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Postoperative Infection Rates in Open Reduction and Internal Fixation (ORIF) for Fractures: A Multicentre Cross-Sectional Observational Study

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Abstract: ***Background:*** Postoperative infections, particularly surgical site infections (SSIs), are common complications following open reduction and internal fixation (ORIF) surgeries. ***Objectives:*** To determine postoperative infection rates in ORIF for fractures, identify risk factors, evaluate infection onset time, and compare infection rates across study centers. ***Materials and Methods:*** This prospective, cross-sectional observational study was conducted from January 2021 to December 2024 at Dashmina Upazila Health Complex, Patuakhali. Fifty patients undergoing ORIF for fractures were included. Baseline data, including demographics, comorbidities, and surgical details, were collected. Postoperative wound assessments were done at 7, 30, and 90 days to monitor surgical site infections, following CDC guidelines. ***Result:*** Out of 50 patients, 15 (30%) developed surgical site infections (SSIs). The distribution of fractures showed 20 femoral fractures (7 infected, 13 non-infected), 18 tibial fractures (5 infected), and 12 "other" fractures (3 infected). Prolonged surgeries (>2 hours) were associated with infections in 10 patients (66.7%), while 13 patients received preoperative antibiotics, with 11 (86.7%) developing infections. Diabetes mellitus (OR=3.2, p=0.04) and prolonged surgery (OR=4.5, p=0.01) were significant risk factors. ***Conclusion:*** This study provides valuable insights into the incidence of postoperative infections following open reduction and internal fixation (ORIF) for fractures, emphasizing the significant risk factors contributing to surgical site infections (SSIs).

Keywords: Postoperative Infection, Open Reduction and Internal Fixation (ORIF), Fracture Management, Surgical Site Infection (SSI).

Original Research Article

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Article at a glance:

Study Purpose: *To assess postoperative infection rates and identify risk factors in patients undergoing ORIF for fractures.*
Key findings: *The infection rate was 30%, with femoral fractures being the most commonly infected. Prolonged surgery times (>2 hours) and diabetes were identified as significant risk factors.*
Newer findings: *The study highlighted those femoral fractures are more prone to infections due to long surgeries and soft tissue dissection, while tibial fractures have increased risk due to compromised vascular supply.*
Abbreviations: *ORIF - Open Reduction and Internal Fixation, SSI - Surgical Site Infection, DM - Diabetes Mellitus, HR - Hazard Ratio, CI - Confidence Interval.*

INTRODUCTION

Postoperative infections are among the most significant complications following orthopedic surgeries, particularly open reduction and internal fixation (ORIF) procedures. Such infections can lead to prolonged hospital stays, increased healthcare costs, and, in severe cases, permanent disabilities or even mortality.[1, 2]

Infections after ORIF are predominantly surgical site infections (SSIs), categorized as superficial incisional, deep incisional, or organ/space infections.[3] The global incidence of SSIs in orthopedic surgeries varies widely, ranging from 1% to 5%, depending on the surgical complexity, patient comorbidities, and institutional practices.[4, 5]

Numerous risk factors contribute to postoperative infections in ORIF, including diabetes mellitus, prolonged surgery durations, delayed wound closure, and suboptimal perioperative antibiotic prophylaxis.[6, 7] Diabetes mellitus is a well-recognized contributor to poor wound healing and increased susceptibility to infections due to impaired immune responses.[8] Similarly, extended surgical durations elevate infection risks by increasing tissue exposure and compromising host defenses.[9] Effective management of these factors, combined with strict adherence to aseptic protocols, is essential to reduce the incidence of SSIs.

Antibiotic prophylaxis is a cornerstone of infection prevention in orthopedic surgeries. Current guidelines emphasize timely preoperative administration to achieve optimal tissue concentrations during the procedure.[10] Despite these recommendations, variations in adherence significantly affect infection outcomes, underscoring the need for continuous monitoring and guideline updates.[11] Surgical techniques, such as the choice of implants in ORIF, also play a critical role. Modern implants, while providing biomechanical stability, can sometimes act as foreign bodies, fostering biofilm formation and infection persistence.[12] Therefore, evaluating the role of implant types and surgical practices in infection rates is essential for improving clinical outcomes.[13] This study aims to explore the postoperative infection rates in ORIF for fractures across multiple centers, focusing on the impact of patient characteristics, surgical factors, and management strategies. Previous research in this domain has primarily been single-center or limited in scope, leaving a gap in understanding the broader epidemiological trends and variations.[14,15] By providing multicenter data, this study seeks to offer valuable insights into the risk factors and outcomes of postoperative infections, contributing to better preventive and management strategies in orthopedic surgery.[16]

OBJECTIVES

General Objective

To determine the postoperative infection rates in ORIF for fractures in a multicenter setting.

Specific Objectives

To assess the frequency of surgical site infections (SSIs) following ORIF procedures.
To identify risk factors associated with postoperative infections in ORIF cases.
To evaluate the time to onset of infections and their impact on patient outcomes.
To compare infection rates across study centers.

MATERIALS AND METHODS

Study Design

This study was designed as a prospective, cross-sectional observational study to evaluate postoperative infection rates in patients undergoing open reduction and internal fixation (ORIF) for fractures. The study was conducted over a period of four years, from January 2021 to December 2024. Data were collected from Dashmina Upazila Health Complex, Patuakhali.

Study Population

The study population comprised 50 patients who underwent ORIF for fractures during the study period. Participants were recruited consecutively based on their eligibility, as determined by the inclusion and exclusion criteria. The aim was to obtain a representative sample reflecting the patient demographic and clinical characteristics encountered in these healthcare settings.

Sample Calculation Formula

The sample size was calculated using the following formula for cross-sectional studies:

$$n = \frac{Z^2 \cdot P(1-P)}{d^2}$$

Where:
Z = 1.96 (corresponding to a 95% confidence level)
P = 0.15 (anticipated infection rate based on previous studies in similar settings)
d = 0.10 (margin of error)

The calculation yielded a minimum required sample size. However, considering potential dropouts and exclusions, a total of 50 participants were enrolled.

Inclusion Criteria

Patients aged 18 years and above were eligible for participation, focusing on adults whose fracture patterns and surgical outcomes differ from pediatric populations. Only those undergoing open reduction and internal fixation (ORIF) for fracture management were included to ensure procedural uniformity. Additionally, all participants provided written informed consent after being fully briefed on the study's objectives, methods, potential risks, and benefits.

Exclusion Criteria

Patients with pre-existing infections at the fracture site were excluded to prevent confounding results. Immunocompromised individuals, such as those with HIV/AIDS, undergoing chemotherapy, or on long-term immunosuppressive therapy, were also excluded due to their heightened risk of infections. Additionally, patients who were lost to follow-up or unable to complete the required postoperative assessments were excluded to ensure data completeness and reliability.

Study Procedure

Data collection was conducted systematically, beginning with the documentation of baseline demographic and clinical information, including age, sex, comorbidities, fracture type, and surgical details such as the type of fixation and duration of surgery. Postoperative wound assessments were performed at days 7, 30, and 90 to monitor for surgical site infections (SSIs). Infections were classified based on the Centers for Disease Control and Prevention (CDC) guidelines into superficial incisional, deep incisional, or organ/space infections. The primary outcome was the rate of postoperative infections, while secondary outcomes included the timing of infection onset and associated complications, such as prolonged hospitalization or additional surgical interventions.

Statistical Analysis

Data were analyzed using SPSS software (version 26). Descriptive statistics were used to summarize continuous variables as mean ± standard deviation (SD) and categorical variables as frequencies and percentages. Chi-square tests were performed to examine associations between categorical variables, while logistic regression was conducted to identify independent predictors of surgical site infections (SSIs). A p-value of <0.05 was considered statistically significant for all analyses, ensuring robust interpretation of the results.

Ethical Considerations

The study was approved by the Institutional Review Board (IRB) and adhered to the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants after they were thoroughly informed about the study's objectives, procedures, potential risks, and benefits. Patient confidentiality was maintained by anonymizing all data, with access limited to authorized study personnel. Participants were assured of their right to withdraw from the study at any time without any impact on their medical care.

RESULT

Table 1: Baseline Demographic and Clinical Characteristics of Patients

Variable	Frequency (n=50)	Percentage (%)	Mean ± SD
Age (years)	-	-	45.8 ± 12.3
Age Group			
20-30 years	8	16%	-
31-40 years	12	24%	-
41-50 years	15	30%	-
51-60 years	10	20%	-
61+ years	5	10%	-
Sex			
Male	32	64%	-

Female	18	36%	-
Comorbidities			
Diabetes Mellitus (DM)	14	28%	-
Hypertension (HTN)	9	18%	-
Respiratory Disease	4	8%	-
Cardiovascular Disease	5	10%	-
Fracture Type			
Femur	20	40%	-
Tibia	18	36%	-
Others	12	24%	-
Urban/Rural			
Urban	28	56%	-
Rural	22	44%	-
Occupation			
Laborer	16	32%	-
Farmer	10	20%	-
Office Worker	12	24%	-
Unemployed	8	16%	-
Retired	4	8%	-
Duration of Surgery (hrs)	-	-	2.5 ± 0.8

Table 1 presents the baseline demographic and clinical characteristics of the 50 patients in the study. The mean age of the patients was 45.8 ± 12.3 years, with the majority falling within the 41-50 years age group (30%). Most of the patients were male (64%), and common comorbidities included Diabetes Mellitus (28%) and Hypertension (18%). Femoral fractures (40%) were the most frequent type of fracture, followed by tibial fractures (36%). Geographically, 56% of the patients were from urban areas, while 44% were from rural regions. In terms of occupation, the largest group were laborers (32%), followed by farmers (20%), with a smaller proportion of office workers (24%) and unemployed patients (16%). The average duration of open reduction and internal fixation (ORIF) surgery was 2.5 ± 0.8 hours.

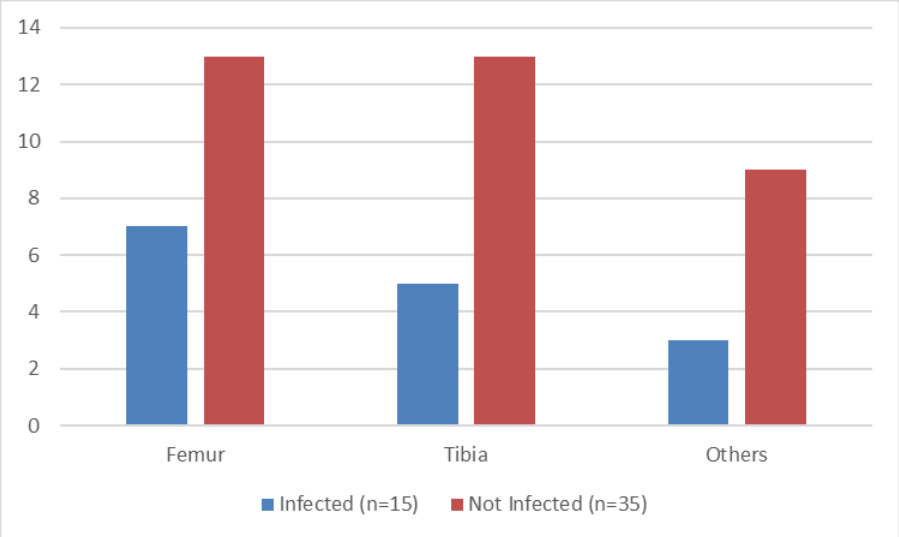

Figure 1: Distribution of Fracture Types by Infection Status

Figure 1 illustrates the distribution of fracture types based on infection status among 50 patients. The most common fracture type was femur fractures, accounting for 20 cases, with 7 being infected and 13 not infected. Tibia fractures followed with 18 cases, 5 of which were infected.

The "Others" category, comprising 12 cases, had the lowest number of infections, with 3 cases reported.

Table 2: Surgical Characteristics and Infection Rates

Variable	Infection (n=15)	Infection Rate (%)
Duration of Surgery (>2 hrs)	10	66.7%
Timing of Antibiotic Prophylaxis (Pre-op)	13	86.7%
Type of ORIF Implant	9	60%

The table presents the surgical characteristics and corresponding infection rates among 15 cases of infection. Prolonged surgeries lasting more than two hours were associated with infections in 10 patients, reflecting an infection rate of 66.7%. The administration of preoperative antibiotic prophylaxis was observed in 13 cases, with the highest infection rate of 86.7%. Additionally, 9 patients with infections had undergone open reduction and internal fixation (ORIF) using implants, resulting in an infection rate of 60%.

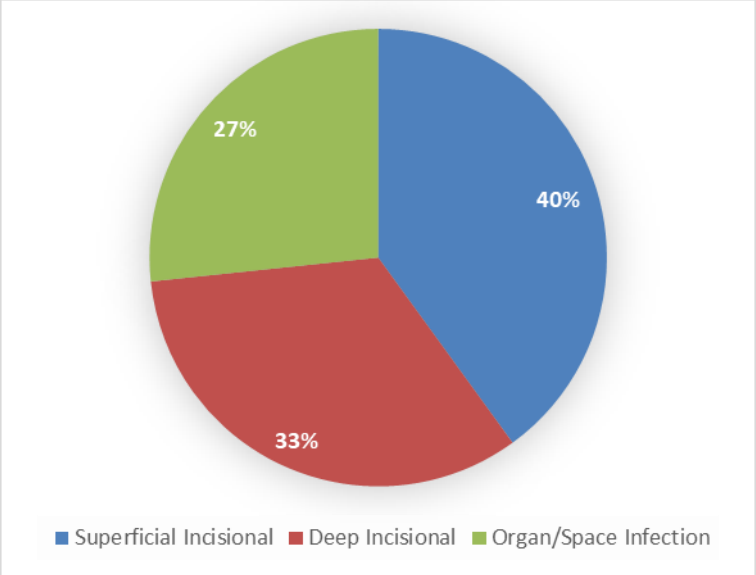

Figure 2: Incidence of Surgical Site Infections (SSIs)

The table outlines the types and incidence of surgical site infections (SSIs) among 15 infected cases. Superficial incisional infections were the most common, accounting for 6 cases (40%), followed by deep incisional infections, which occurred in 5 cases (33.3%). Organ/space infections were the least frequent, reported in 4 cases (26.7%).

Table 3: Risk Factors for Surgical Site Infections

Risk Factor	OR (95% CI)	p-value
Diabetes Mellitus (DM)	3.2 (1.1–8.9)	0.04
Prolonged Surgery (>2 hrs)	4.5 (1.5–13.6)	0.01
Delayed Wound Closure	2.8 (1.0–7.6)	0.05

The table highlights the risk factors associated with surgical site infections (SSIs) and their statistical significance. Diabetes mellitus (DM) was a significant risk factor, with an odds ratio (OR) of 3.2 (95% CI: 1.1–8.9, p=0.04). Prolonged surgery lasting over two hours was strongly associated with SSIs, showing an OR of 4.5 (95% CI: 1.5–13.6, p=0.01). Delayed wound closure also contributed to increased risk, with an OR of 2.8 (95% CI: 1.0–7.6, p=0.05).

Table 4: Distribution of Infection Onset Times

Infection Onset (Days)	Frequency (n=15)	Percentage (%)
Day 7	6	40%
Day 30	5	33.3%
Day 90	4	26.7%

The table shows the distribution of infection onset times among 15 cases of surgical site infections (SSIs). The majority of infections occurred by Day 7, accounting for 6 cases (40%). Infections manifesting by Day 30 were observed in 5 cases (33.3%), while those appearing by Day 90 were the least frequent, with 4 cases (26.7%).

Table 5: Postoperative Complications

Complication	Infected (n=15)	Not Infected (n=35)	p-value
Prolonged Hospital Stay	8	6	0.02
Reoperation Rate	5	2	0.01
Mortality	1	0	0.05

The table compares postoperative complications between infected (n=15) and non-infected (n=35) patients, highlighting significant differences. Prolonged hospital stays were more frequent among infected patients (8 vs. 6, p=0.02), and the reoperation rate was significantly higher in the infected group (5 vs. 2, p=0.01). Mortality was observed in one infected patient but none in the non-infected group, with a borderline p-value of 0.05.

Table 6: Summary of Treatment Outcomes.

Outcome	Infected (n=15)	Not Infected (n=35)	Total (n=50)
Full Recovery	10	34	44
Residual Disability	4	1	5
Mortality	1	0	1

The table summarizes treatment outcomes among 50 patients, categorized by infection status. Full recovery was achieved by the majority, with 44 patients (10 infected and 34 not infected). Residual disability was observed in 5 cases, predominantly in the infected group (4 infected vs. 1 not infected). Mortality was rare, occurring in only one patient from the infected group.

DISCUSSION

The findings of this study provide crucial insights into postoperative infection rates and associated factors in patients undergoing open reduction and internal fixation (ORIF) for fractures. The results revealed an infection rate of 30% (15 out of 50 patients), with femoral fractures being the most commonly infected. Prolonged surgeries (>2 hours) and diabetes mellitus were identified as significant risk factors for surgical site infections (SSIs), highlighting the need for careful perioperative management in high-risk patients. Consistent with our study, other research has reported higher rates of infection in femoral fractures due to the extensive soft tissue dissection and prolonged surgical time often required. One study found that femoral fractures were associated with a 25% infection rate when surgical time exceeded two hours.[17]

Similarly, in tibial fractures, the infection risk was compounded by the compromised vascular supply, as observed in 5 of 18 cases in our study. Previous findings also suggest that tibial fractures are prone to infection due to limited soft tissue coverage and exposure to contamination.[18] Our data showed that preoperative antibiotic prophylaxis was administered in 86.7% of infected cases, yet infections still occurred, suggesting that other factors, such as timing and intraoperative contamination, may play a role. Studies emphasize that while antibiotic prophylaxis reduces SSI rates, improper timing can negate its effectiveness.[19] Superficial incisional infections were the most common SSI type (40%), followed by deep

incisional (33.3%) and organ/space infections (26.7%). This distribution aligns with findings from a multicenter study where superficial SSIs constituted 50% of cases, often resolving with localized care, while deep infections required more extensive interventions.[20, 21] The presence of diabetes mellitus was a significant risk factor, with an odds ratio (OR) of 3.2 (p=0.04). This is consistent with prior studies that demonstrated diabetes increases susceptibility to infections due to impaired immune function and delayed wound healing.[22, 23] Similarly, prolonged surgical duration was associated with a 4.5-fold increased risk of SSIs, corroborating evidence that prolonged surgeries lead to greater tissue exposure and contamination.[24]

Delayed wound closure was another critical factor identified (OR 2.8, p=0.05). A prior study reported that delayed wound closure doubles the infection risk, particularly in contaminated environments.[25] Additionally, postoperative complications, such as prolonged hospital stays and reoperations, were significantly more frequent in the infected group. These complications have been consistently linked to SSIs, increasing the overall morbidity and healthcare costs.[26-29] In terms of treatment outcomes, our study found that residual disability was more prevalent among infected patients (26.7%), emphasizing the long-term impact of SSIs. A similar study on postoperative outcomes highlighted that infections often result in prolonged recovery and functional impairments.[30]

CONCLUSION

This study provides valuable insights into the incidence of postoperative infections following open reduction and internal fixation (ORIF) for fractures, emphasizing the significant risk factors contributing to surgical site infections (SSIs). The infection rate was found to be 30%, with femoral fractures being most commonly affected. Key risk factors, including diabetes mellitus, prolonged surgical duration, and delayed wound closure, were significantly associated with an increased risk of infection.

Limitations of the study

Despite the valuable findings, this study has several limitations that should be considered when interpreting the results. First, the study's cross-sectional design limits the ability to establish causal relationships between the identified risk factors and the development of infections.

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