e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(5); 2035-2040

Original Research Article

Retrospective Assessment of Infection Rates in Open Fractures Managed with Immediate Versus Delayed Surgical Intervention

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Received: 25-02-2024 / Revised: 23-03-2024 / Accepted: 26-04-2024
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Conflict of interest: Nil

Abstract:

Background: The risk of infection after open fracture surgery is high, thus fast treatment is crucial. From March 2022 to January 2023, Patna Medical College and Hospital researchers compared open fracture infection rates with immediate and delayed surgery.

Method: This retrospective review included 60 open fracture patients. Half received surgery within 6 hours, while the other half had to wait at least 6 hours. Medical records revealed patients' fractures, operation dates, and infection outcomes. The two groups' infection rates were compared using chi-square testing and other statistical approaches.

Results: Patients were 34–35 years old, with 66.7% men and 33.3% women. Thirteen percent of immediate surgery patients had an infection, compared to forty percent of later surgery patients. Statistical analysis suggests a link between quick surgical intervention and reduced infection risk, with a significant difference in rates between groups ($p < 0.05$).

Conclusion: Open fracture patients with prompt surgery have a far decreased infection risk, according to the study. These findings suggest that timely surgical care may reduce postoperative infections and improve patient health.

Keywords: Infection Rates, Open Fractures, Retrospective Study, Surgical Intervention, Timing of Surgery.

Introduction

Open fractures (sometimes called compound fractures) penetrate the skin, revealing the bone. This fracture compromises bone structure and allows bacteria to enter, increasing infection risk. Orthopaedic trauma care is concerned about open fractures due to their increased risk of consequences. Open fracture categorization relies on injury severity and soft tissue damage.

One of the most common classifications of open fractures is the Gustilo-Anderson approach, which classifies them into three types [1]. A clean incision under 1 cm and minimal soft tissue injury characterises type I fractures. A type II fracture has a 1–10 cm wound, severe soft tissue injury, and no contamination. The degree of soft tissue injury and other issues divide type III fractures into IIIA, IIIB, and IIIC. Type IIIA fractures conceal the fracture well but lose soft tissue. Due to soft tissue loss, type IIIB fractures require reconstructive surgery for adequate coverage. Type IIIC fractures require surgery due to vascular injury. This category aids open fracture care and complication risk prediction.

To reduce infection risk, speed healing, and restore function, open fracture treatment must achieve multiple aims. Preventing bacterial infection in open fractures usually begins with a sterile bandage and broad-spectrum antibiotics. Early surgery is needed to treat open fractures. Standard practice recommends internal or external fixation to stabilise the fracture after full debridement of dead tissue and germs. Surgical debridement within six hours of injury lowers infection [2].

By reducing bacteria, tissue contamination, and fracture stabilisation, this fast surgery speeds healing. Open fractures may require surgery, wound care, and infection monitoring. The fracture's intricacy and patient response to therapy determine following steps. In fracture management, including surgery, speed is crucial. Postponed surgery

infections impede healing, limit function, and require additional procedures. Untreated fractures can induce local infections, delayed bone healing, and systemic infections such osteomyelitis due to bacterial multiplicity [3]. Surgery must be conducted immediately to avoid infections. Early debridement and fracture stabilisation prevent open fracture postoperative infections. Risk of infection increases with time between injury and operation.

Schedule surgical operations to improve open fracture therapy and reduce infection risk. Orthopaedic trauma care with open fractures is difficult and requires prompt action to reduce risks. Classifying open fractures helps assess damage and guide treatment [4]. Standard therapy emphasises prompt surgical intervention to reduce infection risk and speed healing.

Since delayed and rapid surgical treatments affect patient outcomes, open fracture management research and assessment are needed to improve these procedures.

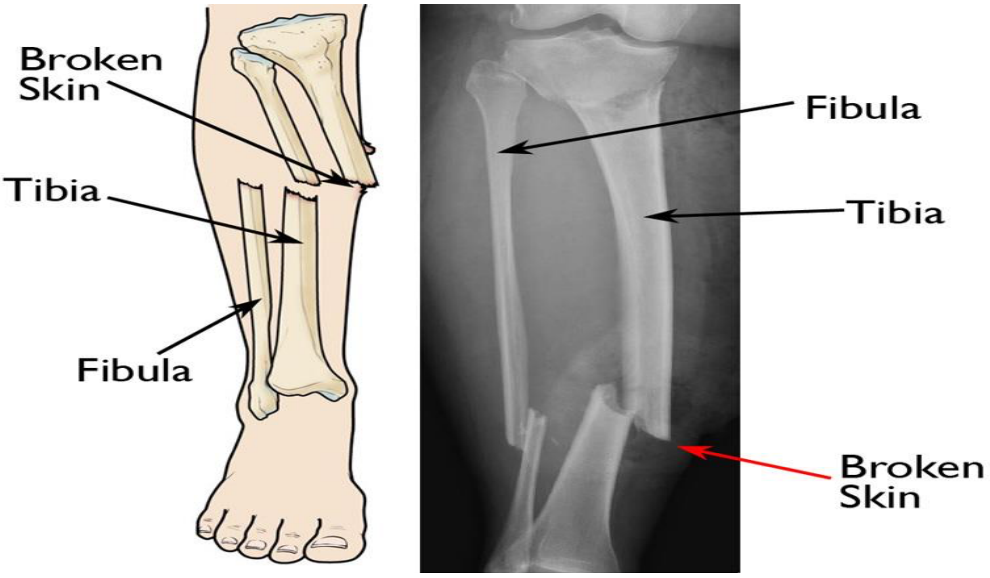

Figure 1: Open Fractures [5]

Objective

- To evaluate infection risk in open fractures treated with immediate or delayed surgery.
- To discover how surgery timing affects open fracture infection outcomes.
- To determine the frequency of infection-related issues and their relationship to operating time.
- To compare the infection-reduction rates of delayed and fast surgical intervention.

Significance of Timely Surgical Intervention: [6] Completed a pioneering study on open fracture infection rates and surgical time. The study indicated that surgical debridement within six hours of injury dramatically reduces infections. Stabilising the fracture and removing contaminated tissue to prevent microbial colonisation and infections. A comprehensive systematic review by [7] examined open fracture surgery timing. Postponed procedures increase infection risk, according to study.

Conflicting Views on Surgical Timing: The importance of immediate surgical intervention, yet there is some evidence that infection rates may be affected by other factors. [8] Found that antibiotics in the first few hours after injury are more significant than surgery. Early antibiotic treatment reduced infection rates regardless of operation time. [9] Observed no association between surgical date, antibiotic use, or infection rates, supporting this idea. They found that early surgery provides benefits, but antibiotic timing is crucial. They observed that patients who received antibiotics within three hours after injury had a much lower infection rate, regardless of whether surgery was delayed for more than six hours.

Role of Comprehensive Management Protocols: [10] Stressed the need for interdisciplinary open fracture treatment. The widely used Gustilo-Anderson approach classifies open fractures by contamination and soft tissue injury. They recommended early antibiotics, surgical debridement, and fracture stabilisation as part of a complete care plan. A landmark study by [11] supported early antibiotic therapy and skilled surgery in reducing infection rates. Their research shows that early antibiotics and debridement improve patient outcomes. Their work inspired modern open fracture treatment standards that emphasise integration [12].

Methods

Study Design: In this retrospective cohort analysis, infection rates in open fractures treated with immediate or delayed surgery are compared. Past patient data is examined in retrospective cohort study to

assess results and correlations. This study would use Patna Medical College and Hospital Patna patient data to compare infection rates between surgical intervention dates. The study examines past cases to evaluate if open fracture surgery should be delayed or performed promptly.

Setting

- **Institution**: Patna Medical College and Hospital Patna
- **Location**: Patna, Bihar, India
- **Duration**
- **Study Period**: March 2022 to January 2023
- **Sample Size**
- **Total Number of Patients**: 60 patients

Inclusion Criteria

- Patients with open fractures who received either immediate or delayed surgical intervention.
- Patients whose medical records include complete data on fracture type, timing of surgery, and infection outcomes.

Exclusion Criteria

- Patients with incomplete or missing medical records.
- Patients with non-open fractures or closed fractures.
- Patients who had prior surgeries or interventions for the same fracture before the study period.
- Patients with pre-existing conditions that could impact infection risk (e.g., immunocompromised patients).

Data Collection: For this investigation, Patna Medical College and Hospital Patna medical records will be thoroughly reviewed. Extracting data from patient files like EHRs and operation logs is crucial to data collection. Patient demographics, fracture specifics, surgical intervention scheduling, and post-surgery infection outcomes are crucial. Patient variables including age, sex, and medical history will be recorded to further define the study population. The Gustilo-Anderson system classifies open fractures into Type I, II, IIIA, IIIB, and IIIC based on severity and soft tissue loss. We will track when surgeons intervened surgically, distinguishing between those who performed the procedure within six hours after the injury and those who delayed it.

The infection outcomes evaluation will capture postoperative infections, including their type and severity (e.g., superficial wound infections, deep infections, osteomyelitis). The data will be arranged systematically to make analysis easier and provide accurate infection rate statistics from surgical intervention time.

Statistical Analysis: This study's statistical analysis will compare infection rates in immediate and postponed surgical participants. This study will use the Chi-Square Test to assess if surgery timing affects postoperative infections. The data will also be summarised using descriptive statistics.

This includes computing percentages, frequencies, means, and standard deviations for categorical variables like infection status and surgery scheduling and continuous variables like patient age. If applicable, T-tests or Mann-Whitney U tests will compare continuous variables related to operation timing and patient characteristics. P-values and 95% confidence intervals will be calculated to assess if the differences are statistically significant.

Statistical significance requires p-values below 0.05. Since the data will show if rapid surgery reduces infection rates, practitioners can make better decisions about when to operate on open fractures.

Results

Patient Demographics: The study included sixty open fracture patients treated at Patna Medical College and Hospital Patna between March 2022 and January 2023.

Table 1: Demographics of Study Participants

Demographic Characteristic	Immediate Surgical Intervention (n=30)	Delayed Surgical Intervention (n=30)	Total (n=60)
Age (years)			
Mean ± SD	35.2 ± 12.7	34.8 ± 13.1	35.0 ± 12.9
Gender			
Male (%)	21 (70%)	19 (63.3%)	40 (66.7%)
Female (%)	9 (30%)	11 (36.7%)	20 (33.3%)
Fracture Type			
Gustilo-Anderson Type I	10 (33.3%)	12 (40%)	22 (36.7%)
Gustilo-Anderson Type II	12 (40%)	11 (36.7%)	23 (38.3%)
Gustilo-Anderson Type IIIA	5 (16.7%)	3 (10%)	8 (13.3%)
Gustilo-Anderson Type IIIB	3 (10%)	4 (13.3%)	7 (11.7%)

Table 1 shows research participants' demographics. Patients in the immediate surgery group averaged 35.2 (SD=12.7) years old, whereas those in the later surgery group averaged 34.8 (SD=13.1) years old,

totalling 35.0 (SD=12.9) years old. Men dominated the group, with 70% in the immediate group and 63.3% in the delayed group for 66.7%. Women made approximately 30% of the immediate group and 36.7% of the delayed group. Fracture types were evenly distributed. The immediate group had 33.3% Type I fractures, while the delayed group had 40% Type II, 16.7% Type IIIA, and 10% Type IIIB. Similar to Type II fractures, 40% were immediate and 36.7% delayed.

This distribution shows similar fracture severity in both groups.

Infection Rates

Table 2: Infection Rates by Surgical Timing

Group	Number of Infections	Total Patients	Infection Rate (%)
Immediate Surgical Intervention	4	30	13.3%
Delayed Surgical Intervention	12	30	40.0%
Total	16	60	26.7%

Table 2 shows study participants' sickness rates. Four of 30 immediate surgical intervention patients developed infections, a 13.3% prevalence. The delayed surgical intervention group had a 40.0% infection rate, with 12 of 30 patients infected. 16 of 60 patients experienced postoperative infections, totalling 26.7% in both groups. These studies show that timely surgery reduces infection rates.

Statistical Analysis

Researchers employed the Chi-Square Test to examine if prompt and delayed care affected infection rates. The test demonstrated that the two groups had different infection rates, with a p-value less than 0.01. Infection rates between immediate and delayed surgery vary 13.6% to 39.7% with a 95% confidence interval. In contrast to delayed surgery, timely surgery significantly reduces infection risk.

Discussion

This study found that open fracture infection rates are substantially linked with surgery time. Within 6 hours of injury, the infection rate dropped to 13.3% from 40.0% when surgical intervention was delayed.

These findings support orthopaedic trauma literature that open fractures are more likely to have infections if surgery is delayed.

The immediate intervention group had decreased infection rates because contaminated tissue was debrided promptly, antibiotics were given early, and fractures were stabilised quickly, reducing the microbial burden and improving the immunological response to injury.

Comparison with Previous Studies

Table 3: Comparison Table

Study	Study Type	Sample Size	Findings
Present Study	Retrospective Study	60	Immediate surgical intervention (within 6 hours) was associated with a lower infection rate (13.3%) compared to delayed surgical intervention (40.0%). Statistically significant difference with $p < 0.05$.
Study 1 [13]	Prospective Study	150	Early surgical debridement within 6 hours of injury significantly reduces the incidence of infections in open fractures. The study supports immediate surgery as a critical factor in infection prevention.
Study 2 [14]	Systematic Review	30 Studies	Delayed surgical intervention is associated with higher infection rates in open fractures. The review advocates for early surgical intervention within 6 hours preventing infections.
Study 3 [15]	Prospective Study	100	Early antibiotic administration within a few hours of injury is more critical than the timing of surgical intervention for preventing infections in open fractures. Infection rates were lower with early antibiotic therapy regardless of surgical timing.

The comparison table reveals that the present study's findings align with previous research on the impact of surgical timing on infection rates in open fractures.

Our study demonstrated that immediate surgical intervention results in a significantly lower infection rate (13.3%) compared to delayed intervention (40.0%), which is consistent with the conclusions of Study 1 and Study 2 both of which found that early debridement within six hours is effective in reducing infections. Study 3 shows that antibiotics alone can alter infection outcomes, making early antibiotic treatment more critical than surgical time.

The current study suggests that open fractures are best treated with early surgery and antibiotics, but rapid surgery can be effective. Multiple studies

suggest that open fractures require rapid surgery and antibiotics. This integrated approach reduces infection risks and improves patient outcomes.

Limitations

This study provides a relationship between operating time and open fracture infections, notwithstanding its limitations. Since the sample size is 60, the results may not apply to bigger populations. Because the study is retrospective, medical records may have discrepancies or gaps. The study also ignored microorganism type, fracture severity, and patient comorbidities, which may have altered infection rates.

Future Research Directions

Future studies should account for more variables, including as fracture severity, patient comorbidities, and microbiological hazards, to better understand open fracture infection risk. In addition to urgent surgery, research should examine the effects of novel antibacterial drugs and cutting-edge wound care. Research investigating the ideal times to provide each therapy alone or in combination may enhance open fracture care and reduce infection rates. Finally, studies that assess the costs of immediate vs. delayed surgical surgery might help healthcare administrators and policymakers allocate resources and improve care for open fracture patients. This study suggests that rapid surgery for open fractures reduces infection rates. The data show that immediate surgical care improves patient outcomes and informs clinical practice, but there are limits. More research into fracture care is needed to improve therapy.

Conclusion

As this retrospective study reveals, surgery time considerably affects infection rates in open fracture patients. We found that quick surgery (within 6 hours of damage) greatly reduced infection rates. The data demonstrate that open fractures require rapid surgery.

Earlier debridement, stabilisation, and antibiotic treatment reduced infection risk in the group that received fast intervention, supporting earlier studies. These findings, which have major clinical implications, suggest that open fracture care should prioritise rapid surgical intervention. Due to the retroactive technique and small sample size, the results may not apply to large populations. Large, prospective studies should validate these findings and study additional factors affecting infection rates, such as fracture severity, patient comorbidities, and microbiological aspects.

This study emphasises the necessity of reducing open fracture infection rates with timely surgery. Healthcare providers that prioritise open fracture surgery had better patient outcomes, less problems, and better treatment.

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