

Risk Factors and Predictors of Surgical Site Infection Following Operative Treatment of Tibial Plateau Fractures: A Retrospective Cohort Study-100 cases

Authors:

Md. Sanaul Huq^{1*}, SM Mainul Hassan², Ruhul Amin Khan³, Ashiq Ahmed⁴, Muhammad Raquib Hussain⁵

¹Assistant Professor, Department of Orthopaedic Surgery, Kurmitola Multicare Specialized Hospital, Dhaka, Bangladesh.

²Assistant Professor, Department of Orthopaedic Surgery, Hosenpur Upazila Health Complex, Kishoreganj, Bangladesh.

³Junior Consultant, Department of Orthopaedic Surgery, Sakhipur Upazila Health Complex, Tangail, Bangladesh.

⁴Junior Consultant, Department of Orthopaedic Surgery, Raninagar Upazila Health Complex, Naogaon, Bangladesh.

⁵ Medical Officer, Agailjhara Upazila Health Complex, Barishal, Bangladesh.

*Corresponding Author:

Md. Sanaul Huq, Assistant Professor, Department of Orthopaedic Surgery, Kurmitola Multicare Specialized Hospital, Dhaka, Bangladesh, Email: sanaul.shuvo@gmail.com

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ABSTRACT

Background: Tibial plateau fractures frequently require operative fixation and may be complicated by surgical site infection (SSI). Identifying risk factors can facilitate perioperative risk stratification and prevention. **Objective:** To determine the incidence and independent predictors of SSI following operative treatment of tibial plateau fractures. **Methods:** This retrospective cohort study included 100 consecutive adult patients who underwent operative treatment for tibial plateau fractures at Kurmitola Multicare Specialized Hospital, Dhaka, Bangladesh, between January and December 2025. Demographic, clinical, fracture-related and operative variables were analyzed. SSI was classified as superficial or deep. Univariable and multivariable logistic regression analyses were performed, with odds ratios (ORs) and 95% confidence intervals (CIs). **Results:** SSI occurred in 9 (9.0%) patients, including 5 (5.0%) superficial and 4 (4.0%) deep infections. Open fracture, compartment syndrome, hypoalbuminemia and operative duration ≥ 180 minutes were significantly associated with SSI and remained independent predictors in multivariable analysis. Adjusted ORs were 5.72 (95% CI 1.18–27.71) for open fracture, 6.91 (95% CI 1.40–34.10) for compartment syndrome, 4.83 (95% CI 1.09–21.41) for hypoalbuminemia and 4.96 (95% CI 1.20–20.55) for prolonged operative duration. **Conclusion:** SSI occurred in 9% of patients following operative treatment of tibial plateau fractures. Open fracture, compartment syndrome, hypoalbuminemia and prolonged operative duration were independent predictors. Early risk identification, soft-tissue management, nutritional optimization and meticulous perioperative care may help reduce SSI.

Keywords: Tibial Plateau Fracture; Surgical Site Infection; Risk Factors; Predictors; Open Reduction and Internal Fixation; Orthopaedic Trauma.

INTRODUCTION

Tibial plateau fractures are intra-articular injuries involving the proximal tibia and represent a substantial challenge in orthopaedic trauma because the injury simultaneously affects the articular surface, subchondral bone, metaphysis and surrounding soft tissues. Their management requires restoration of articular congruity, mechanical alignment and sufficient stability to permit rehabilitation while minimizing complications. Contemporary treatment

strategies include nonoperative management for selected stable injuries and operative fixation for displaced, unstable or complex fractures. The choice and timing of fixation depend not only on fracture morphology but also on the condition of the surrounding soft-tissue envelope.[1,2]

Surgical site infection is one of the most clinically important complications following operative fixation of tibial plateau fractures. Infection may be superficial and responsive to local treatment or may extend to the

implant and fracture site, resulting in fracture-related infection, repeated surgical debridement, prolonged antimicrobial therapy, implant removal, delayed fracture healing and compromised functional recovery. Published infection rates vary substantially according to patient population, fracture severity, definition of infection, follow-up duration and treatment strategy.[3-6] A prospective multicentre study involving 235 patients reported SSI in 5.1% of cases, including 2.1% deep and 3.0% superficial infections.[3] A large prospective study restricted to closed fractures reported a lower SSI rate of 2.3% among 1108 patients.[4] The development of infection following tibial plateau fixation is multifactorial. Open fracture, smoking, compartment syndrome, severe fracture morphology and prolonged operative duration have repeatedly been associated with increased infection risk.[3,5-8] A systematic review and meta-analysis identified open fracture, compartment syndrome, prolonged operative time, tobacco use and external fixation among significant risk factors.[9] Similarly, a multicentre study involving 2106 operatively treated tibial plateau fractures found that diabetes mellitus, higher body mass index, multiple comorbidities, OTA/AO type C fracture, compartment syndrome and open fracture were associated with deep SSI.[10] Recent evidence has expanded attention beyond traditional trauma-related risk factors. Nutritional status may influence postoperative wound healing and host defense. A 2025 retrospective study of 460 adult patients with closed tibial plateau fractures reported an overall SSI rate of 5%, including 2.4% deep and 2.6% superficial infections, and identified fracture type and preoperative hypoalbuminemia as independent predictors.[11] Another contemporary retrospective study of 314 patients found that high-energy injury, compartment syndrome and use of two or more plates were independently associated with infection.[12] These observations suggest that infection risk should be assessed using an integrated model incorporating patient condition, injury severity, soft-tissue status and surgical complexity. The definition of postoperative infection is also important. Modern fracture-related infection consensus criteria distinguish confirmatory findings such as sinus or wound breakdown communicating with the fracture, purulent drainage, compatible organisms from multiple deep tissue samples, or microorganisms demonstrated in deep tissue by histopathology, from suggestive clinical and laboratory findings.[13,14] Standardized definitions improve comparability between studies and facilitate appropriate postoperative surveillance. Although substantial international literature exists, locally generated data from Bangladesh remain comparatively limited, particularly regarding SSI after operative treatment of tibial plateau fractures. Differences in patient characteristics, smoking prevalence, nutritional status, healthcare access, injury patterns, antimicrobial practices, operative resources and postoperative

follow-up may influence the observed infection burden. Therefore, institution-specific evaluation is clinically relevant. The present retrospective cohort study was undertaken in the Department of Orthopaedic Surgery, Kurmitola Multicare Specialized Hospital, Dhaka, Bangladesh, to determine the incidence of SSI among 100 patients undergoing operative treatment of tibial plateau fractures during 2025. The study further aimed to identify patient-, injury- and procedure-related factors associated with infection and to determine independent predictors using multivariable logistic regression.

METHODS

Study design and setting

This retrospective cohort study was conducted in the Department of Orthopaedic Surgery, Kurmitola Multicare Specialized Hospital, Dhaka, Bangladesh. Medical records of patients undergoing operative treatment of tibial plateau fractures between January 2025 and December 2025 were reviewed. The study population consisted of 100 consecutive eligible patients treated surgically during the defined study period.

Eligibility criteria

Patients were eligible if they:

1. were adults;
2. had a radiologically confirmed tibial plateau fracture;
3. underwent operative fixation at the study hospital during the study period; and
4. had sufficient clinical records for assessment of postoperative wound status.

Patients were excluded if they had pre-existing infection at the operative site, pathological fractures, previous surgery involving the same knee, incomplete records regarding the primary outcome, or definitive fracture fixation performed at another institution.

Data collection

A structured data-extraction form was used. Variables included age, sex, BMI, smoking status, diabetes mellitus, hypertension, other relevant comorbidities, ASA physical status, fracture side, fracture classification, open versus closed injury, compartment syndrome, fasciotomy, preoperative hemoglobin, white blood cell count, serum albumin, timing of definitive surgery, temporary external fixation, surgical approach, number of plates, bone grafting, operative duration, estimated blood loss and postoperative hospital stay. Fracture morphology was recorded using the Schatzker classification where available. High-energy patterns were considered separately because severe articular and metaphyseal comminution may be accompanied by greater soft-tissue damage.

Surgical treatment

Patients underwent operative fixation according to fracture morphology, soft-tissue condition and surgeon assessment. Depending on injury characteristics, treatment included open reduction and internal fixation with locking plates or conventional plates, single- or dual-plate constructs and, where indicated, staged management with temporary external fixation followed by definitive fixation. Perioperative antimicrobial prophylaxis and postoperative wound management followed institutional practice and contemporary orthopaedic principles.

Outcome definition

The primary outcome was postoperative SSI occurring after definitive fracture fixation during the defined follow-up period. SSI was classified as superficial when infection was limited to skin or subcutaneous tissues without evidence of deep implant or fracture involvement. Deep SSI was defined as infection involving deeper tissues, implant-associated infection or clinical findings consistent with fracture-related infection. Where deep infection was suspected, microbiological specimens were obtained during surgical intervention whenever clinically appropriate. The contemporary fracture-related infection consensus framework was used to improve consistency of classification. [13,14]

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean $\pm$ SD or median (IQR), and categorical variables as frequencies and percentages. The SSI and non-SSI groups were compared using the independent t test or Mann–Whitney U test for continuous variables and chi-square or Fisher's exact test for categorical variables. Variables with $P < 0.10$ in univariable analysis were entered into multivariable logistic regression. Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported. A two-sided $P < 0.05$ was considered statistically significant.

Ethical Consideration

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and applicable institutional requirements for retrospective medical-record research. Ethical approval was obtained from the Institutional Review Board/Ethics Committee of Kurmitola Multicare Specialized Hospital, Dhaka, Bangladesh, before commencement of the study. As this study involved a retrospective review of existing medical records, the requirement for individual written informed consent was waived by the Institutional Review Board. Patient confidentiality and privacy were strictly maintained throughout the study, and all personal identifiers were removed before data analysis.

RESULTS

Patient Characteristics

A total of 100 patients who underwent operative treatment for tibial plateau fractures during the study period were included in the analysis. The mean age of the study population was 46.8 ± 13.7 years, and 68 (68.0%) patients were male and 32 (32.0%) were female. The mean BMI was 25.9 ± 3.8 kg/m². Twenty-two (22.0%) patients were current smokers and 14 (14.0%) had diabetes mellitus. During postoperative follow-up, SSI developed in 9 (9.0%) patients, including 5 (5.0%) with superficial SSI and 4 (4.0%) with deep SSI.

As shown in **Table 1**, obesity, smoking, diabetes mellitus, ASA class ≥ 3 , and hypoalbuminemia were more common among patients who developed SSI. Obesity was significantly more frequent in the SSI group than in the non-SSI group (44.4% vs. 12.1%, $P = 0.011$). Similarly, current smoking was more common among patients with SSI (55.6% vs. 18.7%, $P = 0.015$), as was diabetes mellitus (44.4% vs. 11.0%, $P = 0.009$). ASA class ≥ 3 was also significantly more frequent in the SSI group (44.4% vs. 16.5%, $P = 0.039$). Hypoalbuminemia was present in 44.4% of patients with SSI compared with 14.3% of patients without SSI ($P = 0.018$). There was no statistically significant difference in age, sex, or hypertension between the two groups.

Table 1. Demographic and clinical characteristics of patients according to SSI status

Variable	Total (n=100)	SSI (n=9)	No SSI (n=91)	P value
Age, years	46.8 $\pm$ 13.7	51.6 $\pm$ 12.1	46.3 $\pm$ 13.8	0.248
Male sex	68 (68.0%)	7 (77.8%)	61 (67.0%)	0.514
BMI ≥ 30 kg/m ²	15 (15.0%)	4 (44.4%)	11 (12.1%)	0.011
Current smoking	22 (22.0%)	5 (55.6%)	17 (18.7%)	0.015
Diabetes mellitus	14 (14.0%)	4 (44.4%)	10 (11.0%)	0.009
Hypertension	18 (18.0%)	3 (33.3%)	15 (16.5%)	0.211
ASA ≥ 3	19 (19.0%)	4 (44.4%)	15 (16.5%)	0.039
Hypoalbuminemia	17 (17.0%)	4 (44.4%)	13 (14.3%)	0.018

Values are presented as mean $\pm$ SD or n (%).

Fracture-Related Characteristics

The fracture-related and soft-tissue characteristics are presented in **Table 2**. Twelve (12.0%) patients had open fractures, while 88 (88.0%) had closed injuries. Open fractures were significantly more frequent among patients who developed SSI than among those without infection (44.4% vs. 8.8%, $P=0.002$). High-energy injury was also more common in the SSI group (66.7% vs. 27.5%, $P=0.014$).

Regarding fracture classification, 73 (73.0%) patients had Schatzker type I–III fractures and 27 (27.0%) had

Schatzker type IV–VI fractures. High-grade Schatzker IV–VI fractures were significantly more frequent in the SSI group than in the non-SSI group (66.7% vs. 23.1%, $P=0.006$). Compartment syndrome occurred in 10 (10.0%) patients overall and was substantially more frequent among patients who developed SSI (44.4% vs. 6.6%, $P<0.001$). Similarly, fasciotomy was required in 33.3% of patients with SSI compared with 5.5% of those without SSI ($P=0.006$).

Table 2. Fracture characteristics and soft-tissue injury according to SSI status

Variable	Total (n=100)	SSI (n=9)	No SSI (n=91)	P value
Open fracture	12 (12.0%)	4 (44.4%)	8 (8.8%)	0.002
High-energy injury	31 (31.0%)	6 (66.7%)	25 (27.5%)	0.014
Schatzker I–III	73 (73.0%)	3 (33.3%)	70 (76.9%)	0.006
Schatzker IV–VI	27 (27.0%)	6 (66.7%)	21 (23.1%)	0.006
Compartment syndrome	10 (10.0%)	4 (44.4%)	6 (6.6%)	<0.001
Fasciotomy	8 (8.0%)	3 (33.3%)	5 (5.5%)	0.006

Values are presented as n (%).

Operative Characteristics

The operative characteristics are summarized in **Table 3**. Temporary external fixation before definitive fixation was performed in 16 (16.0%) patients. SSI developed in 5 (55.6%) patients who required temporary external fixation compared with 11 (12.1%) patients without SSI ($P=0.002$). Similarly, fixation with two or more plates was significantly more frequent in the SSI group than in the non-SSI group (66.7% vs. 25.3%, $P=0.006$).

Multiple surgical approaches were used in 21 (21.0%) patients and were significantly more frequent among

those who developed SSI (55.6% vs. 17.6%, $P=0.008$). Bone grafting was performed in 18 (18.0%) patients, with no statistically significant difference between the SSI and non-SSI groups ($P=0.194$).

The mean operative duration for the entire cohort was 148.5 ± 41.2 minutes. Patients who developed SSI had significantly longer operations than those without infection (196.4 ± 42.6 vs. 143.8 ± 38.7 minutes, $P<0.001$). Operative duration ≥ 180 minutes occurred in 66.7% of the SSI group compared with 24.2% of the non-SSI group ($P=0.006$).

Table 3. Operative characteristics according to SSI status

Variable	Total (n=100)	SSI (n=9)	No SSI (n=91)	P value
Temporary external fixation	16 (16.0%)	5 (55.6%)	11 (12.1%)	0.002
Two or more plates	29 (29.0%)	6 (66.7%)	23 (25.3%)	0.006
Multiple surgical approaches	21 (21.0%)	5 (55.6%)	16 (17.6%)	0.008
Bone grafting	18 (18.0%)	3 (33.3%)	15 (16.5%)	0.194
Operative duration, min	148.5 ± 41.2	196.4 ± 42.6	143.8 ± 38.7	<0.001
Operative duration ≥ 180 min	28 (28.0%)	6 (66.7%)	22 (24.2%)	0.006

Values are presented as mean $\pm$ SD or n (%).

Incidence and Characteristics of Surgical Site Infection

During postoperative follow-up, 9 of the 100 patients developed SSI, giving an overall infection rate of 9.0%. As shown in **Table 4**, 5 (5.0%) patients developed superficial SSI and 4 (4.0%) developed deep SSI. Three patients required formal surgical

debridement, while two subsequently required implant removal. Seven (7.0%) patients had culture-positive infections and two (2.0%) had culture-negative infections. The median interval between definitive fixation and diagnosis of SSI was 18 days, with a range of 7–46 days.

Table 4. Characteristics and management of postoperative SSI

Outcome	n (%)
Overall SSI	9 (9.0%)
Superficial SSI	5 (5.0%)
Deep SSI	4 (4.0%)
Debridement required	3 (3.0%)
Implant retained	7 (7.0%)
Implant removal	2 (2.0%)
Repeat surgery	3 (3.0%)
Culture-positive infection	7 (7.0%)
Culture-negative infection	2 (2.0%)

Values are presented as n (%).

Microbiological Findings

Microbiological findings from the culture-positive infections are presented in **Table 5**. Of the 9 patients with SSI, cultures were positive in 7 (77.8%). *Staphylococcus aureus* was the most frequently isolated organism, accounting for 3 of the 7 culture-

positive cases (42.9%). One of these isolates was identified as methicillin-resistant *S. aureus* (MRSA). *Escherichia coli*, *Klebsiella* spp., and another Gram-negative organism were each identified in one case (14.3%).

Table 5. Microbiological profile of culture-positive SSI

Organism	n (%)
<i>Staphylococcus aureus</i>	3 (42.9%)
MRSA	1 (14.3%)
<i>Escherichia coli</i>	1 (14.3%)
<i>Klebsiella</i> spp.	1 (14.3%)
Other Gram-negative organism	1 (14.3%)
Total culture-positive cases	7 (100%)

Percentages are calculated among the 7 culture-positive infections.

Univariable Analysis of Risk Factors for SSI

Univariable logistic regression analysis demonstrated significant associations between SSI and several patient-, fracture- and operative-related factors (**Table 6**). Obesity was associated with approximately six-fold higher odds of SSI (OR 5.84, 95% CI 1.48–23.06, $P=0.011$). Smoking and diabetes mellitus were also significantly associated with infection, with crude ORs of 5.43 and 6.48, respectively.

Among fracture-related factors, open fracture demonstrated a strong association with SSI (OR 8.21,

95% CI 1.98–34.08, $P=0.004$). Schatzker IV–VI fracture patterns were associated with increased odds of infection (OR 6.64, 95% CI 1.62–27.28, $P=0.009$), while compartment syndrome showed the strongest crude association (OR 11.29, 95% CI 2.54–50.16, $P=0.001$).

Temporary external fixation, use of two or more plates, and operative duration ≥ 180 minutes were also significantly associated with SSI.

Table 6. Univariable logistic regression analysis of potential risk factors for SSI

Risk factor	Crude OR	95% CI	P value
BMI ≥ 30 kg/m ²	5.84	1.48–23.06	0.011
Smoking	5.43	1.32–22.36	0.019
Diabetes mellitus	6.48	1.53–27.44	0.011
Hypoalbuminemia	4.81	1.25–18.54	0.022
Open fracture	8.21	1.98–34.08	0.004
Schatzker IV–VI	6.64	1.62–27.28	0.009
Compartment syndrome	11.29	2.54–50.16	0.001
Temporary external fixation	6.84	1.83–25.58	0.004
Two or more plates	5.96	1.48–24.03	0.012
Operative duration ≥ 180 min	6.27	1.59–24.70	0.009

Multivariable Analysis of Independent Predictors of SSI

Variables demonstrating a clinically relevant association with SSI and/or $P < 0.10$ in univariable analysis were considered for multivariable logistic regression. The adjusted results are presented in **Table 7**. After adjustment for potential confounding factors, open fracture, compartment syndrome, hypoalbuminemia and operative duration ≥ 180 minutes remained independently associated with SSI. Patients with an open fracture had approximately 5.7-fold higher adjusted odds of developing SSI than those with closed fractures (adjusted OR 5.72, 95% CI 1.18–

27.71, $P = 0.030$). Compartment syndrome was associated with the highest adjusted odds of infection (adjusted OR 6.91, 95% CI 1.40–34.10, $P = 0.018$). Hypoalbuminemia was also independently associated with SSI (adjusted OR 4.83, 95% CI 1.09–21.41, $P = 0.038$). Operative duration ≥ 180 minutes was associated with approximately five-fold higher adjusted odds of SSI (adjusted OR 4.96, 95% CI 1.20–20.55, $P = 0.027$).

Although smoking, diabetes mellitus, and fixation with two or more plates remained associated with increased odds numerically, these variables did not retain statistical significance in the adjusted model.

Table 7. Multivariable logistic regression analysis of independent predictors of SSI

Predictor	Adjusted OR	95% CI	P value
Open fracture	5.72	1.18–27.71	0.030
Compartment syndrome	6.91	1.40–34.10	0.018
Hypoalbuminemia	4.83	1.09–21.41	0.038
Operative duration ≥ 180 min	4.96	1.20–20.55	0.027
Smoking	2.41	0.59–9.84	0.220
Diabetes mellitus	2.83	0.63–12.74	0.173
Two or more plates	2.64	0.67–10.43	0.167

DISCUSSION

The present study evaluated risk factors and independent predictors of SSI following operative treatment of tibial plateau fractures. In this cohort of 100 patients, SSI occurred in 9.0% of cases. The analysis demonstrated that infection was associated with several patient-, injury- and procedure-related factors. Open fracture, compartment syndrome, hypoalbuminemia and prolonged operative duration remained independent predictors after multivariable adjustment. The observed infection burden is clinically important because SSI following tibial plateau fixation may result in prolonged antibiotic treatment, repeated surgical intervention, implant-related complications and impaired fracture healing. Previous investigations have reported variable infection rates, reflecting differences in fracture severity, patient characteristics, infection definitions and follow-up protocols. A systematic review and meta-analysis demonstrated that SSI after tibial plateau ORIF is influenced by several injury and treatment factors, particularly open fracture, compartment syndrome, smoking, prolonged operative duration and external fixation.[8] The current findings are broadly consistent with this multifactorial model. Open fracture was one of the strongest independent predictors in the present analysis. Patients with open injuries had substantially higher odds of developing SSI compared with those with closed fractures. This observation is biologically plausible because open fractures involve direct communication between the fracture site and the external environment, increasing bacterial contamination and frequently producing substantial soft-tissue damage. Previous literature has consistently identified open fracture as an important

predictor of infection after tibial plateau fixation. [8,9] The increased infection risk emphasizes the importance of early antibiotic administration, meticulous irrigation and debridement, appropriate soft-tissue management and carefully selected timing of definitive fixation. Compartment syndrome was another important independent predictor. Patients with compartment syndrome frequently sustain high-energy trauma associated with severe soft-tissue swelling and tissue ischemia. Fasciotomy may require additional incisions and may further increase the complexity of subsequent reconstruction. The systematic review by Shao et al. identified compartment syndrome as a significant risk factor for postoperative infection.[8] Henkelmann et al., in a large multicentre study, similarly reported compartment syndrome as an independent risk factor for deep SSI after operative treatment of tibial plateau fractures.[10] More recently, Olivieri et al. also identified compartment syndrome as an independent predictor among 314 patients.[12] These findings reinforce the importance of considering compartment syndrome as a marker of both injury severity and elevated postoperative infection risk. Fracture severity was also associated with infection in the unadjusted analysis. Schatzker IV–VI patterns were considerably more frequent in infected patients. High-grade fractures typically involve greater articular displacement, metaphyseal comminution and soft-tissue injury and often require more extensive surgical exposure and fixation. Henkelmann et al. found that OTA/AO type C fractures were associated with increased deep SSI risk.[10] Olivieri et al. similarly found high-energy fractures to be independently associated with infection.[12] Thus, fracture

classification may provide useful information for early risk stratification, although it should not be considered independently of the soft-tissue condition. Hypoalbuminemia remained an independent predictor in the multivariable model. This finding is particularly relevant because nutritional status is potentially modifiable. Albumin may reflect nutritional reserve as well as systemic inflammation and acute physiological stress. Patients with low albumin may have impaired wound healing, reduced immune competence and poorer tolerance of major surgery. A recent study involving 460 patients with closed tibial plateau fractures reported preoperative hypoalbuminemia as an independent risk factor for SSI.[11] These findings suggest that nutritional screening may be useful when evaluating patients before definitive fixation, particularly when staged management permits a period of optimization. Operative duration ≥ 180 minutes was also independently associated with infection. Prolonged surgery may reflect greater fracture complexity, extensive soft-tissue dissection, multiple approaches or technically demanding reduction and fixation. It may also increase the duration of tissue exposure and physiological stress. Colman et al. previously reported that prolonged operative time increased infection rates following tibial plateau fracture surgery.[7] The present finding therefore supports efforts to optimize preoperative planning, surgical exposure and implant strategy. Nevertheless, prolonged operative time may partly act as a surrogate for fracture complexity, and the relationship should not be interpreted as entirely causal. Temporary external fixation was associated with infection in univariable analysis but did not remain an independent predictor after adjustment. This is an important distinction. Staged external fixation is frequently used in severe tibial plateau fractures with significant swelling or soft-tissue compromise. Therefore, the apparent association may arise because external fixation is preferentially used in the most severe injuries. The finding is consistent with the systematic review demonstrating an association between external fixation and SSI.[8] However, it should not be interpreted as evidence that staged external fixation itself should be avoided when clinically indicated. The use of multiple plates was similarly associated with infection before adjustment but lost statistical significance in the multivariable model. Multiple plates are commonly required for bicondylar or highly comminuted fractures. Olivieri et al. reported two or more plates as an independent risk factor in their 314-patient cohort.[12] Differences between studies may reflect sample size, fracture distribution, surgical approaches and adjustment strategies. In the present 100-patient study, the relatively small number of infection events may have limited the power to demonstrate independent associations. Smoking and diabetes mellitus were associated with SSI in univariable analysis but were not independent predictors following

adjustment. Tobacco exposure is biologically associated with impaired microvascular perfusion and wound healing and previous studies have identified smoking as an important risk factor.[8,10] Diabetes may similarly impair immune function and wound healing. The absence of statistical significance after adjustment in a small cohort should not be interpreted as evidence that these factors have no clinical relevance. Rather, the relatively small number of SSI events may produce wide confidence intervals and insufficient statistical power.

The microbiological findings showed *S. aureus* as the most common organism among culture-positive infections. This is consistent with previous reports of tibial plateau fracture infection in which *S. aureus* has been frequently identified.[9,10] The presence of resistant organisms, including MRSA, highlights the importance of culture-directed antimicrobial treatment and awareness of local resistance patterns. However, antimicrobial prophylaxis should be guided by institutional protocols and local microbiological surveillance rather than by the findings of a small single-centre cohort alone. The clinical implications of these findings are significant. Patients with open fractures, compartment syndrome, poor nutritional status or anticipated prolonged procedures can be recognized as higher-risk patients before definitive fixation. Such patients may benefit from intensified soft-tissue surveillance, optimization of modifiable factors, appropriate timing of surgery and careful postoperative follow-up. The AAOS guidance on SSI prevention after major extremity trauma supports a multimodal strategy rather than reliance on antimicrobial prophylaxis alone.[15,16] The study should also be interpreted in the context of contemporary fracture-related infection definitions. The international consensus definition distinguishes confirmatory criteria, such as sinus formation, purulence or microbiological evidence from multiple deep samples, from suggestive clinical findings.[13] Standardized definitions are particularly important in retrospective studies because superficial wound problems and true deep fracture-related infection may otherwise be grouped together. Contemporary recommendations further emphasize multidisciplinary management and appropriate systemic antimicrobial therapy when fracture-related infection is established.[17-19] Several limitations should be acknowledged. First, the retrospective study design limits the ability to establish causal relationships. Second, the cohort consisted of only 100 patients, and the number of SSI events was relatively small. Consequently, the multivariable model should remain parsimonious to avoid overfitting. Third, this was a single-centre study, which may limit generalizability to other hospitals and healthcare systems. Fourth, some infections occurring after discharge may have been missed if patients received treatment elsewhere. Fifth, variables such as exact timing of antibiotic prophylaxis, surgeon

experience, operating-room conditions and detailed wound-care practices may not have been completely available from retrospective records. Despite these limitations, the study provides a clinically relevant framework for identifying patients at increased risk of infection following tibial plateau fracture fixation. The findings suggest that infection prevention should begin before surgery and continue through the postoperative period with particular attention to severe soft-tissue injury, nutritional status and operative complexity.

CONCLUSION

Surgical site infection represents an important complication following operative treatment of tibial plateau fractures. In this 100-patient cohort, SSI was associated with multiple patient-, fracture- and procedure-related factors. Open fracture, compartment syndrome, hypoalbuminemia and prolonged operative duration were identified as independent predictors after multivariable adjustment. These findings emphasize that SSI prevention should involve a comprehensive perioperative strategy rather than dependence on antibiotic prophylaxis alone. Early recognition of severe soft-tissue injury, appropriate timing of definitive fixation, meticulous surgical technique, optimization of nutritional status, smoking cessation, appropriate management of diabetes and careful postoperative surveillance may help reduce infection-related morbidity. Further prospective multicentre studies involving larger Bangladeshi patient populations are warranted to validate these predictors and develop a reliable local SSI risk-prediction model for tibial plateau fracture surgery.

Declarations

Consent for Publication: Not applicable, as no personally identifiable information is presented.

Availability of Data and Materials: The data supporting the findings of this study are available from the corresponding author upon reasonable request and subject to institutional confidentiality requirements.

Competing Interests: The authors declare that they have no competing interests.

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Authors' Contributions: All authors contributed to the conception and design of the study, data collection, analysis and interpretation, manuscript preparation, critical revision and approval of the final manuscript.

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