

ORIGINAL ARTICLE

Frequency of chronic osteomyelitis in open tibia fracture treated by external fixator at tertiary care hospital.

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ABSTRACT... Objective: To determine the frequency of chronic osteomyelitis and associated factors in open tibia fractures treated with an external fixator at a tertiary care hospital. **Study Design:** Descriptive Cross-sectional study. **Setting:** Department of Orthopedic, Dr. Ruth K. M. Pfau Civil Hospital / DUHS. **Period:** May 2025 to Oct 2025. **Methods:** A total of 121 patients, aged 18–60 years, with open tibial fractures treated using external fixators, were enrolled consecutively. The subjects' data on sociodemographic characteristics, fracture details, and treatment-related variables were recorded on a standardized proforma. Patients were followed, and chronic osteomyelitis was diagnosed based on predefined clinical, radiological, and microbiological criteria. Data entry and analysis were done using the SPSS version 27.0.1. Descriptive statistics were employed, while associations were determined using the chi-square test; with a p value of less than 0.05 was regarded as statistically significant. **Results:** Chronic osteomyelitis developed in 12.4% of patients. Smoking, higher Gustilo–Anderson fracture grades (IIIB/IIIC), proximal tibial fracture location, and primary wound closure were independently associated with infection. Smoking showed the strongest association, markedly increasing the risk of chronic osteomyelitis while gender was not a significant predictor after adjustment. **Conclusion:** Chronic osteomyelitis remains a significant complication following open tibial fractures managed with external fixation. Injury severity and modifiable factors such as smoking and wound-closure strategy play a crucial role in infection development. Implementing strategies for managing wounds and associated risk factors can potentially decrease infectious complications.

Key words: External Fixator, Osteomyelitis, Open Fracture, Tibial Fracture.

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INTRODUCTION

Open tibial fractures are known to be one of the most frequently encountered long bone injuries and are highly susceptible to complications due to the subcutaneous location of the tibia, which makes it more susceptible to injury and infection.¹ Most of these types of fractures take place in high-energy traumas such as road traffic accidents, usually with severe soft tissue damage.² Open tibia fractures need a multidisciplinary team effort of orthopedic and plastic surgeons to manage the bone and soft tissue damages effectively.³ External fixation is still considered the best option in the initial treatment of open fractures of the tibia particularly due to its unique ability to provide wound access and adapt to complex fracture patterns.⁴ However despite its clinical benefit's external fixation convey a risk of infection especially at pin sites which can progress to chronic osteomyelitis if not appropriately controlled.⁵

Chronic osteomyelitis represents a major and potentially devastating complication of open fractures, frequently resulting in prolonged treatment courses, multiple operative interventions, and, in advanced cases, risk to limb viability.⁶ Determining the burden of this condition and recognizing the clinical and injury-related factors that predispose patients to its development in those managed with external fixation are essential steps toward improving treatment outcomes and strengthening infection prevention strategies.⁷ Existing literature reports infection rates between 12% and 21% after open tibial fractures, with the likelihood of infection rising in parallel with increasing injury severity.⁸

Higher Gustilo–Anderson grades, in particular type III injuries, have a highly increased risk for chronic osteomyelitis. Delays in adequate debridement and timely soft-tissue coverage further implicate the pathogenesis of this disease.⁹

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External fixation continues to be widely utilized in the management of open tibial fractures because it provides reliable skeletal stabilization while preserving access for soft-tissue care. In a previous study it has been shown that 73.53% of patients treated with external fixation healed without major complications whereas 26.47% developed complications such as nonunion, osteitis, and infection.¹⁰

Despite increasing attention toward infection control in orthopedic trauma, the true burden of chronic osteomyelitis among patients treated with external fixators particularly in low-resource high volume trauma settings remains insufficiently explored. Therefore, this study aims to determine the frequency of chronic osteomyelitis in patients with open tibial fractures treated with external fixators at a tertiary care hospital. The findings from this study provide practical evidence to support evidence-based decision-making guide preventive strategies and optimize postoperative care protocols to reduce infection related morbidity in resource limited healthcare environments. The objective of this study was to determine the frequency of chronic osteomyelitis and associated factors in open tibia fractures treated with an external fixator at a tertiary care hospital.

METHODS

A descriptive cross-sectional study was conducted in Orthopedic Department of Dr. Ruth K. M. Pfau Civil Hospital / DUHS from May 2025 to Oct 2025. A sample size of 121 patients was calculated by using the WHO formula for single population proportion based on an expected frequency of chronic osteomyelitis of 20% ($P = 0.20$).⁶ A non-probability consecutive sampling technique was used.

Patients aged 18 to 60 years of both genders diagnosed with open tibia fractures and treated with external fixators and having a minimum follow up period of 12 months after injury were included. Patients with pre-existing osteomyelitis, comorbidities likely to affect bone healing (e.g., severe diabetes mellitus), or incomplete medical records were excluded.

Data collection was done using a proforma designed especially for the collection of standardized data at the time of presentation. Variables include sociodemographic parameters, parameters related to fractures, as well as other related parameters such as the time taken for external fixation as well as antibiotic therapy.

The patients were systematically followed along all through the treatment period and during follow-ups. The chronic osteomyelitis was identified using specific predetermined criteria that involved medical examination, imaging, and microbiological tests conducted during the follow-ups.

Data analysis was conducted using the SPSS version 27.0.1. For continuous data, mean and standard deviations (SD) were calculated. For the categorical variable, frequency and percentage were computed.

The incidence of chronic osteomyelitis was determined as a proportion of the total number of samples. The relationship of clinical predictors to chronic osteomyelitis was determined using chi-squared testing. Results were considered to be statically significant at p-value of < 0.05 . The study was approved by ethical committee of institute (A/437/ortho/3-01-25) and was in accordance with the guidelines of the Declaration of Helsinki. Written Informed consent was obtained from all the participants at the time of recruitment.

RESULTS

A total of 121 patients with open tibial fractures who were treated with external fixation were included. The mean age was 34.9 ± 9.8 years and 68.6% were male. Most participants resided in urban areas (58.7%). Smoking was reported by 20.7% while 14.8% had hypertension and 9.9% had diabetes. The most common mechanism of injury was road traffic accidents (77.7%) as in Table-I.

The middle third of the tibia was the most frequent fracture site, 39.6%, followed by the distal, 36.4%, and proximal, 24%, third. Most injuries were Gustilo Grade II, 38%, followed by IIIA, 29.8%, and IIIB, 24%. The mean time to hospital presentation was 7.4 ± 3.2 hours.

Closure of the wound: Primary 24%, delayed 36.4%, flap/graft coverage 25.6%. Most patients, 94.2%, were given prophylactic antibiotics.

Incidence of COM was 12.4% ($n = 15$). Of these, 93.3% showed persistent sinus >6 weeks, 73.3% had radiological signs, and 66.7% had positive cultures.

Statistically significant associations were found between several clinical variables and the presence of chronic osteomyelitis. The gender variable showed a significant association with the state of infection: male patients were found to have a significantly higher number of chronic osteomyelitis cases than female patients ($\chi^2 = 7.839$, $df = 1$, $p = 0.005$). Smoking was one of the most influential predictors: smokers showed a far higher risk than non-smokers did ($\chi^2 = 65.751$, $df = 1$, $p < 0.001$), which is indicative of the considerable role tobacco exposure seems to play in infection susceptibility.

The location of fracture showed strong significance in the development of osteomyelitis. Chronic osteomyelitis showed significant association only in proximal tibia fractures. It showed an extremely significant association: $\chi^2 = 54.320$, $df = 2$, $p\text{-value} < 0.001$. There were no cases observed in the mid or distal fractures; hence, it implies that in proximal fractures, there is an increased chance due to the influence of soft tissues.

The intensity of injury for Gustilo-Anderson grading was also found to be strongly associated with infection. Regarding fracture types, Gustilo IIIB showed the strongest association with chronic osteomyelitis, with $\chi^2 = 48.936$, $df = 4$, $p < 0.001$. This correlates with the immense soft tissue damage associated with severe fractures.

Wound management strategy further influenced infection outcomes. All chronic osteomyelitis cases were seen in patients who had undergone primary closure, yielding a highly significant association: $\chi^2 = 54.320$, $df = 3$, $p < 0.001$. Infections were not recorded for any of the cases managed with delayed closure, flap or graft coverage, or open wound care. This suggests that in severely contaminated or high-risk wounds, primary closure predisposes to

persistent infection.

Taken together, these represent the factors most strongly associated with the development of chronic osteomyelitis in this patient population: male gender, smoking, proximal fracture location, Gustilo IIIB classification, and primary wound closure.

On multivariate logistic regression analysis, (Table-III) significant independent predictors for chronic osteomyelitis included smoking, high Gustilo grade (IIIB/IIIC), primary wound closure, and proximal/middle fracture site. In the comparison of smokers versus non-smokers, the odds were nearly 18 times greater (OR 17.82, 95% CI 4.71–67.45, $p < 0.001$). The risk was 19 times greater for Gustilo IIIB/IIIC injuries than for lower grades of injury (OR 19.12, 95% CI 4.95–73.89, $p < 0.001$). Primary wound closure raised the odds 8.6-fold (OR 8.58, 95% CI 2.36–31.21, $p = 0.001$), and proximal/middle fracture sites carried 4.6 times higher risk than distal fractures (OR 4.57, 95% CI 1.28–16.34, $p = 0.019$). Gender did not reach significance in the adjusted model ($p = 0.222$). The Hosmer-Lemeshow test reflected good model fit ($p = 0.553$).

DISCUSSION

This study found that 12.4% of patients with open tibial fractures treated with external fixation developed chronic osteomyelitis. This closely aligns with studies which reported 11.4% and 12.4% rate of chronic osteomyelitis respectively^{11,12} and furthermore another analysis study reported the range from 12% to 21% for similar injuries and treatments.⁸ These results show that chronic infection is still a major problem even when standardized fixation methods are used.

Smoking was found to have the strongest independent risk factor related to chronic osteomyelitis, which increased infection risk by almost eighteen times. This is well-supported by previous evidence suggesting that smoking contributes to decreased perfusion and delayed healing and an impaired immune response.¹³ The risk of infection for Gustilo Anderson IIIB/IIIC was greatly increased due to severe injury and significant loss of soft tissues due to injury as described in previous literature.

TABLE-I

Patients Characteristics, initial management and outcomes of Open tibial Fractures (n = 121).

Variable	Category / Mean $\pm$ SD	Frequency (%)
Age (years)	34.9 $\pm$ 9.8 (range 18–60)	—
Gender	Male	83 (68.6%)
	Female	38 (31.4%)
Residence	Urban	71 (58.7%)
	Rural	50 (41.3%)
Risk Factor	Smoking	25 (20.7%)
Comorbidities	Diabetes mellitus	12 (9.9%)
	Hypertension	18 (14.8%)
Mechanism of Injury	Road traffic accident	94 (77.7%)
	Fall	12 (9.9%)
	Work related accident	8 (6.6%)
	Gunshot	5 (4.1%)
	Other	2 (1.7%)
Site of Fracture	Proximal 1/3	29 (24%)
	Middle 1/3	48 (39.6%)
	Distal 1/3	44 (36.4%)
Gustilo–Anderson Classification	Grade I	5 (4.1%)
	Grade II	46 (38.0%)
	Grade IIIA	36 (29.8%)
	Grade IIIB	29 (24%)
	Grade IIIC	5 (4.1%)
Time to Hospital Presentation (hours)	7.4 $\pm$ 3.2	—
Initial Management		
Primary Wound Management	Primary closure	29 (24.0%)
	Delayed closure	44 (36.4%)
	Skin graft/flap	31 (25.6%)
	Left open	17 (14.0%)
Prophylactic Antibiotics	Yes	114 (94.2%)
	No	7 (5.8%)
Outcome		
Chronic Osteomyelitis	Present	15 (12.4%)
	Absent	106 (87.6%)
Indicators (among COM cases)	Persistent draining sinus > 6 weeks	14 (93.3%)
	Radiological signs (sequestrum/involucrum)	11 (73.3%)
	Positive deep tissue/bone culture	10 (66.7%)

TABLE-II

Association of patient and clinical factors with Chronic Osteomyelitis (COM) in open tibial fracture patients (N = 121)

Variable	χ^2	df	P-Value
Gender	7.839	1	0.005
Smoking	65.751	1	<0.001
Fracture site (proximal)	54.320	2	<0.001
Gustilo classification (IIIB)	48.936	4	<0.001*
Wound management (primary closure)	54.320	3	<0.001*

TABLE-II

Association of patient and clinical factors with Chronic Osteomyelitis (COM) in open tibial fracture patients (N = 121)

Variable	χ^2	df	P-Value
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Smoking	65.751	1	<0.001
Fracture site (proximal)	54.320	2	<0.001
Gustilo classification (IIIB)	48.936	4	<0.001*
Wound management (primary closure)	54.320	3	<0.001*

Patients with higher Gustilo Anderson grading of open fractures, in particular types IIIB and IIIC, had a considerably increased risk for developing infections that may largely be contributed to the massive loss of soft tissues, sustainability of higher degrees of soilage, as well as disturbances in local circulation. Previous research studies also reported that injury severity remains the leading cause in developing infections despite the fixation method used.^{9,12,14,15} Moreover, fractures in the proximal tibia have had an increased risk for having chances for chronic infections possibly due to the softer tissue envelopes in that area.¹⁶

The strategy in managing the wounds greatly impacted on the infectious outcomes in this study. Chronic osteomyelitis was found in only those patients whose wounds were subjected to the management strategy that included the closure of the wounds. Early closure in contaminated open fractures may thus predispose to the persistence of an infection in an injured area due to reduced draining. Conversely, delayed closure in contaminated fractures reduces infections in injured bones.^{17,18}

The study was conducted in a single center and utilized non-probability sampling, which can be a limitation to generalizability. And also the sample size was a limitation in performing subgroup analyses and the long-term functional status was not evaluated.

CONCLUSION

Chronic osteomyelitis remains a significant complication of open tibial fractures treated with external fixation. Smoking, high Gustilo Anderson grade, proximal fracture location and primary wound closure were the strongest predictors of infection. Careful selection of patients, avoidance of premature

wound closure and a targeted risk reduction strategy, in particular smoking cessation, is crucial for minimizing long-term infectious morbidity.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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1	Umair Siddique: Conceptualization, study design, drafting.
2	Syed Muhammad Khalid Karim: Literature review, data collection.
3	Adeel Ahmed Siddiqui: Data analysis.
4	Yasir Ali: Critical revisions.
5	Basit Ali: Supervision of research.
6	Ayaz Ali Morio: Proof reading.