e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com

International Journal of Pharmaceutical Quality Assurance 2026; 17(2); 84-87

Original Research Article

Predictors of Early Complications Following Operative Management of Musculoskeletal Trauma: A Prospective One-Year Study at a Tertiary Care Center in West Bengal

Pervez Alam[1], Navin Yadav[2]

[1]Consultant Orthopedic Surgeon, Department of Orthopaedics, Durgapur Steel Plant Main Hospital, Durgapur, West Bengal, India

[2]Assistant Professor, Department of Orthopaedics, IQ City Medical College & Hospital, Durgapur, West Bengal, India

Received: 25-11-2025 / Revised: 23-12-2025 / Accepted: 26-01-2026

Corresponding Author: Dr. Pervez Alam

Conflict of interest: Nil

Abstract:

Background: Musculoskeletal trauma, largely driven by road traffic accidents in India, frequently requires operative fixation, but early postoperative complications such as surgical site infection, wound dehiscence, and thromboembolism remain common, contributing to morbidity and extended hospital stays. Identifying predictors in resource-limited tertiary settings is essential to guide preventive strategies and improve patient outcomes in high-burden regions like West Bengal.

Material and Methods: Our prospective observational study was conducted over a year at a tertiary care center. Consecutive adult patients (≥18 years) with acute fractures or dislocations undergoing operative management were enrolled (n=312) after ethical approval and informed consent. Data included demographics, injury mechanism, fracture type (open/closed, AO/OTA), comorbidities (diabetes, smoking), time from injury to surgery, operative duration, and complications within 30 days (using CDC criteria for SSI and clinical/radiological assessment for others). Follow-up occurred at 2, 6, and 12 weeks. Univariate analysis (χ^2, t-test) and multivariate logistic regression identified independent predictors ($p<0.05$).

Result: Mean age was 38.5±12.3 years; 78% male. Road traffic accidents caused 62% of cases; open fractures comprised 28%. Early complications occurred in 17.3% (54/312), primarily SSI (9.6%), wound dehiscence (3.8%), and DVT (2.2%). Multivariate analysis revealed open fracture (aOR 3.8, 95% CI 1.9–7.6, $p<0.001$), diabetes (aOR 2.7, 95% CI 1.3–5.6, $p=0.01$), delay >24 hours to surgery (aOR 2.4, 95% CI 1.2–4.8, $p=0.02$), smoking (aOR 1.9, 95% CI 1.1–3.3, $p=0.04$), and operative time >90 minutes (aOR 1.02 per minute, 95% CI 1.01–1.03, $p=0.03$) as independent predictors.

Conclusion: In this high-volume Indian tertiary setting, open fractures, diabetes, surgical delay, smoking, and prolonged operative time strongly predict early complications. Implementing early surgery protocols, glycemic control, smoking cessation advice, and operative efficiency could substantially lower rates and enhance recovery.

Keywords: Musculoskeletal trauma, early complications, predictors, open fractures, surgical site infection, tertiary care.

DOI: 10.25258/ijpqa.17.2.15

Introduction

Musculoskeletal trauma represents a major public health challenge in India, with road traffic accidents accounting for the majority of cases and leading to significant disability and economic burden. Operative management through internal fixation has become the standard approach for unstable fractures, offering better alignment and early mobilization compared to conservative methods.

However, early postoperative complications—such as surgical site infections, wound healing problems, deep vein thrombosis, and implant-related issues—occur in 10–30% of cases globally and often more frequently in low- and middle-income settings due to delayed presentation, resource constraints, and high contamination risks in open injuries. [1,2] Studies from various regions highlight that patient factors (e.g., diabetes, smoking), injury characteristics (e.g., open fractures), and treatment variables (e.g., surgical delay, operative time) influence complication rates.

In India, rising vehicular traffic in urbanizing areas like West Bengal exacerbates the trauma load at tertiary centers, where high patient volumes and variable pre-hospital care increase vulnerability to adverse events. [3,4] Despite advances in trauma care, limited local data exist on predictors specific to early complications following operative fixation in this demographic and setting. Previous research has focused mainly on specific fractures (e.g., tibial plateau, hip) or infections alone, leaving a gap in comprehensive analysis for varied musculoskeletal trauma. [5]

Our study addresses that gap by prospectively evaluating predictors of early (≤30 days) complications in a consecutive cohort at a busy tertiary center in West Bengal, aiming to provide evidence for targeted interventions to reduce morbidity in similar high-burden environments.

Materials and Methods

Our study was undertaken at a tertiary care center in West Bengal with a high volume of trauma cases. The study period was of 1 year. Institutional Ethics Committee approval was obtained, and written informed consent was secured from all participants or their legally authorized representatives.

Adult patients (≥18 years) presenting with acute musculoskeletal trauma (fractures or dislocations) requiring operative intervention were consecutively enrolled. Detailed history, clinical examination, and imaging guided management per standard protocols, including early antibiotics and debridement for open fractures.

Inclusion criteria encompassed skeletally mature patients with traumatic fractures/dislocations undergoing primary operative fixation. Exclusion criteria included pathological fractures, non-traumatic etiologies, and polytrauma with overriding life-threatening injuries delaying orthopedic intervention, prior surgery at the site, or incomplete follow-up data.

Data were collected via a structured proforma covering demographics, injury mechanism (RTA, fall, etc.), fracture classification (AO/OTA, Gustilo-Anderson for open), comorbidities (diabetes, smoking status), time from injury to surgery, operative details (duration, blood loss), and 30-day complications (SSI per CDC definitions, wound dehiscence, DVT confirmed by Doppler, implant issues, etc.). Follow-up assessments occurred at outpatient visits (2, 6, 12 weeks) with clinical and radiological evaluation.

Statistical analysis used SPSS version 26. Descriptive statistics included means±SD for continuous variables and frequencies/percentages for categorical. Univariate comparisons employed independent t-test or χ^2/Fisher exact test. Multivariate binary logistic regression identified independent predictors of complications, entering variables with $p<0.10$ on univariate analysis. Significance was set at $p<0.05$; model fit assessed via Nagelkerke R^2 and Hosmer-Lemeshow test.

Results

A total of 312 patients were included, with mean age 38.5±12.3 years; 243 (78%) male and 69 (22%) female. Road traffic accidents caused 193 (62%) injuries, falls 72 (23%), and others 47 (15%). Lower limb fractures predominated (68%), followed by upper limb (22%) and pelvis/spine (10%).

Open fractures occurred in 87 (28%) cases, with 45 Grade I/II and 42 Grade III per Gustilo-Anderson. Comorbidities included diabetes in 58 (19%) and current smoking in 92 (29%). Median time from injury to surgery was 28 hours (IQR 12–48); 42% had delay >24 hours. Mean operative time was 85±32 minutes.

Early complications developed in 54 patients (17.3%). Surgical site infection was most frequent (30 cases, 9.6%; 18 superficial, 12 deep), followed by wound dehiscence (12, 3.8%), DVT (7, 2.2%), early implant failure (3, 1.0%), and miscellaneous (2, 0.6%). No complication-related mortality occurred during the 30-day period.

Univariate analysis showed significantly higher complication rates with open fractures (32% vs 12%, $p<0.001$), diabetes (31% vs 14%, $p=0.003$), smoking (25% vs 14%, $p=0.02$), delay >24 hours (24% vs 11%, $p=0.005$), and operative time >90 minutes (22% vs 10%, $p=0.01$). Age, gender, and other comorbidities did not differ significantly.

Multivariate logistic regression confirmed independent predictors: open fracture (aOR 3.8, 95% CI 1.9–7.6, $p<0.001$), diabetes (aOR 2.7, 95% CI 1.3–5.6, $p=0.01$), delay >24 hours (aOR 2.4, 95% CI 1.2–4.8, $p=0.02$), smoking (aOR 1.9, 95% CI 1.1–3.3, $p=0.04$), and operative time per minute (aOR 1.02, 95% CI 1.01–1.03, $p=0.03$). The model explained 28% variance (Nagelkerke $R^2=0.28$) and correctly classified 84% of cases.

Table 1: Baseline Characteristics by Complication Status

Variable	Total (n=312)	Complication (n=54)	No Complication (n=258)	p-value*
Age (years), mean ± SD	38.5 ± 12.3	41.2 ± 13.1	37.9 ± 12.0	0.09
Male sex, n (%)	243 (78)	44 (81)	199 (77)	0.52
Open fracture, n (%)	87 (28)	32 (59)	55 (21)	<0.001
Diabetes mellitus, n (%)	58 (19)	19 (35)	39 (16)	0.003
Current smoking, n (%)	92 (29)	25 (46)	67 (25)	0.02
Time to surgery >24 hours, n (%)	131 (42)	35 (65)	96 (37)	0.005
Operative time >90 minutes, n (%)	119 (38)	30 (56)	89 (34)	0.01

Table 2: Distribution of Early Complications

Complication Type	n (%)
Surgical site infection	30 (9.6)
Wound dehiscence	12 (3.8)
Deep vein thrombosis	7 (2.2)
Early implant failure	3 (1.0)
Others	2 (0.6)
Total	54 (17.3)

Table 3: Independent Predictors – Multivariate Logistic Regression

Predictor	Adjusted OR (95% CI)	p-value
Open fracture	3.8 (1.9–7.6)	<0.001
Diabetes	2.7 (1.3–5.6)	0.01
Delay >24 h	2.4 (1.2–4.8)	0.02
Current smoking	1.9 (1.1–3.3)	0.04
Operative time (per min)	1.02 (1.01–1.03)	0.03

Table 4: Complication Rates by Key Predictors

Predictor	Complication Rate (%)	p-value (Univariate)
Open vs Closed fracture	32 vs 12	<0.001
Diabetic vs Non-diabetic	31 vs 14	0.003
Delay >24 h vs ≤24 h	24 vs 11	0.005
Smoker vs Non-smoker	25 vs 14	0.02

Discussion

Early complications following operative management of musculoskeletal trauma remain a persistent concern in high-volume trauma centers, particularly in low- and middle-income countries where delayed presentation and resource limitations compound risks. In the present study, an overall early complication rate of 17.3% was observed, aligning with ranges reported in similar settings (11–30%) and reflecting the impact of trauma severity and systemic factors. Surgical site infection emerged as the leading issue (9.6%), consistent with patterns in open and contaminated injuries. [6] Open fractures stood out as the strongest independent predictor (aOR 3.8), a finding echoed in multiple international and Indian studies. Globally, Weinlein et al. (2018) reported open fractures significantly associated with complications in tibial plateau cases, while in Nigeria, Ojo et al. (2024) noted 2.6–3.9 times higher odds for open injuries after intramedullary nailing. Locally, similar patterns appear in Indian trauma cohorts where contamination drives infection rates higher than in closed fractures. This underscores the need for aggressive early debridement and antibiotics in our setting. [7,8] Diabetes mellitus independently increased risk (aOR 2.7), impairing wound healing and immunity. International literature, including Patel et al. (2021) on multiligament knee injuries and multiple meta-analyses, consistently links diabetes to elevated SSI odds (often 2–4 fold). In Indian studies on hip and lower limb trauma, diabetes frequently correlates with poor outcomes, emphasizing preoperative glycemic optimization as a modifiable target in our diabetic-heavy cohort (19%). [9,10] Surgical delay beyond 24 hours doubled complication risk (aOR 2.4), supporting the “early total care” philosophy where feasible. Global evidence from polytrauma and femoral fracture series shows delays >24–48 hours associate with higher infection and systemic issues due to prolonged inflammation. In resource-constrained Indian tertiary centers, logistical delays remain common, yet our data reinforce prioritizing orthopedic intervention within the first day when physiologically stable. [11] Current smoking elevated odds (aOR 1.9), consistent with impaired

vascularity and healing. Meta-analyses confirm smoking as a robust SSI risk factor (OR 2–3) across orthopedic trauma, including ankle and calcaneal fractures. In India, where tobacco use prevails among young trauma victims, preoperative counseling and cessation support could mitigate this avoidable contributor. [12]

Prolonged operative time emerged as a continuous risk (aOR 1.02 per minute), likely proxying complexity or technical challenges. Studies on tibial plateau and calcaneal fractures report similar associations, with each extra hour increasing infection odds by 50–78%. In high-volume centers like ours, streamlining operative workflows and team coordination may reduce this factor. [13,14] Overall, these predictors highlight interplay between injury severity, patient comorbidities, and treatment logistics—modifiable elements amenable to protocolized care in West Bengal's trauma system. Limitations include the single-center design, potentially limiting generalizability, and 30-day focus, which misses late complications like nonunion. Small subgroup sizes for rare events and reliance on clinical follow-up may introduce detection bias. Multicenter studies with longer follow-up would strengthen these observations.

Conclusion

Our study found early complications after musculoskeletal trauma surgery in about one in six patients, mainly infections and wound problems. Open fractures, diabetes, surgical delay beyond 24 hours, smoking, and longer operative time were key predictors. Emphasizing timely fixation, glycemic control, cessation counseling, and multidisciplinary protocols may reduce morbidity; multicenter validation across India is needed.

Bibliography

1. Ojo SA, Nottidge TE, Eyo CS, et al. Predictors of complications after intramedullary nailing for lower extremity fractures in low-resource settings: a 10-year experience with the SIGN nail in Nigeria. Patient Saf Surg. 2025; 19:12.
2. Ruffolo MR, Gettys FK, Montijo HE, Seymour RB, Karunakar MA. Complications and unplanned outcomes following operative treatment of tibial plateau fractures. Injury. 2018;49(8):1464-70.
3. Patel NK, Lee JH, Kim SH, et al. Risk Factors Associated with Complications After Operative Treatment of Multiligament Knee Injury. Orthop J Sports Med. 2021;9(3):2325967121994203.
4. Khera S, Goyal A, Singh S, et al. Prevalence of surgical wound infection and related factors in patients after long bone surgery: A systematic review and meta-analysis. Int Wound J. 2023;20(10):4125-38.
5. Singh S, Kumar A, Kumar S. Surgical site infections in orthopaedic surgeries: incidence and risk factors at tertiary care hospital of South India. Int J Res Orthop. 2023;9(4):789-94.
6. Natoli RM, Sancheti P, Rocha S, Puram C, et al. Infection and Nonunion Rates in Open Fractures: Description of 6,042 Fractures from the FLOW and PREP-IT Trials. J Bone Joint Surg Am. 2025;107(22):e92.
7. Bai J, Zhang Y, Wang C, et al. Using multiple indicators to predict the risk of surgical site infection after ORIF of tibia fractures: a machine learning based study. Front Cell Infect Microbiol. 2023; 13:1206393.
8. Young S, Banza L, Mkandawire N. Complications after intramedullary nailing of femoral fractures in a low-income country. Acta Orthop. 2013;84(5):460-7.
9. Wukich DK, Crim BE, Frykberg RG, et al. Diabetes and its negative impact on outcomes in orthopaedic surgery. World J Orthop. 2015;6(3):331-9.
10. Li J, Zhu Y, Liu B, et al. Incidence and risk factors for surgical site infection following open reduction and internal fixation of adult tibial plateau fractures. J Orthop Surg Res. 2020;15(1):449.
11. Nasell H, Adami J, Samnegard E, et al. Smoking increases postoperative complications after distal radius fracture fixation: a review of 417 patients from a level 1 trauma center. Hand (N Y). 2020;15(5):689-96.
12. Pape HC, Pfeifer R, et al. Current Concepts in Orthopedic Management of Multiple Trauma. Open Orthop J. 2015;9(Suppl 1):275-86.
13. Ma Q, Aierxiding A, Wang G, et al. Incidence and risk factors for deep surgical site infection after open reduction and internal fixation of closed tibial plateau fractures in adults. Int Orthop. 2021;45(6):1601-7.
14. Sancheti P, et al. Incidence and risk factors associated with surgical site infection in acetabular fracture patients: An experience from north India. J Clin Orthop Trauma. 2024; 52:102456.