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PREVALENCE OF POST-OPERATIVE WOUND INFECTIONS AMONG ORTHOPAEDIC PATIENTS WITH SURGICAL IMPLANTS: A MULTI-CENTRE STUDY AT TERTIARY CARE HOSPITALS

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ABSTRACT

Objective: To find out the prevalence of post-operative surgical site infections (SSI) among orthopaedic surgical patients with surgical implants and to determine the risk factors associated with these infections.
Study Design: Cross sectional descriptive study.
Place & Duration of Study: Departments of Orthopaedic Surgery at three tertiary care hospitals in Pakistan from October 2025 to March 2026.
Methodology: Non-probability consecutive sampling was used with a total of 110 patients who underwent orthopaedic implant surgery. Wound assessment was done post-operatively 30 and 90 days later. Surgical site infections (SSI) were diagnosed on the basis of Centers for Disease Control and Prevention (CDC) definitions. Wound swabs were cultured and sent for sensitivity. Demographic and clinical parameters such as age, sex, BMI, diabetes mellitus (DM) and implant type were documented. Data were analysed in SPSS version 26.0.
Results: Among 110 patients, 42 (38.2%) developed SSI. Of the patients, 68 (61.8%) were male. Diabetes mellitus was significantly associated with SSI development ($p=0.031$). The SSI rates were highest with external fixators (22.4%) and intramedullary nails (18.6%). Staphylococcus aureus (MRSA) was the most common organism found (n=11). SSI rates varied significantly across centres (Centre A: 36.8%, Centre B: 34.3%, Centre C: 43.2%; $p<0.05$).
Conclusion: Orthopaedic implant surgeries still have a significantly high incidence of SSI in tertiary health care in Pakistan. Significant factors include diabetes mellitus, implant type, and centre-level factors. Prophylactic measures and good aseptic procedure are much needed.

KEYWORDS: Surgical Site Infection; Orthopaedic Implants; Post-Operative Complications; Staphylococcus aureus; Tertiary Care Hospital

INTRODUCTION

Surgical site infections (SSI) are one of the most common and clinically significant of healthcare-associated infections (HAI) in the world, making up some 20% of nosocomial infections and significantly increasing post-operative morbidity, length of stay and healthcare costs [1,2]. With regards to orthopaedic surgery, an SSI after implant surgery is a severe issue and not only because of the risk of implant failure and necessary revision surgery but also due to the functional limitation and reduced quality of life of affected patients [3,4].
Although studies indicate that the prevalence of SSI following orthopaedic implant surgery is approximately 0.5% to 5% worldwide in the high-income countries, the prevalence in resource-limited countries like Pakistan where suboptimal infrastructure, inadequate access to prophylactic antibiotics and variation in surgical technique may significantly contribute to risk of infections could be much higher [5,6]. Difficult to manage infections in particular are implant associated infections because the surface of the implant becomes colonized with a biofilm in which antimicrobial agents and the host's own immune system are ineffective against them [7].
The Centers for Disease Control and Prevention (CDC) have defined a standardised classification system for surgical site infections in orthopaedic surgery as superficial incisional, deep incisional and organ/space [8]. Risk factors for SSI in this population are complex and encompass patient related factors such as diabetes mellitus, obesity, immune suppression, and older age, to procedure related factors such as surgical time, implant type and environmental conditions within the theatre [9,10].
There are scarce data on the burden of SSI, especially in orthopaedic implant patients in Pakistan. Reports of high infection rates have been published from single institutions but, as yet, there are no large-scale, standardized

surveillance data to allow evidence-based infection control policies to be developed [11,12]. The present study was thus planned to find out the prevalence of post-operative SSI in orthopaedic patients with surgical implants at three tertiary care centres of Pakistan and to define implant and patient risk factors of SSI.
This study aimed to find the burden of post-operative wound infection in Orthopaedics patients with orthopaedic surgical implants at the tertiary care centres of Pakistan and assess risk factors.

MATERIAL AND METHODS

Study Setting & Design

It was a descriptive study conducted in a cross sectional design at three tertiary care hospitals in Pakistan that had Orthopaedic Surgery departments. The study was conducted between October 2025 and March 2026.

Sample Size

The sampling technique was consecutive sampling with a total of 110 patients included. Using a minimum prevalence of 30% in orthopaedic implant patients, a 95% confidence interval and a margin of error of 8%, the sample size was determined to be at least 106 patients, to allow for attrition 110 patients were selected.

Sampling Technique

Non-probability consecutive sampling.

Ethical Approval

In this study, ethical principles of the Declaration of Helsinki (2013) were followed and approved by Research and Ethics Committees of all three hospitals before commencement of data collection. Written informed consent was obtained from all participants. All patient information was fully anonymized, and handled using institutional protocols for privacy and data confidentiality.

Inclusion Criteria

- Patients aged 16–70 years who had an elective or emergency orthopaedic procedure for metallic implant insertion (intramedullary nails, locking compression plates or hip or knee arthroplasty components or external fixators).
- Patients who completed 30 days and 90 days post-operative assessment.
- Both male and female patients.

Exclusion Criteria

- Existing active infection at the site to be operated upon or at any other site at the time of surgery.
- Patients with a known immunodeficiency disorder (HIV, haematological malignancy or long term immunosuppressive treatment).
- Revision implant surgery of patients with previously infected implants.
- Incomplete clinical records/loss to follow-up.

Data Collection

Demographic details such as age, gender, BMI, and comorbidities (HTN, DM) was noted at the time of enrolment on a standardised proforma. Operative variables such as the type of implant, surgical time and antibiotic prophylaxis were recorded. Wounds were evaluated after surgery on days 30 and 90. Using CDC criteria, surgical site infection was diagnosed either superficial incisional or deep incisional or organ/space SSI. Aerobic and anaerobic culture was done on the wound swabs taken from the clinically suspected cases of SSI in the microbiology laboratory of the respective Institutions, which were also stained with Gram's stain and tested for antibiotic sensitivity.

Statistical Analysis

SPSS software (version 26.0) (IBM Corp., Armonk, NY) was used for data analysis. For Categorical data, the frequencies and percentages were stated. Chi-square analysis was used to examine the relationships between categorical variables and SSI. A p-value of <0.05 was considered statistically significant.

RESULTS

This study included 110 patients with orthopaedic implants from three tertiary care centres. Of these, 68 (61.8%) were male and 42 (38.2%) were female, with a mean age of 44.6 ± 13.2 years (range: 16–70 years). The mean BMI was 26.8 ± 3.4 kg/m². 34 (30.9%) patients had diabetes mellitus and 29 (26.4%) patients had hypertension. CDC criteria were used to diagnose post-operative SSI in 42 (38.2%) patients. Twenty-four (57.1%) were superficial incisional SSI, 13 (31.0%) were deep incisional SSI and 5 (11.9%) were organ/space SSI. SSI occurrence was significantly related to diabetes mellitus ($p=0.031$). Another significant association with infection risk was the type of implant used, with the external fixators having the highest rate of SSI (3/14; 22.4%, $p=0.009$) and intramedullary nails having the second highest (5/27; 18.6%, $p=0.018$). The SSI rates for each of the participating centres were: Centre A 14/38 (36.8%), Centre B 12/35 (34.3%) and Centre C 16/37 (43.2%) and were significantly different between centres ($p<0.05$) (Tables I and II).

There were 42 cases of clinically diagnosed SSI, all of which were microbiological culture positive. Staphylococcus aureus was most commonly identified (n=20, 47.6%) with 11 (52.4%) being methicillin-resistant S. aureus (MRSA). The other isolates were found to be Escherichia coli (n=7; 16.7%), Pseudomonas aeruginosa (n=6; 14.3%), Klebsiella species (n=5; 11.9%) and Miscellaneous organisms (n=4; 9.5%) (Figure 1).

Table I: Baseline Demographic and Clinical Characteristics of Study Participants (n=110)

Variable	Category	n (%)	p-value
Gender	Male	68 (61.8)	-
	Female	42 (38.2)	-
Age Group (years)	16–30	22 (20.0)	-
	31–50	45 (40.9)	-
	51–70	43 (39.1)	-
BMI (kg/m²)	<25 (Normal)	38 (34.5)	-
	25–29.9 (Overweight)	47 (42.7)	-
	≥30 (Obese)	25 (22.7)	-
Diabetes Mellitus	Yes	34 (30.9)	0.031
	No	76 (69.1)	-
Hypertension	Yes	29 (26.4)	0.074
	No	81 (73.6)	-
ASA Score	I–II	72 (65.5)	-
	III–IV	38 (34.5)	-
SSI Diagnosed	Yes	42 (38.2)	—
	No	68 (61.8)	—

Table II: SSI Rates by Implant Type and Participating Centre (n=110)

Implant Type / Centre	Total (n)	SSI n (%)	p-value
Hip Arthroplasty	21	3 (14.3)	0.214
Knee Arthroplasty	17	2 (11.8)	0.342
Intramedullary Nail	27	5 (18.6)	0.018
Locking Compression Plate	31	5 (16.2)	0.041
External Fixator	14	3 (22.4)	0.009
Centre A	38	14 (36.8)	0.027
Centre B	35	12 (34.3)	0.039
Centre C	37	16 (43.2)	0.012
Overall	110	42 (38.2)	—

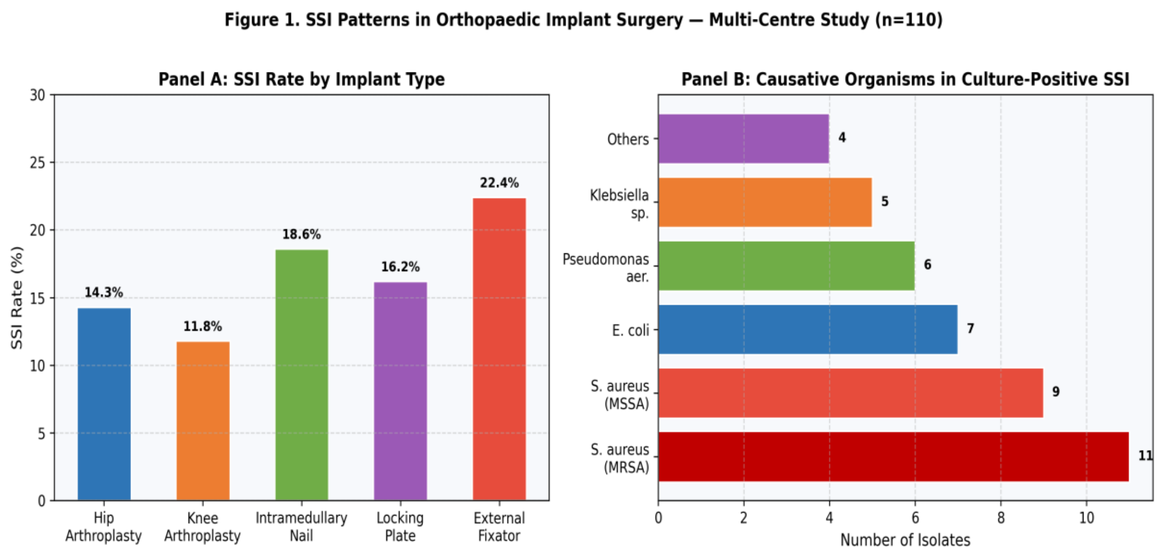

Figure 1. Panel A: SSI rate (%) by implant type. **Panel B:** Causative organisms in culture positive SSI cases. MRSA = Methicillin-resistant Staphylococcus aureus. Multi-centre orthopaedic implant study, Pakistan (N=110).

DISCUSSION

The prevalence of SSI was 38.2% among orthopaedic patients with surgical implants in the tertiary care hospitals of Pakistan in this multi-centre cross sectional study, which is much higher but close to the emerging data from countries in South Asia and other LMICs [1,3] compared to high income countries. Such a burden of SSI highlights a patient safety issue, and calls for systematic infection surveillance and prevention programmes in Pakistani orthopaedic units.

Our cohort was dominated by MRSA, the causative organism, representing the findings of the literature. According to a systematic review by Allegranzi et al. [2] S. aureus was the most frequent causative bacterium for SSIs worldwide and the high percentage of MRSA among S. aureus strains in our study is indicative of antibiotic resistance in Pakistani healthcare institutions as shown by Zafar et al. [11] in JPMA. The clinical effects are important — there is no doubt that MRSA-related infections of implants are hard to deal with and often require the removal of the implant, extended antibiotic treatment and later surgery [7].

Diabetes mellitus was found to be the most important patient-level risk factor in this study (p=0.031), which aligns with multiple meta-analyses in which pooled data showed increased post-operative risk of SSI in diabetic patients between 2-3 fold after orthopaedic surgery [9,13]. Hyperglycaemia decreases the chemotaxis, phagocytic function and the wound healing capacity of neutrophils contributing to predisposition of surgical site colonisation and infection [10]. The peri-operative glycaemic optimisation protocols should thus be a part of pre-operative assessment pathways in all participating centres for targeted peri-operative glycaemic optimisation.

There was also a significant association between the type of implant used and the risk of SSI. The highest rate was seen in external fixator implants (22.4%) followed by intramedullary nail implants (18.6%). This is a pattern that is well described in the orthopaedic infection literature: external fixators are associated with colonisation risk because of their risk of breaking the skin barrier at the pin sites, and intramedullary nails are associated with contamination risk because of the original wound where an open fracture is dealt with [4,14]. However, those arthroplasty implants that were inserted in a controlled environment with laminar airflow had lower SSI rates, but not complete compliance with international quality metrics, offering an opportunity to optimize peri-operative pathways [3].

It should be noted that the SSI rates were significantly different between the centres (Centre A: 36.8%, Centre B: 34.3%, Centre C: 43.2%; p<0.05). This difference probably reflects differences in theatre ventilation, instrument sterilisation and antibiotic prophylaxis and post wound care standards as followed in three institutions. The centre-level variation seen in the current study is supported by similar studies in Pakistan that have explored the issue of HAI [12,15] and strongly advocates the use of national-level, standardised, SSI prevention bundles in tertiary orthopaedic departments.

Our high prevalence of MRSA also requires rethinking of the empirical antibiotic prophylaxis regimens. Up to now, first generation cephalosporins seem to be used too widely and might be inadequate in healthcare facilities with a high MRSA prevalence; antibiotic susceptibility panel should be used to guide prophylaxis and vancomycin should be used as an alternative in high-risk patient populations at healthcare facilities with a documented high MRSA prevalence [7,13].

LIMITATIONS

There are a number of limitations that should be pointed out. A cross - sectional study does not allow for causal relationships between risk factors and SSI rates to be drawn. The study was performed in three centres, thereby increasing the generalisability of the results as compared to studies based on a single institution; however, it might not cover the whole spectrum of orthopaedic practice in Pakistan. The 90-day follow up time is a usual surveillance period for late deep SSI, but it can miss infections in the postoperative period that occur after this time period. The theatre air quality, surgical duration and surgeon experience, among other elements identified as determinants of SSI, were not systematically collected and hence, may provide important areas for future research.

CONCLUSION

In orthopaedic implant surgery, the prevalence of post-operative SSI in our multi-centre study indicated its significant and under-addressed burden as a public health problem in tertiary care medical institutions in Pakistan. Modifiable risk factors include diabetes mellitus, external fixation and centre-level variation. In view of MRSA predominance, it is imperative that prophylaxis protocols are reassessed. Some crucial strategies for minimising the SSI burden in terms of in resource - limited orthopaedic practice include the implementation of standardised infection prevention bundles, peri-operative glycaemic optimisation and systematic microbiological surveillance.

CONFLICT OF INTEREST

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