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Risk factors for infection after operative fixation of Tibial plateau fractures

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ABSTRACT

Introduction: Tibial plateau fractures are challenging to treat due to the high incidence of postoperative infections. Treating physicians should be aware of risk factors for postoperative infection in patients who undergo operative fixation.

Patients and methods: A retrospective review was undertaken to identify all patients with tibial plateau fractures over a 10 year period (2003–2012) who underwent open reduction internal fixation. A total of 532 patients were identified who met the inclusion criteria. Several patient and clinical characteristics were recorded, and those variables with a significant association ($p < 0.05$) with postoperative infection after a univariate analysis were further analyzed using a multivariate analysis.

Results: Fifty-nine (11.1%) of the 532 patients developed a deep infection. The average length of follow-up for patients was 19.5 months. Methicillin-resistant *Staphylococcus aureus* was the most common species, and it was isolated in 26 (44.1%) patients. Open fractures, the presence of compartment syndrome, and a Schatzker type IV–VI were found to be independent risk factors for deep infection.

Conclusions: The rate of deep infection remains high after operative fixation of tibial plateau fractures. Patients with risk factors for infection should be counseled on the possibility of reoperation, and surgeons should consider MRSA prophylaxis in those patients who are at higher risk.

Introduction

Historically, tibial plateau fractures were complicated with wound complication rates as high as 88% [1]. Over the last decade, a change in clinical practice focusing on preservation of the soft tissue envelope has resulted in a decrease in wound complications and associated postoperative infections. Egol et al. [2] demonstrated a 5% incidence of deep infection following a damage control approach for high-energy tibial plateau fractures. Similarly, Barei et al. [3] demonstrated a 6% incidence of infection when utilizing two incisions for fragment-specific fixation of tibial plateau fractures.

Larger clinical series employing modern, damage control techniques, however, have deep infection rates up to 14% [4]. Risk factors previously shown to be associated with postoperative infections in high-energy tibial plateau fractures include: open fractures, smoking, compartment syndrome, prolonged operative time, and fractures requiring two incisions and two plates [1,3,5–8]. Postoperative infections are often associated with prolonged intravenous antibiotics, multiple operations, loss of function, loss of limb, and pose an economic burden on the healthcare system.

The purpose of this study was to identify injury, patient, and surgical risk factors for deep infection in patients with tibial plateau fractures undergoing operative fixation. Our hypotheses were that certain patient factors (tobacco use and diabetes) and injury characteristics (concomitant compartment syndrome, Schatzker types IV–VI fractures, and open fractures) would be associated with infection. We further hypothesized that increased operative time and number of personnel scrubbed would be risk factors for infection.

Patients and methods

Following institutional review board approval, all AO/OTA 41 tibial plateau fractures from a single high volume level I academic trauma center were collected over a 10 year period from

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2003 to 2012 using current procedural terminology (CPT) codes. Each chart was then reviewed for inclusion or exclusion. Inclusion criteria were: articular fracture (AO/OTA B/C) and age >19 years. Patients were excluded if they were: pregnant, had insufficient documentation for review, or transferred following any surgery other than damage control orthopaedic procedures.

Patient-related factors (gender, race, age, body mass index (BMI), diabetes, tobacco use, and intravenous (IV) drug use) and injury-related factors (Schatzker type, open versus closed fracture, presence of compartment syndrome, and vascular injury) were recorded. Potential treatment risk factors for infection including time to surgery (both to external fixation and definitive fixation), operative time, number of incisions, number of plates, tourniquet use, and the number of healthcare staff scrubbed in the definitive operation were evaluated. In addition, the variables were stratified by timing of infection. Early infections were defined as those presenting earlier than 6 weeks while late infections were those presenting after 6 weeks. All patients were treated by fellowship trained orthopedic trauma surgeons, and fixation schema was at the discretion of the treating surgeon.

Those fractures too swollen for acute definitive fixation were either splinted or placed in an external fixator for a planned staged procedure, which is standard practice for this institution since 2003. Deep infections were defined as requiring both operative irrigation and debridement and IV antibiotics. The incidence of wound complications were recorded in addition to the pathogen isolated.

For closed fractures, weight-based dosing of cefazolin was given within 1 h prior to incision. If the patient reported an allergy that would preclude cefazolin, clindamycin was given. The same antibiotic was continued for 1 day postoperatively. All open fractures underwent urgent debridement and irrigation. These patients received IV antibiotics (piperacillin/tazobactam) upon hospital presentation, and antibiotics were continued until 48 h status post-definitive coverage.

Statistics were calculated using Statistical Analysis System 9.3 (Cary, NC, USA). A *t*-test was used to compare continuous variables and a chi-square test was used to compare categorical variables. Univariate logistic regression was used to assess the risk of deep infection for each of the covariates. Any covariates that were statistically significant ($p < 0.05$) were then included in a multivariate logistic regression.

Results

Following a retrospective chart review, 657 patients were identified by CPT code 27535 (tibial plateau ORIF). One hundred-fifteen patients had incomplete records or failed to meet inclusion criteria, and 10 patients were lost to follow up and excluded from the study. Of the remaining 532 patients, 59 (11.1%) developed a deep infection. The average follow up for these patients was 19.5 months.

Three hundred and forty (64%) patients were male. The average age was 47.8 years (range, 20–89). Sixty-four percent of patients were Caucasian. One hundred ninety-four patients were obese (BMI > 30), and 38 patients were morbidly obese (BMI > 40). Obesity (BMI 30−40) and morbid obesity (BMI > 40) did not correlate significantly with infection. Sixty-nine patients (13%) had diabetes; two hundred and forty patients (45.2%) endorsed tobacco use. The presence of diabetes or tobacco use trended toward deep infection. These demographics are summarized in Table 1.

Table 1
Comparison of demographic, injury, and clinical characteristics between patients with tibial plateau fracture who did and did not have deep infection following fixation.

	Total (*N* = 532)	No deep infection (*N* = 473)	Deep infection (*N* = 59)	p-value*
DEMOGRAPHIC				
Male (%)	341 (64.1)	295 (62.4)	46 (78.0)	0.0208
Race/Ethnicity (%)				
Black	178 (33.5)	153 (32.4)	25 (42.4)	0.2736
Other	11 (2.1)	10 (2.1)	1 (1.7)	
White	343 (64.6)	310 (65.7)	33 (55.9)	
Age (yrs)	47.76 ± 15.2	47.83 ± 15.36	47.37 ± 13.53	0.8239
BMI (%)				
<30	335 (63.3)	305 (64.9)	30 (50.8)	0.0903
30−40	156 (29.5)	132 (28.1)	24 (40.7)	
>40	38 (7.2)	33 (7.0)	5 (8.5)	
Tobacco use (%)	240 (45.3)	207 (43.9)	33 (55.9)	0.0959
Diabetes (%)	69 (13.0)	57 (12.1)	12 (20.3)	0.0975
INJURY				
Open fracture (%)	84 (15.8)	65 (13.7)	19 (32.2)	0.0009
Gustillo Anderson category (%)				
Not open	448 (85.5)	408 (87.2)	40 (71.4)	0.0026
I	16 (3.1)	15 (3.2)	1 (1.8)	
II	17 (3.2)	14 (3.0)	3 (5.4)	
III	43 (8.2)	31 (6.6)	12 (21.4)	
Schatzker classification (%)				
1−3	170 (32.1)	163 (34.6)	7 (11.9)	0.0003
4−6	360 (67.9)	308 (65.4)	52 (88.1)	
Vascular injury (%)	15 (2.8)	12 (2.5)	3 (5.1)	0.2257
Compartment syndrome (%)	44 (8.3)	31 (6.6)	13 (22.0)	0.0004
CLINICAL				
Mean days to ORIF	7.44 ± 6.30	7.33 ± 6.30	8.28 ± 6.28	0.2825
Mean number scrubbed	5.39 ± 1.85	5.38 ± 1.87	5.47 ± 1.67	0.7303
External fixator (%)	180 (33.8)	147 (31.1)	33 (55.9)	0.0002
Single incision (%)	390 (73.6)	351 (74.5)	39 (66.1)	0.2093
Single plate (%)	403 (76.9)	363 (77.7)	40 (70.2)	0.2428
Bone graft (%)	145 (27.3)	134 (28.4)	11 (18.6)	0.1233
IVDU (%)	23 (4.3)	21 (4.5)	2 (3.4)	1.0000

* Estimated from Fischer's exact and t-test for categorical and continuous variables, respectively