Removal of Implants After Open Reduction and Internal Fixation of Tibial Plateau Fractures Improves Clinical Outcomes

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Purpose: Tibial plateau fractures are common injuries often treated with open reduction and internal fixation. Anecdotally, we have noted improved patient satisfaction following hardware removal for these patients. The purpose of this study was to objectively assess the effect of the removal of surgical implants after union on patient reported outcomes.

Methods: Since 2009 all patients at our Level I trauma center undergoing open reduction and internal fixation by the senior surgeon (D.G.L.) are enrolled into a prospective registry and have outcomes recorded routinely at follow-up (Knee Outcomes Survey [KOS] and Lower Extremity Functional Scale [LEFS]). Visual analog scale (VAS) pain was also recorded. This registry was divided into two cohorts: those who had undergone removal of their surgical implants and those who had not. The decision to remove implants was based upon patient preference. Outcome scores were compared between the two study populations using a two-tailed Student *t*-test.

Results: A total of 80 patients were identified as having completed outcome scores: 33 had retained implants and 47 had implants removed. Results can be seen in Table 1. Outcomes were significantly better in patients who had implants removed compared to those who did not ($P = 0.002$ for KOS, $P = 0.002$ for LEFS). There was no significant difference seen in VAS pain scores (1.59 vs. 1.56, $P = 0.94$).

Conclusion: The results of this study indicate that patients who have removal of their surgical implants after open reduction and internal fixation of a tibial plateau fracture have significantly better outcomes than those who have retained implants. Patients who are unhappy with their clinical result should be counseled that removal of the implant may improve function, but may not improve pain.

Table 1. Follow-up and Outcome Scores for Patients with and without Retained Implants.

	Retained	Removed	*P* Value
Follow-up (mos)*	8.2 (2.9-30.1)	6.1 (0.3-20.4)	0.094
KOS (avg.)	52.7 (14-72)	63.4 (31-80)	0.002
LEFS (avg.)	44.7 (5-80)	61.7 (19-80)	0.0002
VAS	1.59 (0-5.8)	1.56 (0-7.4)	0.94

*Indicates months after most recent surgery

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Comparing Outcomes Between Hinged Knee Bracing and No Bracing After Open Reduction and Internal Fixation of Tibial Plateau Fractures

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Purpose: This trial was conducted to compare outcomes of hinged knee bracing to no bracing for patients after tibial plateau fracture open reduction and internal fixation (ORIF). Drawbacks of bracing include additional cost to the patient, brace-related wound complications, and possible loss of motion. Our hypothesis is that there will be no difference between both groups in terms of long-term radiographic, functional, and subjective outcomes.

Methods: After IRB approval, a prospective trial was initiated that randomized patients to either 6 weeks of hinged knee bracing or no bracing after tibial plateau fracture ORIF. Radiographic union, failure of fixation, wound complications, and postoperative range of motion were followed. Short Form-36 (SF-36) questionnaires were administered at the longest possible follow-up either during office visits or by phone if they were unable to come back for re-evaluation. Patients with open physes, unstable ligamentous injuries, and <6 months of prospective data or clinical follow-up were excluded.

Results: The brace group (N = 24) had an average age of 51 ± 12 years with 13 females and the non-bracing group (N = 25) had an average age of 51 ± 15 years with 9 females. The braced group had 2 open fractures and included 13 AO/OTA 41-B3 (54%), 7 C1, 2 C2, and 2 C3 fractures; the non-braced group had 4 open fractures and included 2 AO/OTA 41-B1, 14 B3 (56%), 2 C1, 3 C2, and 4 C3 fractures. There were two wound complications in the brace group: a wound eschar treated nonoperatively, and one patient with an open fracture that had a wound infection treated 7 months after surgery. There were 4 wound complications in the non-braced group: two patients with local wound breakdown treated nonoperatively and two patients, both with open fractures, with one acute wound infection/dehiscence requiring surgery and the other with an infected nonunion treated 6 months after surgery. Average radiographic union for the brace group was 12 ± 5 weeks with one nonunion, and for the non-braced group was 12 ± 4 weeks ($P = 0.90$) with two nonunions. Average final postoperative extension for bracing was 1° ± 2° and for non-bracing was 1° ± 3° ($P = 0.85$). Average final postoperative flexion for bracing was 118° ± 15° and for non-bracing was 123° ± 11° ($P = 0.13$). Average final clinical follow-up for range of motion was 9 ± 3 months for bracing and 9.4 ± 3 months for no bracing. At final radiographic follow-up for braced patients there were no alignment changes. For the non-braced group there was one late joint collapse with valgus malalignment (>10°). The SF-36 scores for the braced group at an average follow-up of 18 ± 11 months revealed Physical and Mental Component Summary scores of 40 ± 9 and 50 ± 12 compared to the non-bracing group, which had an average follow-up 21 ± 12 months with Physical and Mental Component Summary scores of 39 ± 10 ($P = 0.64$) and 48 ± 10 ($P = 0.57$).

Conclusion: Based on our study, there is no statistically significant difference between bracing and no bracing in terms of long-term radiographic, functional, and subjective

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outcomes. A larger multicenter study may prove valuable, but based on our data, there is no benefit to bracing. Bracing has been discontinued for routine postoperative management of tibial plateau fracture ORIF at our institution.

ΔRandomized Clinical Trial of Supra- Versus Infrapatellar Tibial Nailing: A Pilot Study

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Purpose: The standard treatment for tibial shaft fractures is intramedullary nailing. This procedure has been described to include two approaches: infrapatellar (IP) and suprapatellar (SP). To our knowledge, no study has directly compared these two techniques. The purpose of this study is through a randomized clinical trial to compare the clinical outcomes and functional status of the knee after IP versus SP tibial nailing.

Methods: After IRB approval, skeletally mature patients with middle 3/5 tibial shaft fractures were randomized into the IP or SP nailing groups after informed consent was obtained. Patients with intra-articular involvement, ipsilateral concomitant injuries, prior knee surgery, or history of gout, rheumatoid, or osteoarthritis were excluded. Standard surgical techniques were employed which included a medial parapatellar IP approach, and a longitudinal quadriceps tendon split SP approach. SP patients also underwent a pre- and post-nailing knee arthroscopy to obtain a visual description of the patellofemoral joint (reviewed by a fellowship-trained sports medicine orthopaedic surgeon). Patients underwent routine follow-up (6 weeks; 3, 6, and 12-months) with standard tibia and knee radiographs, as well as visual analog scale (VAS) and pain diagram documentation. At the 6- and 12-month visits, a complete knee function questionnaire (Lysholm knee scale) and Short Form-36 (SF-36v2) were completed. Additionally, MRI of the affected knee was obtained at 12 months and independently reviewed by a board-certified, fellowship-trained musculoskeletal radiologist. As a pilot study, formal sample size calculations were not performed, and the information obtained from this investigation would enable a proper power analysis for the future larger prospective study. Therefore, 20 patients in each group were planned, with consideration for patient attrition across 12 months of follow-up.

Results: 41 total patients were enrolled, and 26 patients (13 IP, 13 SP) completed 12 months of follow-up. The average ages were 40 and 41 years for IP and SP, respectively. Similarly, each group was comprised of 9 males in IP, 8 in SP. At 12 months, all 26 patients had proceeded to successful union, and functional VAS and Lysholm knee scores showed no significant differences between groups ($P > 0.05$). The SF-36v2 comparison also revealed no significant differences in the overall score, all 4 mental components, and 3 of 4 physical components ($P > 0.05$). The bodily pain component score was superior in the SP group (46 vs. 36, $P = 0.022$) suggesting less pain and disability. Clinically, the differences between the affected and unaffected knee in extension and flexion were both near zero (extension: 0° IP, 1° SP, $P = 0.5$; flexion 1° IP, –3° SP, $P = 1.0$). 11 of 13 SP patients obtained MRI at 1 year. Four of the interpretations included chondromalacia patellae; however, in three of these patients chondromalacia can be noted in their pre-nailing arthroscopy assessment. The fourth patient's pre- and post-nailing arthroscopy documented no appreciable changes in the patellofemoral articular surfaces.

Δ OTA Grant

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Conclusion: Overall, there are no significant differences in pain, disability, or knee range of motion between these two tibial intramedullary nailing techniques after 12 months of follow-up. The suprapatellar approach can be performed safely with comparable clinical and functional outcomes to the infrapatellar method. A larger prospective trial with long-term follow-up is needed to improve statistical power and establish if any late sequelae exist.

Type III Open Tibia Fractures: Immediate Antibiotics and Earliest Possible Wound Coverage Minimize Infections

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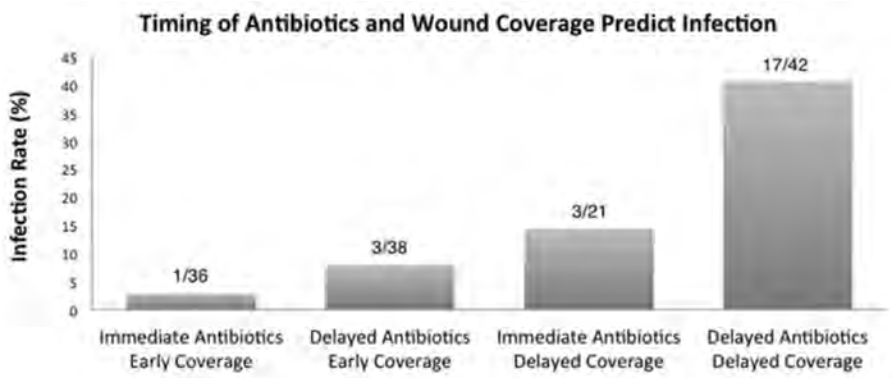
Purpose: Antibiotic prophylaxis is the standard of care after an open fracture. However, evidence regarding antibiotic timing is limited. Our purpose was to examine the association between antibiotic timing and deep infection of type III open tibia fractures.

Methods: We retrospectively studied 162 consecutive type III open tibia fractures at a Level I trauma center. The final population consisted of 137 patients after exclusions for missing data (13), nonreconstructible limbs (9), and/or absence of 90-day outcome (3). Deep infection within 90 days was the primary outcome defined by criteria from the Centers for Disease Control and Prevention. We analyzed days to wound coverage, time to antibiotics, open fracture subclassification (type IIIA vs. IIIB/C), ISS, antibiotic agent, age, smoking, and diabetes.

Results: Age, smoking, diabetes, ISS, type IIIA versus IIIB/C injury, and time to surgical debridement were not associated with infection on univariate analysis. Greater than 5 days to wound coverage ($P < 0.001$) and greater than 66 minutes to antibiotics ($P < 0.01$) were univariate predictors of infection. Multivariate analysis found wound coverage beyond 5 days (odds ratio 7.39, 95% confidence interval [CI] 2.33-23.45, $P < 0.001$) and antibiotics beyond an hour from injury (odds ratio 3.78, 95% CI 1.16-12.31, $P = 0.03$) independently predicted infection. Immediate antibiotics and early coverage limited the infection rate (1 of 36, 2.8%) relative to delay in either factor (6 of 59, 10.2%) or delay in both factors (17 of 42, 40.5%).

Conclusion: Time from injury to antibiotics and to wound coverage independently predict infection of type III open tibia fractures. Both should be achieved as early as possible, with coverage being dependent on the condition of the wound. Given the relatively short therapeutic window for antibiotic prophylaxis (within an hour of injury), prehospital antibiotics may substantially improve outcomes for severe open fractures.



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Damage Control Plating in Open Tibial Shaft Fractures:
A Cheaper and Equally Effective Alternative to Spanning External Fixation

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Background/Purpose: External fixation has traditionally been utilized to provisionally stabilize open tibial shaft fractures when definitive fixation is not advisable. An alternative to external fixation is temporary damage control plating (DCP), which utilizes temporary internal fixation with a single plate to give temporary stability, length, and alignment. The purpose of this study is to determine whether DCP is a good alternative to external fixation for open tibial shaft fractures by comparing complication rates and implant costs.

Methods: A retrospective chart review at a Level I trauma center identified patients who underwent operative management of open tibial shaft fractures from 2008 to 2012. Radiographs were reviewed to identify patients who underwent DCP or external fixation followed by definitive fixation. Initial implants were removed at time of definitive fracture stabilization. Rates of complication requiring an unplanned surgical intervention were compared using a c^2 analysis. The implant costs were provided by the institution's financial services.

Results: 445 patients who underwent operative management of an open tibial shaft fracture were identified. 31 patients met inclusion criteria, 12 (39%) of whom had DCP and 19 (61%) of whom had external-fixation. Both DCP and external fixation samples were composed of mostly Gustilo grade III fractures (67% and 58%, respectively). There was no significant difference in the rate of complications between DCP (25.0%) and external fixation (26.3%). The average implant costs for DCP ranged from $360.50 to $1,879.50, which was 2.7 to 14 times less than the average costs for external fixation at $5073 (Figure 1).

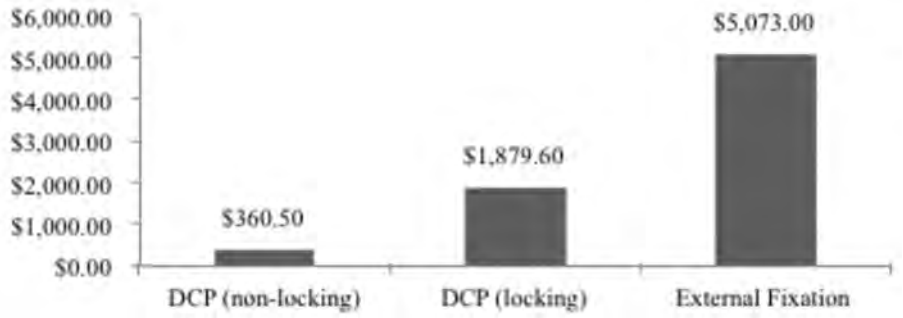

Figure 1. Costs for DCP and external fixation

Conclusion: As our health-care system renews focus on cost-cutting efforts, orthopaedic trauma surgeons must explore less expensive yet equally effective treatment alternatives. In this study, which is the first to compare the use of DCP and external fixation to temporize open tibial shaft fractures, data suggest that DCP is an equally safe yet less expensive alternative to external fixation for a tibial shaft fracture.

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The Gustilo-Anderson Classification System as Predictor of Nonunion and Infection in Open Tibia Fractures

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Purpose: Open tibia fractures are known to have a very high risk of complications. However, previous large studies, including the SPRINT trial (Study to Prospectively evaluate Reamed Intramedullary Nails in Tibial fractures), have focused primarily on closed injuries or excluded higher grade open fractures. The purpose of this study was to conduct the largest retrospective study to date of open tibia fractures and describe incidence of complications and evaluate potential predictive risk factors for complications.

Methods: After IRB approval, patients treated for open tibia fractures by intramedullary nailing across a 10-year period were identified by a CPT code search at a Level I trauma center. Charts were reviewed and potential risk factors including age, gender, American Society of Anesthesiologists (ASA) score, hospital length of stay (LOS), type (T) of open fracture, distance of fracture from the plafond, and the sum of 31 comorbidities were recorded. Patients under the age of 16 were excluded from analysis. Charts were reviewed for complications leading to reoperations including infection, nonunion, and amputation. A multivariate analysis was conducted to determine if any of the potential risk factors described above were associated with a greater risk of complications.

Results: 486 patients with open tibia fractures were analyzed (TI: 63, TII: 202, TIIIa: 140, TIIIb: 73, TIIIc: 8). The average age was 33 years (± 15; range, 16-85). 78% of patients were male. Overall 13% (n = 64) of patients had infections, 12% (n = 56) had nonunions, and 1% (n = 7) had amputations. Infection rates were TI, 2%; TII, 8%; TIIIa, 14%; TIIIb, 30%; and TIIIc, 62%: Nonunion rates were TI, 6%; TII, 7%; TIIIa, 11%; TIIIb, 26%; and TIIIc, 25%. Amputation rates were TI and TII, 0%; TIIIa, 1%; TIIIb, 7%; and TIIIc, 12%. TIII fractures had much higher rates of infection, nonunion, and amputation than TI and TII fractures (Table 1). After examining all potential risk factors described above, we found that fracture type was a highly significant risk factor for both nonunion and infection. The risk of nonunion was 4× higher with TIIIb fractures and 5× higher ($P = 0.001$) with TIIIc fractures ($P = 0.06$) compared to TI and TII fractures. In terms of infection, the risk was 2× higher for TIIIa fractures, 6× higher for TIIIb fractures, and 29× higher for TIIIc fractures compared to TI and TII fractures.

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Table 1. Complications based on Gustilo Grade			
Grade	Infection	Nonunion	Amputation
I (n=63)	**2%** (1/63)	**6%**(4/63)	**0%**(0/63)
II (n=202)	**8%**(17/202)	**7%**(15/202)	**0%**(0/202)
IIIa (n=140)	**14%**(19/140)	**11%**(16/140)	**1%**(1/140)
IIIb (n=73)	**30%**(22/73)	**26%**(19/73)	**7%**(5/73)
IIIc (n=8)	**62%**(5/8)	**25%**(2/8)	**12%**(1/8)
Overall	**13%**(64/486)	**12%**(56/486)	**1%**(7/486)

Table 2.Odds ratio based on Gustilo Grade				
Grade	Nonunion		Infection	
	OR	p	OR	p
IIIa	1.409	0.368	2.132	0.036
IIIb	**3.810**	**0.001**	**5.993**	**<0.001**
IIIc	5.320	0.062	**28.570**	**<0.001**

Conclusion: This study, which is the largest analysis of open tibia fractures to date, determined that the Gustilo grade of open tibia fractures is by far the greatest predictor of nonunion and infection. The risk of nonunion and infection was 5× and 29× higher, respectively, for Type IIIc fractures compared to Type I/II fractures. Similar findings were found for Type IIIb fractures. Our findings can be used to compare similar fractures at any institution or study and develop a risk calculator for open tibias, which can be used by surgeons to predict care and advise patients with this high-risk injury.

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Prediction of Tibial Nonunions at 3 Months After Intramedullary Nailing

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Purpose: Interest exists in predicting which tibia fractures are likely to result in nonunion and require additional surgery. Multiple parameters might predict likelihood for nonunion, including patient and fracture characteristics, time until weight bearing is allowed, and the radiographic healing of the tibia or fibula. We hypothesized that a prediction tool could be created based on information available at 3 months that would be useful in predicting tibial nonunion.

Methods: A retrospective review of all tibia shaft fractures treated at a single Level I trauma facility between 2006 and 2012 yielded 59 nonunions. Patients were excluded if they were treated with anything other than an intramedullary nail, if there was a planned surgical intervention to prevent nonunion after the index procedure, or if the fracture pattern had a critical defect of >3 cm. 21 patients met the inclusion criteria and were compared to a randomly selected control group of 76 patients treated with an intramedullary nail who went on to radiographic union without the need for further intervention. Patient data were collected for each to include: fracture grade, American Society of Anesthesiologists Score (ASA) class, body mass index (BMI), smoking status, and time until weight bearing was allowed. An image set was created of these 97 cases utilizing their 3-month interval follow-up radiographs. The image set was presented in random order and viewed using standard clinical software to clinicians who were blinded to the final outcome. Four fellowship-trained orthopaedic traumatologists were asked to review the radiographs. The previously described RUST (radiographic union score of the tibia) score for each of the four cortices of the tibia were recorded as it was for the fibula. In the cases of a segmental fracture, the reviewer was asked to grade the fracture with the least amount of radiographic healing.

Results: As shown in Table 1, the tibia RUST score at 3 months was a powerful predictor of tibia nonunion. Patients with a score of 8 or above had a 0% (0/44) nonunion rate. Although application of the RUST score to the fibula at 3 months was predictive of nonunion in bivariate analysis ($P = 0.002$), this effect was not observed when used in combination with tibia RUST. For patients with tibia RUST scores below 8, a separate predictive model was developed. Predictors of nonunion in this model included: open fracture (odds ratio: 11.7, 95% confidence interval [CI] :1.2-118, $P = 0.04$) and tibia RUST score (odds ratio: 0.3 per RUST point, 95% CI: 0.14 to 0.67, $P = 0.003$). This model was highly predictive of tibial nonunion, accounting for >60% of variance in these outcomes.

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Table 1. Tibia RUST Score at 3 Months and History of Open Fracture Versus Chance of Nonunion

	Tibia RUST Score			
Fracture Type	**8-12**	**7-7.9**	**6-6.9**	**4-5.9**
Closed	0% (0/26)	0% (0/8)	0% (0/3)	33% (2/6)
Open	0% (0/18)	18% (2/11)	50% (4/8)	76% (13/17)

Conclusion: The RUST score applied to tibia healing at 3 months appears to be a powerful predictor of need for tibial nonunion surgery. We have developed a simple, clinically practical model that predicts need for tibial nonunion surgery based on data available at the 3-month time point.

Does Progressive Radiographic Healing Result in Better Function? A Prospective Evaluation of PCS and RUST Scoring in Tibial Shaft Fractures Treated with IM Nailing

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Background/Purpose: Multiple large trials have reported validated patient-based outcomes of tibial nailing at final follow-up, while others have reported on the problems of patients with nonunions. However, there are no data on the recovery of function over time, or how progressive radiographic healing is related to outcome. The purpose of this study is to describe the recovery curve of patients after intramedullary (IM) nailing using the SF-36 PCS (36-Item Short Form Health Survey, physical component summary score) and to evaluate its association with progressive healing using the RUST score (radiographic union score of the tibia).

Methods: In a prospective multicenter trial 501 patients were treated with IM nailing and followed at 6, 12, 18, 26, 38, and 52 weeks with SF-36 PCS at all visits and radiographs at each visit until an independent adjudication committee determined the fractures to be healed (defined as remodeled callus on 3 cortices). All radiographs were scored and adjudicated using the RUST method based on the callus on each of the 4 cortices. All disagreements in scoring were resolved by an adjudication panel resulting in a consensus decision. The association of PCS with RUST and with time from surgery was determined using a repeated-measures analysis. In a separate analysis, the PCS over time (recovery curve) of patients with delayed union (defined as not healed by 6 months) were compared with those patients who were united by 6 months.

Results: The recovery curve (mean PCS) and the mean RUST scores per visit are seen in Figure 1 for all patients. PCS plateaus at 6 months for the group as a whole. The PCS curve and the RUST curve have a strong statistical association ($P < 0.001$). PCS was also associated with time from surgery and decreased age after adjusting for the RUST score. Patients who were not healed by 6 months had statistically different PCS scores at all time points after 6 weeks than those who were healed by 6 months (Figure 2). The recovery curve for patients with delayed union was shifted to the right compared with those united by 6 months, indicating a strong association of progressive healing with PCS.

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Figure 1 PCS blue, RUST green.

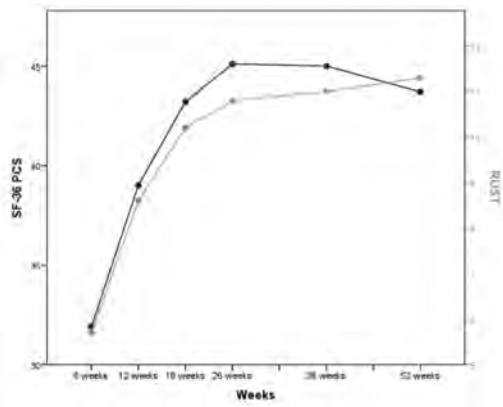
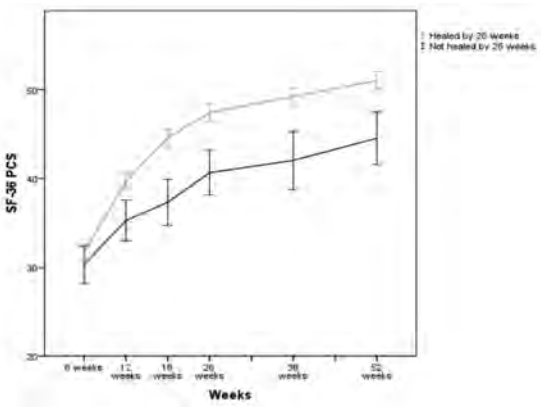


Figure 2 Healed <6 mos vs. >6 mos.



Conclusion: Recovery after tibial nailing is strongly associated with progressive radiographic healing. The average SF-36 PCS plateaus near 6 months for the majority of patients. This plateau is delayed until 52 weeks for patients with delayed union (not healed by 6 months). PCS was also associated with time from surgery and age. This is the first large trial to demonstrate the association of progressive healing with patient-based outcome, and to demonstrate the recovery curve after tibial nailing. Patients may be counseled regarding their expected outcomes based on their radiographic progress towards union.

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The Incidence of Deep Vein Thrombosis and Pulmonary Embolism in Fractures of the Tibia: An Analysis of the National Trauma Data Bank

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Background/Purpose: The incidence of deep vein thrombosis (DVT) and pulmonary embolism (PE) after a fracture of tibia is generally believed to be low. There is disagreement in the literature and in clinical practice with regards to chemical prophylaxis after fracture and its subsequent treatment in tibia fractures.

Methods: The National Trauma Data Bank (NTDB) data set (2009 to 2011) was used to evaluate the incidence of thromboembolism after tibia fracture. Risk factors associated with the thromboembolic events were identified (Tables 1 and 2). The NTDB data included demographic information, comorbidities, procedure codes, diagnosis codes, and complication data, including DVT and PE, which were collected from the data set for analysis. We identified 148,936 patients with tibia fractures and excluded 51,569 with other lower extremity orthopaedic trauma and 11,291 with polytrauma. The remaining 86,076 patients were examined to evaluate the incidence of DVT and PE and identify risk factors for these complications

Results: The incidence of DVT and PE was 0.48% and 0.31%, respectively. The risk factors statistically significant for DVT and PE in tibia/fibula trauma were older age (DVT, odds ratio [OR] 1.02, 95% confidence interval [CI] 1.02 to 1.03; PE, OR 1.02, 95% CI 1.01 to 1.03), male gender (DVT, OR 1.64, 95% CI 1.27 to 2.12; PE, OR 1.46, 95% CI 1.09 to 1.97), and higher ISS (DVT, OR 1.16, 95% CI 1.12 to 1.20; PE, OR 1.08, 95% CI 1.04 to 1.12).

Conclusion: The incidence of thromboembolic events after fracture of the tibia is low. Those at low risk for DVT/PE with isolated fractures of the tibia can be treated safely without the routine use of antithromboembolic chemoprophylaxis.

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Tables 1 and 2: Logistic Regression Analysis Results, Including Only Significant Variables, for Risk Factors Associated With DVT (Table 1) and PE (Table 2) (N = 66,952)

Deep Vein Thrombosis Variable	Odds Ratio	95% Confidence Interval	p-value
Gender	1.64	1.27-2.12	0.0002
Age	1.02	1.02-1.03	<.0001
ISS	1.16	1.12-1.20	<.0001
Obesity	2.51	1.72-3.65	<.0001
Prophylaxis	3.04	1.12-8.25	0.0290
Myocardial infarction	6.20	2.40-15.97	0.0002
ARDS	5.90	3.02-11.52	<.0001

Pulmonary Embolism Variable	Odds Ratio	95% Confidence Interval	p-value
Gender	1.46	1.09-1.97	0.0117
Age	1.02	1.01-1.03	<.0001
ISS	1.08	1.04-1.12	0.0003
Impaired sensorium	1.98	1.30-3.03	0.0016
Myocardial infarction	5.58	1.70-18.28	0.0045
ARDS	5.89	2.54-13.65	<.0001

ARDS= Acute respiratory distress syndrome

Ankle Injuries in Spiral Distal Tibial Shaft Fractures: Results From an Institutional Change in Imaging Protocol

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Background/Purpose: Posterior malleolus and other articular ankle injuries are known to concomitantly occur with tibial shaft fractures, especially spiral fractures of the distal one-third diaphysis (OTA 42-A1). Recent publications utilizing CT have shown that the rate of this combined injury is higher than previously reported with an incidence of 39% to 49%. Due to our heightened awareness of this combined injury, our department instituted a new preoperative ankle imaging protocol for all distal one-third spiral tibia shaft fractures. The purpose of this study was to evaluate the effectiveness of an imaging protocol involving radiographs, CT, and MRI in a distal one-third spiral tibia fracture cohort.

Methods: All operatively treated patients with a spiral distal one-third tibial shaft fracture (OTA 42-A1) from February 2012 to March 2013 underwent a standardized ankle imaging protocol. Patients had preoperative orthogonal ankle radiographs as well as a CT scan of the tibia that included the ankle. All ankle imaging was scrutinized by the on-call orthopaedic resident for evidence of an articular ankle injury such as a posterior malleolus fracture (PMF), medial malleolus fracture (MMF), or other tibial plafond fracture variant. If no articular ankle fracture was identified, patients would then undergo ankle MRI. All patients with an acute distal one-third spiral tibial shaft fracture and completion of the imaging protocol were included for analysis. Patients less than 16 years of age and individuals with evidence of a prior ankle fracture and retained surgical implants were excluded.

Results: 25 patients met the inclusion and exclusion criteria for this study. The average patient age was 47.4 years (range, 16.9-94.6) and 52% (13/25) were male. Of these patients, concomitant ankle injuries were identified by radiograph and CT in 56% (14/25) of cases. The remaining 44% (11/25) of patients had no evidence of a combined injury by radiograph or CT and therefore underwent MRI. Of the MRI cohort, 64% (7/11) were found to have an occult articular ankle fracture including five occult fractures of the posterior malleolus (71%), one fracture of the medial malleolus (14%), and one AITFL (anterior inferior tibiofibular ligament) avulsion fracture (14%). The overall incidence of a combined injury using our protocol was 84% (21/25). Identification of an occult injury led to a change in the surgical plan or rehabilitation for all of these patients.

Conclusions: Concomitant ipsilateral articular ankle and distal one-third spiral tibial shaft fractures are more common than previously reported. Utilizing an imaging protocol that consisted of orthogonal ankle radiographs, CT, and MRI, we found that the incidence of this combined injury was 84%. The addition of MRI to our imaging protocol resulted in a 50% increase in the diagnosis of these combined injuries. Recognition of the ankle fracture component in this tibial shaft cohort can be important as it may alter the surgical plan and postoperative management.

See pages 99 - 147 for financial disclosure information.