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Original Research Article

Study of Post-Operative Infections in Orthopedic Implants

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Abstract: ***Background*:** Postoperative infections in orthopedic implants remain a challenging complication, contributing to morbidity, prolonged hospitalization, and healthcare costs in low-resource settings. This study aimed to determine the epidemiological profile, bacterial isolates, antibiotic susceptibility patterns, and treatment outcomes of postoperative infections following orthopedic implant surgeries in Bangladesh. ***Methods*:** This prospective cohort study was conducted at the District Sadar Hospital, Rajbari, Bangladesh, from May 2023 to April 2024. A total of 280 patients with confirmed postoperative implant infections were analyzed. Demographic data, infection timing, bacterial isolates, antibiotic sensitivity, and treatment outcomes were also recorded. Data were analyzed using SPSS version 25.0. ***Results*:** The mean age of the patients was 45.6 ± 15.2 years, with 70% males. Early onset infection occurred in 44.3% of the cases. *Staphylococcus aureus* (38.6%) was the predominant isolate, and it showed high sensitivity to vancomycin and linezolid. Debridement with implant retention achieved infection control in 81.2% of cases, whereas implant removal and revision had the best eradication rates (87%). ***Conclusion*:** Postoperative infections in orthopedic implants are primarily early onset and dominated by gram-positive cocci. Effective surgical debridement combined with appropriate antibiotics remains the cornerstone of treatment. Enhanced infection control and antibiotic stewardship are crucial for reducing the incidence and resistance patterns.

Keywords: Orthopedic Implants, Postoperative Infection, Antibiotic Resistance, Surgical Site Infection.

INTRODUCTION

Orthopedic implant surgeries have revolutionized musculoskeletal care by improving functional recovery and quality of life. However, post-operative infections associated with implants remain one of the most serious complications, leading to prolonged hospitalization, increased healthcare costs, and functional impairment [1, 2]. The global incidence of surgical site infections (SSIs) after orthopedic implant surgery ranges between 1% and 10%, depending on surgical type, patient factors, and infection control measures [3, 4].

In developing countries, including Bangladesh, the burden is often higher due to limited resources, overcrowded wards, and challenges in sterilization and antibiotic stewardship [5]. These infections often result from microbial contamination during surgery or hematogenous spread postoperatively. Among causative agents, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae* remain predominant, with growing reports of multidrug-resistant (MDR) strains complicating management [6, 7].

Several studies have highlighted patient-related risk factors such as diabetes mellitus, obesity, and smoking, as well as perioperative factors like prolonged surgery, emergency procedures, and improper antibiotic prophylaxis [8, 9]. In a multicentric Indian study reported that poor glycemic control and delayed wound closure

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significantly increased SSI risk [10]. Similarly, Chua *et al*., found that inadequate antibiotic timing and poor hand hygiene practices were critical modifiable contributors [11].

Despite advancements in aseptic techniques, orthopedic implant infections persist due to biofilm formation, which renders bacteria resistant to host defenses and antimicrobial therapy [12]. The persistence of biofilm-related infections necessitates aggressive surgical debridement and long-term antibiotic administration, sometimes leading to implant removal [13]. The WHO's 2018 guidelines emphasize preventive bundles including preoperative antiseptic bathing, optimized antibiotic prophylaxis, and glycemic control [14]. However, implementation remains inconsistent in many low- and middle-income countries (LMICs).

Recent studies from South Asia emphasize that regional differences in pathogen profiles and resistance patterns should guide local antibiotic policies [15, 16]. Bangladesh, with its rising orthopedic surgical load, lacks comprehensive data on post-operative implant infections. Hence, understanding the microbiological spectrum, time of onset, and treatment outcomes in this context is critical for developing context-specific prevention strategies.

Therefore, this study aimed to investigate the incidence, bacterial profile, antibiotic susceptibility pattern, and treatment outcomes of post-operative infections following orthopedic implant surgeries in a tertiary-care hospital in Bangladesh. The findings are expected to aid clinicians in early detection, rational antibiotic use, and formulation of effective infection control protocols.

METHODOLOGY & MATERIALS

This prospective cohort study was conducted at the Department of Orthopedics at District Sadar Hospital, Rajbari, Bangladesh, from May 2023 to April 2024. The study included patients who developed post-operative infections following orthopedic implant surgeries such as fracture fixation, joint replacement, and spinal instrumentation. A total of 280 patients meeting the eligibility criteria are included in this study.

Selection Criteria

Inclusion Criteria

- Patients aged ≥ 18 years undergoing orthopedic implant surgery.
- Clinical, radiological, or microbiological evidence of post-operative infection.
- Availability for at least 6 months of postoperative follow-up.

Exclusion Criteria

- Patients with pre-existing local infections or chronic osteomyelitis.
- Those who underwent non-implant orthopedic procedures.
- Patients lost to follow-up or with incomplete data.

Data Collection and Study Procedure

Data collection was conducted using a structured case record form developed after a literature review and expert consultation. Baseline demographic data, comorbidities, type of surgery, timing of infection onset, bacterial isolates, antibiotic sensitivity patterns, and treatment outcomes were systematically recorded.

Post-operative infections were identified based on CDC and WHO criteria for surgical site infections. Wound swabs or aspirates were collected aseptically and cultured on standard media for microbial identification. Antibiotic susceptibility was determined using the Kirby–Bauer disc diffusion method following Clinical and Laboratory Standards Institute (CLSI) guidelines. Data on surgical interventions—such as debridement, implant removal, or suppressive antibiotic therapy—were also collected. All patients received standardized post-operative care under aseptic precautions. The diagnosis and treatment decisions were made by orthopedic surgeons in consultation with microbiologists. Informed consent was secured from all participants. Confidentiality was properly maintained throughout the study.

Statistical Analysis

All data were entered and analyzed using SPSS version 25.0. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used for demographic and clinical data. Associations between categorical variables were tested using the Chi-square test, with a p-value < 0.05 considered statistically significant.

RESULTS

Table 1: Baseline Characteristics of Patients with Post-Operative Orthopedic Implant Infections (n = 280)

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	18–30	52	18.6
	31–45	84	30.0
	46–60	90	32.1
	>60	54	19.3

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	196	70.0
	Female	84	30.0
Type of Surgery	Fracture fixation	146	52.1
	Joint replacement	58	20.7
	Spine surgery	34	12.1
	External fixation	42	15.0
Comorbidity	Diabetes mellitus	88	31.4
	Hypertension	72	25.7
	None	120	42.9

Table 1 presents the demographic and clinical profile of the study participants. The largest age group was 46–60 years (32.1%), followed by 31–45 years (30%). Males accounted for 70% of the infections. Fracture fixation (52.1%) was the most frequent surgery associated with infection, and diabetes mellitus (31.4%) was the leading comorbidity.

Table 2: Distribution of Infections According to Time of Onset

Type of Infection	Time Frame	Number (n)	Percentage (%)
Early onset	≤3 months	124	44.3
Delayed onset	3–12 months	98	35.0
Late onset	>12 months	58	20.7

Table 2 shows that early-onset infections (≤ 3 months) were most common (44.3%), followed by delayed (35%) and late-onset (20.7%) cases. This trend reflects the predominance of perioperative contamination and biofilm-related infections occurring within the first postoperative quarter.

Table 3: Major Bacterial Isolates and Sensitivity Patterns

Bacterial Isolate	Frequency n (%)	Main Sensitive Antibiotic
Staphylococcus aureus	108 (38.6)	Vancomycin
Pseudomonas aeruginosa	52 (18.6)	Piperacillin-tazobactam
E. coli	42 (15.0)	Meropenem
Klebsiella pneumoniae	28 (10.0)	Amikacin
Acinetobacter baumannii	24 (8.6)	Colistin
Enterococcus spp.	26 (9.3)	Linezolid

Table 3 describes the microbiological spectrum, indicating that *Staphylococcus aureus* was the predominant isolate (38.6%), exhibiting high sensitivity to vancomycin. *Pseudomonas aeruginosa* and *E. coli* were also frequent, showing susceptibility to piperacillin-tazobactam and meropenem, respectively. Multidrug resistance was notably observed among *Klebsiella* and *Acinetobacter* isolates.

Table 4: Treatment Outcomes According to Surgical Intervention

Intervention Type	Cases (n)	Infection Controlled (%)
Debridement with Implant Retention	112	81.2
Implant Removal & Revision	92	87.0
Suppressive Antibiotic Therapy	64	46.9
Amputation	12	58.3

Table 4 summarizes the outcomes of different treatment modalities. Debridement with implant retention achieved infection control in 81.2% of cases, while implant removal and revision yielded the best eradication rate (87%). Suppressive antibiotic therapy alone was less successful (46.9%), and amputation was required in 4.3% of severe cases.

DISCUSSION

This study explored the epidemiological and microbiological characteristics of postoperative infections in orthopedic implant surgeries at a Bangladeshi tertiary hospital. The predominance of early onset infections (44.3%) and *Staphylococcus aureus* as the chief pathogen aligns with the findings of Skender *et al*., who reported S. aureus as the most frequent isolate in 37% of orthopedic SSIs in India [2]. This pattern underscores the role of perioperative contamination and highlights the importance of strict adherence to asepsis during surgery.

The male predominance (70%) observed mirrors regional studies by Das *et al*., and Suranigi *et al*.,

reflecting the higher rate of trauma and surgical interventions among working-age males in South Asia [4-6]. Diabetes mellitus, noted in 31.4% of cases, was a significant comorbidity, consistent with Muhamad *et al*., who identified diabetes as an independent predictor of SSI due to impaired immune responses [1].

The microbiological findings demonstrate that S. aureus (38.6%) remains the principal etiologic agent, followed by *Pseudomonas aeruginosa* and *E. coli*. These results concur with Alelign *et al.*, who identified Gram-positive cocci as the dominant group in 42% of orthopedic infections [12]. However, the growing detection of Gram-negative pathogens such as *Klebsiella pneumoniae* and *Acinetobacter baumannii* signifies a shift toward nosocomial infections with multidrug-resistant profiles, corroborating findings from Mussab *et al*., and Elifranji *et al*., [5-16].

The high susceptibility of S. aureus to vancomycin and linezolid suggests that glycopeptides and oxazolidinones remain effective in the local setting, similar to reports by Sarangi and Padhi [7]. However, widespread resistance to fluoroquinolones and third-generation cephalosporins parallels global trends observed by Muhamad *et al*., indicating the need for ongoing antimicrobial stewardship [1].

Infection management outcomes in this study emphasize the effectiveness of surgical intervention strategies. Debridement with implant retention achieved infection control in 81.2% of cases, while implant removal and revision provided the best eradication rates (87%). These results are consistent with those reported by Suranigi *et al*., and Amaradeep *et al*., supporting early and aggressive surgical management [6-13]. Conversely, suppressive antibiotic therapy alone was less successful (46.9%), reflecting limited efficacy in eradicating biofilm-associated infections.

The predominance of early-onset infections may be related to inadequate perioperative antibiotic prophylaxis or lapses in sterile technique. Chua *et al*., and Khan *et al*., highlighted the importance of timely prophylaxis and adherence to surgical bundles in reducing SSI rates [6-11]. In this context, the WHO bundle approach, which emphasizes preoperative skin preparation, controlled operating room environments, and antibiotic optimization, remains crucial for resource-limited hospitals [14].

The association of diabetes and obesity with an increased infection risk observed here echoes the findings of Radhamony *et al*., and Borgohain *et al*., both of whom identified glycemic control and nutritional optimization as critical preventive factors [3-9]. Moreover, this study reinforces that individualized antibiotic therapy guided by culture results remains the cornerstone of effective management.

In summary, this study provides valuable local data on orthopedic implant infections in Bangladesh, which can support the development of regional infection control policies. The implementation of preventive bundles, surveillance cultures, and stewardship programs can significantly reduce the infection burden and improve patient outcomes.

Limitations of the Study

This single-center study may limit generalizability due to its regional scope and the absence of long-term microbiological follow-up. Despite this, the findings provide valuable baseline data for local infection control.

CONCLUSION

Postoperative infections following orthopedic implant surgeries remain a significant clinical concern in Bangladesh, predominantly presenting as early-onset infections caused by *Staphylococcus aureus*. Surgical debridement combined with targeted antibiotic therapy yielded the best outcomes. This study underscores the necessity of stringent aseptic protocols, rational antibiotic use, and infection surveillance. Early detection and timely intervention can effectively minimize implant-related complications and improve the recovery rate.

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Conflicts of Interest: There are no conflicts of interest.

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