahys, MD, Burt Yaszay, MD, Firoz Miyanji, MD, Baron S. Lonner, MD, Ronald K. Lehman, MD, Peter O. Newton, MD, Patrick J. Cahill, MD, Randal R. Betz, MD

\*Corresponding Author

Amer F. Samdani, MD  
Shriners Hospitals for Children-Philadelphia  
3551 N Broad St, Philadelphia, PA 19140 USA  
Tel. 215-430-4250; Fax: 215-430-4136  
Email: amersamdani@gmail.com

IRB Statement: IRB approval for the study was obtained locally from each contributing institution’s review board, and consent was obtained from each patient prior to data collection.

Funding Statement: This study was supported by a research grant from DePuy Spine to the Setting Scoliosis Straight Foundation of the Harms Study Group.

**Summary:** Intraoperative neurophysiologic monitoring (IONM) is widely used during the surgical treatment of patients with adolescent idiopathic scoliosis (AIS). We sought to determine the effect of IONM alerts on outcomes in these patients. IONM alerts occurred in 5.3% of patients undergoing fusion for AIS. These patients had larger preoperative deformity, longer operative times, more levels fused, increased estimated blood loss (EBL), and more cell saver transfused. Outcomes for patients having IONM alerts resulted in no permanent neurological deficits, similar Cobb correction, and comparable 2-year SRS scores as those without alerts.

**Hypothesis:** Patients undergoing surgery for AIS who experience an IONM alert have similar outcomes as to those with no alert.

**Design:** Retrospective review of prospectively collected multicenter database of patients with AIS with a minimum 2-year follow-up.

**Introduction:** Intraoperative neurophysiologic monitoring (IONM) is widely used during spinal fusion for AIS. Confidence in IONM data can allow surgeons to proceed with surgery even after an alert, assuming the data recovers. We sought to determine the outcomes of surgery after a significant IONM alert.

**Methods:** A prospectively collected multicenter database was retrospectively reviewed to identify patients with AIS who were surgically treated with IONM and had at least 2 years of follow-up. Those patients who experienced a significant loss of IONM ( $\geq 50\%$  drop in SSEPs  $\pm$  tcMEPs) were identified. 676 patients were divided into two cohorts: those who experienced IONM changes in the lower extremities (“A” Group) and those who did not (“NA” group).

**Results:** 5.3% (36/676) of the patients experienced IONM alerts. The alert group had larger major preoperative Cobb angles (A=61 $\pm$ 13 $^\circ$ , NA=55 $\pm$ 12 $^\circ$ , p<0.01), more levels fused (A=12 $\pm$ 2, NA=11 $\pm$ 2, p<0.01), longer operative times (A=357 $\pm$ 157 min, NA=298 $\pm$ 117 min, p<0.01), higher EBL (A=1857 $\pm$ 1323 mL, NA=999 $\pm$ 796 mL, p<0.01), and more cell saver transfused (A=527 $\pm$ 525 mL, NA=268 $\pm$ 327 mL, p<0.01). After intervention, IONM signals improved in 97% (35/36) of patients with return of data averaging 20 minutes. Two procedures were aborted, one in the patient where IONM signals did not improve initially. This patient experienced unilateral weakness that recovered within 72 hours. In those patients where the procedure was completed, postoperative percent Cobb correction (A=66 $\pm$ 13%, NA=64 $\pm$ 19%, p=0.53), percent rib prominence correction (A=49 $\pm$ 36%, NA=47 $\pm$ 46%, p=0.83), and sagittal profile (A=23 $\pm$ 10 $^\circ$ , NA=22 $\pm$ 2 $^\circ$ , p=0.58) was similar to those without an IONM change. Two-year SRS-22 outcome scores were similar between the two cohorts.

**Conclusion:** Significant IONM changes occurred in 5.3% of patients undergoing fusion for AIS. These patients had larger preoperative deformity, longer operative times, more levels fused, increased EBL, and more cell saver transfused. Return of IONM data guided the surgeon to safely complete the procedure with similar correction as to those without a change.

## 9:15 Katharine Harper – “Radiation exposure of the pelvis following total hip arthroplasty”

**Katharine Harper MD, Shidong Li MD, Rachel Jennings BSc, Kamil Amer BSc, Christopher Haydel MD, Sayed Ali MD**

**Purpose:** To determine the effects of implantation of a total hip arthroplasty on the amount of radiation the most radiosensitive organs (stomach, sigmoid colon, gonads) are exposed to when compared to a native hip.

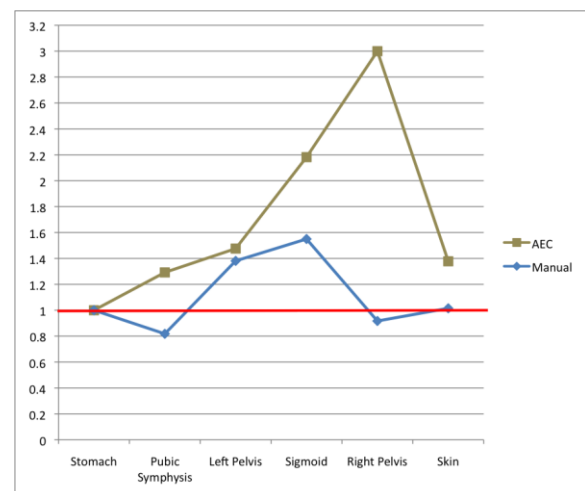
**Methods:** A fresh frozen cadaver was acquired for the purpose of this experiment. Calibration of the radiation chamber used in the experiment was performed at 4 days prior for temperature calibration and 3 days prior for implant calibration. A mobile MOSFET system (BEST Medical) was carefully calibrated with X-ray at kVp of 70, 80, 100, 120, and 138 kVp, phantom temperatures at 0, 21, and 43°C, and exposure range from 0.03 to 10 R confirmed with Raysafe and RadCal dosimeters. On the day of the experiment, both MOSFETs and thermoluminescent dosimeter (TLD) probes were placed at 6 key locations to detect radiation (stomach, sigmoid colon, right pelvic wall, left pelvic wall, pubic symphysis, and skin at the level of the pubic symphysis). These locations were marked with a surgical pen to ensure location consistency. X-rays were then taken using both Manual and Automatic Exposure Control (AEC) settings, with the probes recording the exposure at each location. Following this, a DePuy titanium femoral stem with cobalt chrome head and titanium acetabulum cup with polyethylene liner was placed into the cadaver using a standard posterolateral approach, following which surgical incisions were closed. Following confirmation that probes were placed in the same position, the previously mentioned protocol was then again repeated and values were recorded.

**Results:** Measurements were taken with both manual (immediate results) and AEC (analyzed results) probes. By calibrating for temperature, dose ranges and density, as well as accumulating 10 manual exposures and 20 AEC exposures, we were able to achieve dose-measured accuracy of 6%. Manual results prior to implant placement were stomach: 0.000R; pubic symphysis: 0.274R; left

pelvis: 0.042R; sigmoid colon: 0.040R; right pelvis: 0.036R and skin: 0.135R. Manual results after placement of the implant were stomach: 0.001R; pubic symphysis: 0.224R; left pelvis: 0.058R; sigmoid colon: 0.062R; right pelvis: 0.033R; skin and 0.137R. The differences between the measurements (represented as relative risk of native hip exposure) are stomach: 1.000; pubic symphysis: 0.818; left pelvis: 1.381; sigmoid colon: 1.550; right pelvis: 0.917; skin: 1.015. AEC results prior to implant placement were stomach: 0.000R; pubic symphysis: 0.089R; left pelvis: 0.021R; sigmoid colon: 0.011R; right pelvis: 0.007R and skin: 0.045R. AEC results after placement of implant were stomach: 0.000R; pubic symphysis: 0.115R; left pelvis: 0.031R; sigmoid colon: 0.024R; right pelvis: 0.021R and skin: 0.062R. The differences between the measurements (represented as relative risk of native hip exposure) are: stomach: 1.000; pubic symphysis: 1.292; left pelvis: 1.476; sigmoid colon: 2.182; right pelvis: 3.000; skin: 1.378.

**Conclusion:** Radiation exposure to the most radiosensitive pelvic and abdominal organs increases up to 3x following placement of a total hip implant. This is likely due to increased scatter and difficulty with dose modification secondary to the density of the implant. Further studies should be performed in both clinical and epidemiological settings to determine the clinical outcomes of such long-term increase in dose and radiation exposure.

**Relative Risk Of Radiation Exposure Comparing Implanted to Native Hip**



## **9:30 John Jennings – “How does physician attire influence patient perceptions in the outpatient orthopaedic surgery setting?”**

**Jennings J, Ciaravino SG, Ramsey FV, Haydel C**

**Background:** Previous work to identify patient-preferred attire has delivered conflicting results, however, the strong influence of attire on the patient-physician relationship is well established.

**Questions/Purposes:** The purpose of this study was to investigate how surgeon attire affects patients' perceptions of trust and confidence in an urban orthopaedic outpatient setting.

**Methods:** Eighty-five out of 100 patients solicited completed a three-part questionnaire in the outpatient orthopaedic clinic at an urban teaching hospital. In the first section, participants viewed eight images, four of a male surgeon and four of a female surgeon wearing a white coat over formal attire, scrubs, business attire, and casual attire, and rated each image on a five-level Likert scale. Participants were asked how confident, trustworthy, safe, caring, and smart the surgeon appeared, how well the surgery would go, and how willing they would be to discuss personal information with the pictured surgeon. The participant ranked all images from most to least confident in the second part and the last section obtained demographic information from the patients. Surveys were scored using a 5-level Likert scale and a Friedman test was utilized to detect statistical significance when comparing all attires. For multiple pair-wise comparisons, a Bonferroni correction was applied.

**Results:** The male surgeon wearing a white coat elicited higher ratings in confidence, intelligence, surgical skill, trust, and safety compared with the photographs showing him wearing business and casual attire. For the female surgeon, white coat and scrubs performed equally, however the white coat was preferred to business attire in five of seven categories. Casual clothing was widely disliked in all categories for male and female surgeons. When attire was compared for confidence on a scale, the white coat ranked higher than business and casual attire but not scrubs.

**Conclusions:** In this study, patients' preferences varied based on the gender of the pictured surgeon in the survey. Overall, however, the white coat elicits the highest levels of confidence, intelligence, trust, and safety. Furthermore patients are more willing to discuss personal information and believe that their surgery will go better if the surgeon wears a white coat or scrubs. Given the increasing awareness and concern for physician-spread hospital infection, this study lends support to scrub attire over business or casual attire if physicians do not wear a white coat.

**9:45 William Smith – “Conjoined vs. isolated shoulder tendon transfers in brachial plexus birth palsy”**

Smith W, Greenhill D, Kozin S, Zlotolow D

**Introduction:** Several tendon transfer techniques have been described to augment shoulder external rotation in children with brachial plexus birth palsy (BPPB). However, it is unclear whether transfer of the latissimus dorsi with its conjoined teres major tendon (cLT) versus an isolated teres major tendon transfer (iTM) yields different outcomes.

**Methods:** Records of patients with BPPB who underwent shoulder tendon transfers to augment external rotation were retrospectively reviewed. Transfer type (cLT or iTM) was considered indiscriminate by virtue of different surgeon preference. Age, level of palsy, perioperative modified Mallet Scale (mMS) and/or Active Movement Scale, and all ipsilateral upper extremity procedures were recorded. Patients with less than 6 months follow-up, humeral osteotomy, microsurgery within one year, or incomplete documentation were excluded. Matched cohorts were identified within each tendon transfer group to yield similar preoperative exam characteristics. Fisher’s exact test was utilized to then compare physical exam findings at final follow-up between cLT and iTM transfers.

**Results:** After identifying appropriate cohorts, 52 patients (26 cLT and 26 iTM transfers) were included. Average age at time of transfer was 2.2 and 2.1 years for cLT and iTM transfers, respectively. Follow-up averaged  $4 \pm 3$  years after tendon transfer. There were no statistically significant differences between cohorts in the average shoulder exams scores at final follow-up (Table 1). However, according to a subgroup analysis of patients with available preoperative and follow-up mMS scores, shoulder internal rotation decreased an average of 1.4 versus 0.7 points after cLT (n=14) versus iTM (n=11) transfer, respectively. This difference was statistically significant (p=0.02).

**Conclusions:** Both cLT or iTM transfer are effective options to augment shoulder external rotation in children with BPPB. However, there may be a slightly increased loss of internal rotation with combined tendon transfers as opposed to isolated teres major transfer. The clinical significance of this difference is yet to be determined.

Table 1		Postoperative modified Mallet							Postoperative AMS (shoulder)				
		Abduction	ER	HTN	HTS	HTM	IR	Total	Abduction	Adduction	Flexion	IR	ER
Latissimus dorsi + teres major	mean	3.92	3.71	2.67	2.04	2.88	2.92	18.13	5.18	5.73	4.27	4.45	4.64
	st dev	0.50	0.55	0.70	0.20	0.80	0.65	1.42	1.40	1.85	1.49	1.97	1.36
Teres major	mean	3.90	3.38	2.81	2.10	3.10	2.90	18.19	4.27	6.13	3.53	3.20	3.60
	st dev	0.44	0.74	0.93	0.44	0.89	0.62	1.81	1.58	1.64	1.36	1.70	1.40
	p-value	0.93	0.10	0.56	0.59	0.39	0.95	0.89	0.14	0.56	0.20	0.09	0.07

## 10:50 Mark Solarz – “Underinsured patients experience delays in treatment and higher rates of irreparable meniscal injury following acute anterior cruciate ligament rupture”

Mark K. Solarz, MD, John M. Richmond, MD, Frederick V. Ramsey, PhD, Eric J. Kropf, MD

**Background:** Equitable access to medical care continues to be a social challenge in the United States. Several segments of the population, most notably the poor, racial and ethnic minorities, and the uninsured use fewer health services when compared to non-poor, insured, white counterparts. Limited access may affect the outcome of care, a topic of increased interest to the health-care community. Patients with a variety of backgrounds and level of medical insurance are treated at our urban academic medical center. In this study, patients with an acute anterior cruciate ligament (ACL) tear were evaluated for their access to medical care and several outcome measures were collected. We hypothesized that the underinsured would have longer delays to treatment following acute ACL injury and would have more associated intra-articular pathology including meniscal tears and chondral injuries.

**Methods:** A retrospective review was performed to identify all ACL reconstructions performed by the senior author (EJK) at Temple University Hospital (TUH) during a consecutive 52-month period. To be considered for inclusion, patients had to initiate outpatient treatment for an ACL injury at the TUH Orthopaedic Philadelphia office (zip code: 19140) and complete a minimum follow-up of six months. We excluded all patients seen in suburban satellite locations and those with work-related injuries. Seventy-one patients were identified who met inclusion criteria. After initial chart review, 3 patients were excluded because they either underwent revision reconstruction or elected to delay treatment for personal reasons. Patients were divided into two groups: privately insured and underinsured/Medicaid programs. Multiple variables were collected for each patient, including: the time elapsed from injury until any physician’s office visit, between seeing a physician and seeing the senior author, time from ordering an MRI to completion of the study, time from injury until surgery, the number of postoperative appointments attended, percentage of

meniscal and chondral injuries, and percentage of repairable meniscus tears. Statistical analyses were performed comparing the insured and underinsured groups.

**Results:** The final cohorts included 35 privately insured and 33 underinsured patients. The underinsured patient population experienced multiple statistically significant delays during treatment. These included the time from injury to an initial physician’s office visit (insured: 36.3 days; underinsured: 263.4 days;  $p=0.027$ ), time between seeing the initial physician and the treating surgeon (I: 27.1 days; U: 93.9 days;  $p= 0.015$ ), time between ordering and completion of an MRI (I: 7.4 days; U: 17.1 days;  $p=0.042$ ), and time between injury and surgery (I: 116.7 days; U: 572.4 days;  $p=0.001$ ). Postoperatively, the number of office visits, readmissions and emergency department visits were not statistically different. The number of patients with chondral injury and meniscal tears confirmed during arthroscopy were not statistically different ( $p= 0.99$  and  $0.758$ , respectively). However, when characterizing meniscal tears there was a significantly increased rate of irreparable meniscal tears in the underinsured group (I: 23.8% v. U: 61.9%,  $p= 0.02$ ) that required partial meniscectomy.

**Conclusion:** During the time course from acute ACL injury to surgical reconstruction, the underinsured population experienced multiple delays from the moment they sought treatment through the day of surgery. Even though there were similar rates of meniscal tears and chondral injuries between groups, there was a higher rate of irreparable meniscal tears in the underinsured group. This study demonstrates that delays in treatment after acute ACL injury are associated with progression of meniscal tears and higher rates of meniscectomy at the time of surgery. We believe that this finding will ultimately correlate with more rapid progression of degenerative joint changes and lesser patient reported outcome scores in the underinsured group due to delays in treatment.



### **11:05 Dustin Greenhill – “Relationships between three classification systems in Brachial Plexus Birth Palsy”**

Greenhill DA, Tomlinson-Hansen S, Kozin S, Zlotolow D

**BACKGROUND:** The Mallet scale, Active Movement Scale (AMS), and Toronto Test are validated for use in children with brachial plexus birth palsy (BPBP). However, the inability to compare these evaluation systems has led to difficulty gauging treatment efficacy and interpreting available literature in which multiple scoring systems are reported. Given the critical importance of physical examination, we compared 3 scoring systems to clarify statistical relationships between current validated evaluation methods.

**METHODS:** The medical records of children with BPBP treated at a single institution over a 14-year period were retrospectively reviewed. Modified Mallet, AMS, and Toronto scores were recorded throughout the entire period. Data were included if at least 2 complete scoring systems were documented during the same examination session. Spearman correlation coefficients were calculated for all composite and subscore combinations. A concordance table was constructed for select variables found to be highly correlated.

**RESULTS:** Total single-session score combinations were as follows: 157 Mallet and AMS, 325 AMS and Toronto, and 143 Mallet and Toronto. Composite AMS and Toronto scores were found to have a strong correlation ( $r=0.928$ ,  $P<0.001$ ). A concordance table comparing these variables revealed that a Toronto score of 3.5 is concordant to an AMS score of 45. Modified Mallet scores had only a moderate correlation with composite AMS ( $r=0.512$ ,  $P<0.001$ ) and Toronto ( $r=0.458$ ,  $P<0.001$ ) scores. Specifically regarding the modified Mallet score, maneuvers requiring external rotation had stronger correlations with the composite modified Mallet score than maneuvers highlighting internal rotation.

**CONCLUSIONS:** Modified Mallet scores do not correlate well with AMS or Toronto scores and should be utilized separately when managing children with BPBP. Similarly, AMS and Toronto scores are inadequate to guide clinical decisions for which the literature cites Mallet scores as outcome measures. Lastly, Mallet scores should incorporate an isolated internal rotation component to adequately assess midline function.

## 11:20 James Lachman – “Interosseous fusion techniques in the foot; does it really hurt less?”

Lachman JR, Haydel CL, Eremus JL

### Introduction

Arthrodesis is considered the standard operative treatment for end-stage arthritis in the foot and ankle. The long-term effects of implant choices for fusions are largely unexplored in the literature. Many companies advertise implants as being “lower profile” and “less painful.” The purpose of this study was to perform a clinical and radiographic review to determine outcomes, specifically rates of symptomatic hardware, using four major arthrodesis techniques in joints in the foot and ankle.

### Materials & Methods

A retrospective study was conducted including one-hundred and twenty-three patients (a total of 197 joints) who underwent arthrodesis of the ankle, or joints in the midfoot or hindfoot. A total of 197 joints underwent arthrodesis in this patient group. Four groups were created based on fixation methods; standard screw fixation, plate and screw fixation, screw-in-post fixation(so-called “intra-osseous” fixation), and a group using a combination of fixation methods. Through chart review and radiographic analysis, outcomes including fusion rate, pain at specific follow-up intervals(6-weeks, 3-months, 6-months, and 1-year), and symptomatic hardware requiring hardware removal were compared across groups.

### Results

No differences were found in fusion rates between the four groups. Non-union rates, hardware loosening, infection, and wound breakdown rates were all comparable across the cohort. Rates of reported pain at 6-weeks and 3-months were similar for all groups but the “plate and screw fixation” group reported significantly more pain at 6 months( $p=0.035$ ) and 1 year( $p=0.022$ ) than the other

three groups and, subsequently, rates of symptomatic hardware requiring removal were significantly higher in this group as well. The patient population had higher rates of diabetes mellitus, human-immunodeficiency virus (HIV) and hepatitis C virus (HCV) than reported in recent studies of comparable design.

### Conclusion

In this high risk patient population, implant choice in arthrodesis of the midfoot, hindfoot or ankle has a significant effect on patient-reported pain during follow-up. In this cohort, the group fused with intra-osseous fixation methods did not demonstrate superiority with regards to rates of patient-reported post-operative pain related to hardware. Clinicians should expect significantly increased rates of symptomatic hardware when using plate fixation in fusions of the ankle, midfoot and hindfoot.

Intra-osseous Arthrodesis Techniques- Comparison with Conventional Methods Study Data					
	“Screws Only” Group	“Plate and Screws” Group	“Intra-Osseous” Group	Combination (“Screws” and “intra-osseous”) Group	Totals
Patients	44	27	25	27	123
Number of Joints Fused	76	50	35	36	197
Diabetes	12 (27%)	10 (37%)	9 (36%)	10 (37%)	43 (35%)
HCV/HIV	5 (11.3%)	2 (7.4%)	3 (12%)	3 (11%)	13 (10.6%)
Failure of fusion(# of joints)	4 (5.3%)	2 (4%)	2 (5.7%)	2 (5.5%)	10 (5%)
Pain at 1 year attributable to hardware	2 (4.5%)	8 (29.6%)*	1 (4%)	4 (14.8%)	15 (12.2%)
Pain requiring hardware removal	1 (2.3%)	8 (29.6%)*	1 (4%)	3 (11.1%)	13 (10.1%)

\*denotes statistical significance ( $p<0.05$ )