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# Infection Rates and Risk Factors in Orthopedic Surgeries in a Tertiary Care Hospital of East India

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## ABSTRACT

**Background:** Surgical site infections (SSIs) remain a significant complication of orthopedic surgeries, particularly in resource-limited settings. This study aimed to determine the infection rates and identify risk factors associated with SSIs in a tertiary care hospital in eastern India.

**Methods:** 65 individuals receiving orthopaedic procedures participated in 12-month prospective observational research. SSIs were categorised using CDC criteria, and information on demographic, clinical, and procedural factors was gathered. To find risk factors, univariate and multivariate analyses were conducted.

**Results:** The greatest rates were seen in joint replacements (17.6%) and fracture fixations (14.7%), with an overall SSI rate of 12.3%. It was determined that diabetes mellitus (OR=3.45, 95% CI: 1.12–10.64, p=0.031) and operation lasting more than two hours (OR=4.12, 95% CI: 1.45–11.72, p=0.008) were independent risk factors. At 50% of SSI cases, *Staphylococcus aureus* was the most prevalent pathogen.

**Conclusion:** The high SSI rates in this setting underscore the need for targeted interventions, including preoperative optimization of diabetic patients, efficient surgical planning, and stringent infection control measures. These findings provide valuable insights for reducing SSIs and improving outcomes in resource-limited settings.

**Key-words:** Surgical site infections (SSIs), Orthopedic surgeries, Risk factors, Diabetes mellitus, Prolonged surgery duration, *Staphylococcus aureus*

## INTRODUCTION

Orthopedic surgeries are integral to the management of a wide range of musculoskeletal conditions, including trauma, degenerative diseases, congenital anomalies, and infections. While these procedures have significantly improved patient outcomes and quality of life, they are not without risks.

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SSIs continue to be one of the most dangerous side effects of orthopaedic surgery, increasing morbidity, lengthening hospital stays, and raising medical expenses [1]. Knowing the infection rates and risk variables linked to surgical site infections (SSIs) in orthopaedic surgeries is essential for creating efficient preventative measures and enhancing patient care in a tertiary care hospital in eastern India.

SSIs are infections that develop within 30 days of surgery or a year if an implant is inserted, affecting either the incision site or deeper tissues involved in the procedure [2]. The incidence of SSIs in orthopedic surgeries varies widely across different regions and healthcare settings, with reported rates ranging from 0.5% to 5% in developed countries and significantly higher rates in lowand middle-income countries (LMICs) [3,4]. In India, the burden of SSIs is particularly concerning due to challenges such as overcrowding, limited resources, and varying levels of infection control practices [5]. Orthopedic surgeries, which often involve the implantation of prosthetic devices, are especially vulnerable to infections due to the creation of a foreign body environment that can facilitate bacterial colonization [6].

The etiology of SSIs in orthopedic surgeries is multifactorial, involving patient-related, procedure-related, and environmental factors. Patient-related risk factors include comorbidities such as diabetes mellitus, obesity, malnutrition, and immunocompromised states, all of which can impair wound healing and increase susceptibility to infections [7,8]. Additionally, lifestyle factors such as smoking and alcohol consumption have been linked to higher infection rates [9]. Procedure-related factors include the duration and complexity of the surgery, the use of implants, and the adherence to aseptic techniques [10]. Environmental factors, such as the sterility of the operating room, the availability of antimicrobial prophylaxis, and the overall infection control practices of the healthcare facility, also play a critical role in determining the risk of SSIs [11].

In the setting of a tertiary care hospital in eastern India, the challenges are compounded by the high patient load, limited infrastructure, and socioeconomic factors that influence healthcare-seeking behavior and compliance with postoperative care [12]. The region's unique demographic and epidemiological profile, including a high prevalence of infectious diseases and limited access to preventive healthcare, further exacerbates the risk of SSIs [13]. Despite these challenges, there is a paucity of region-specific data on infection rates and risk factors in orthopedic surgeries, which hinders the development of targeted interventions.

Understanding the local epidemiology of SSIs is essential for implementing evidence-based infection control measures. Previous studies have highlighted the importance of preoperative optimization, appropriate antibiotic prophylaxis, and stringent adherence to infection control protocols in reducing SSI rates [14,15]. However, the effectiveness of these measures can vary depending on the local context, underscoring the need for region-specific research [16]. By identifying the infection rates and risk factors in our setting, this study aims to contribute to the growing body of knowledge on SSIs in orthopedic surgeries and provide actionable insights for improving patient outcomes.

SSIs in orthopedic surgery pose a serious threat to public health, especially in areas with limited resources like eastern India. By examining the infection rates and risk variables related to orthopedic procedures in a tertiary care hospital, this study aims to close the crucial gap in region-specific data. In addition to improving our knowledge of the local epidemiology of SSIs, the research's conclusions will guide the creation of focused interventions aimed at lowering infection rates and raising the standard of care for orthopedic patients.

## MATERIALS AND METHODS

The study was carried out over 12 months at the Department of Orthopedics, SLN Medical College and Hospital, Koraput, a tertiary care facility in eastern India. It was planned as a prospective observational study. All participants provided written informed permission, and the Institutional Ethics Committee (IEC) approved the study procedure.

**Study Design and Setting-** The study was conducted in a tertiary care hospital that serves a large population from rural and semi-urban areas of eastern India. The hospital is equipped with modern operating theatres, but resource constraints such as high patient load and limited infrastructure are common challenges. The study included patients undergoing elective and emergency orthopedic surgeries, including fracture fixations, joint replacements, spinal surgeries, and soft tissue procedures.

**Inclusion Criteria**

1. Patients who are at least eighteen years old.
2. Patients having internal fixation and open reduction orthopaedic operations (ORIF), total joint arthroplasty, spinal instrumentation, and debridement procedures.
3. Patients willing to provide informed consent and comply with follow-up protocols.

**Exclusion Criteria**

1. Patients with pre-existing infections at surgical site.
2. Patients undergoing minor procedures such as wound suturing or incision and drainage.
3. Patients with incomplete follow-up or missing data.

**Sample Size-** The sample size for this study was calculated based on the estimated infection rate of orthopedic surgeries in similar settings. Using a prevalence of 8% for SSIs in orthopedic surgeries from previous studies [1], 65 patients were found to meet the necessary sample size, with a 95% confidence level and a 7% margin of error. This calculation was performed using the formula for sample size estimation in prevalence studies:

$$n=Z^2*p*(1-p)/d^2$$

where: n=sample size,
Z=Z-value (1.96 for 95% confidence level),
p=estimated prevalence (0.08),
d=margin of error (0.07).

**Data Collection-** Data were collected prospectively using a structured proforma designed specifically for this study. The proforma included the following variables:

**Patient-Related Variables**

- ✓ Demographic details: age, gender, socioeconomic status.
- ✓ Comorbidities: diabetes mellitus, hypertension, obesity (BMI≥30), immunocompromised status.
- ✓ Lifestyle factors: smoking, alcohol consumption.
- ✓ Nutritional status: assessed using serum albumin levels and BMI.

**Procedure-Related Variables**

- ✓ Type of surgery: elective or emergency, open or minimally invasive.
- ✓ Duration of surgery: categorized as <1 hour, 1–2 hours, or >2 hours.
- ✓ Use of implants: presence or absence of prosthetic devices or internal fixation hardware.
- ✓ Antibiotic prophylaxis: timing, type, and duration of administration.

**Environmental and Hospital-Related Variables**

- ✓ Operating room sterility: adherence to aseptic techniques and sterilization protocols.
- ✓ Preoperative skin preparation: type of antiseptic used.
- ✓ Postoperative wound care: dressing protocols and follow-up.

**Outcome Measures-** The incidence of SSIs as determined by the Centres for Disease Control and Prevention (CDC) criteria served as the main outcome measure [2]. SSIs were divided into:

1. Infection that solely affects the skin and subcutaneous tissue is known as superficial incisional SSI.
2. Infection affecting deeper soft tissues is known as deep incisional SSI.
3. Organ/space SSI: an infection that affects any anatomical region other than the incision, such as joints or bones.

Secondary outcome measures included the identification of risk factors associated with SSIs, such as patient comorbidities, surgical duration, and adherence to infection control protocols.

**Follow-Up-** After surgery, patients were monitored for at least 30 days, or up to a year if an implant was inserted. After surgery, follow-up appointments were planned for one week, two weeks, one month, and three months. Every visit involved a check for infection at the surgical site and a record of any clinical symptoms, including pain, redness, swelling, or discharge. To determine the microorganisms causing SSI, microbiological samples were taken from probable patients.

**Statistical Analysis-** Software for statistics, such as SPSS version 25.0, was used to analyse the data. Clinical and demographic features were gathered using descriptive statistics. Whereas categorical data were represented by percentages and frequencies, continuous variables were represented by mean±standard deviation (SD). To find independent risk factors for SSIs, univariate and multivariate logistic regression analyses were conducted. The threshold for statistical significance was p<0.05.

**Ethical Considerations-** The Declaration of Helsinki was followed when conducting the study. The Institutional Ethics Committee at SLN Medical College and Hospital in Koraput provided ethical approval. All subjects provided written informed consent, and patient data confidentiality was upheld during the entire trial.

## RESULTS

The incidence of surgical site infections (SSIs) and related risk variables were ascertained by analysing the data from the trial, which involved 65 patients in total. The results are presented below, supported by three detailed tables.

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There were 65 patients in the study, and their average age was 45.3±12.7 years. Males made up 58.5% of the patients (n=38), while females made up 41.5% (n=27). The two most prevalent comorbidities were hypertension (21.5%, n=14) and diabetes mellitus (29.2%, n=19). Among the patients, lifestyle variables including smoking and drinking were reported by 23.1% (n=15) and 18.5% (n=12), respectively. Joint replacements (26.2%), spinal operations (12.3%, n=8), soft tissue treatments (9.2%, n=6), and fracture fixations (52.3%) were among the surgical procedures that were carried out. Table 1 provides an overview of the clinical and demographic characteristics of the research cohort.

**Table 1:** Study Population's Demographic and Clinical Characteristics (n=65)

| Variables | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Age (years) | Mean±SD | 45.3±12.7 | - |
| Gender | Male | 38 | 58.5 |
| | Female | 27 | 41.5 |
| Comorbidities | Diabetes mellitus | 19 | 29.2 |
| | Hypertension | 14 | 21.5 |
| | Obesity (BMI ≥ 30) | 10 | 15.4 |
| Lifestyle Factors | Smoking | 15 | 23.1 |
| | Alcohol consumption | 12 | 18.5 |
| Type of Surgery | Fracture fixation | 34 | 52.3 |
| | Joint replacement | 17 | 26.2 |
| | Spinal surgery | 8 | 12.3 |
| | Soft tissue procedures | 6 | 9.2 |

The overall incidence of SSIs in the study population was 12.3% (n=8). Among these, 62.5% (n=5) were superficial incisional SSIs, 25.0% (n=2) were deep incisional SSIs, and 12.5% (n=1) were organ/space SSIs. The infection rates varied according to the type of surgery, with the highest incidence observed in joint replacements (17.6%, n=3) and fracture fixations (14.7%, n=5). The distribution of SSIs by type of surgery and infection category is presented in Table 2.

**Table 2:** Incidence of Surgical Site Infections by Type of Surgery (n=65)

| Type of Surgery | Total Cases (n) | SSI Cases (n) | SSI Rate (%) | Superficial SSI (n) | Deep SSI (n) | Organ/Space SSI (n) |
|---|---|---|---|---|---|---|
| Fracture fixation | 34 | 5 | 14.7 | 3 | 1 | 1 |
| Joint replacement | 17 | 3 | 17.6 | 2 | 1 | 0 |
| Spinal surgery | 8 | 0 | 0.0 | 0 | 0 | 0 |
| Soft tissue procedures | 6 | 0 | 0.0 | 0 | 0 | 0 |
| Total | 65 | 8 | 12.3 | 5 | 2 | 1 |

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Univariate analysis revealed several significant risk factors for SSIs, including diabetes mellitus (p=0.012), smoking (p=0.023), duration of surgery >2 hours (p=0.008), and inadequate antibiotic prophylaxis (p=0.017). Multivariate logistic regression analysis confirmed that diabetes mellitus (OR=3.45, 95% CI: 1.12–10.64, p=0.031) and duration of surgery >2 hours (OR=4.12, 95% CI: 1.45–11.72, p=0.008) were independent predictors of SSIs. The results of the univariate and multivariate analyses are summarized in Table 3.

**Table 3:** Risk Factors for Surgical Site Infections (n=65)

| Risk Factor | Univariate Analysis (p-value) | Multivariate Analysis | Odds Ratio (OR) | 95% Confidence Interval (CI) | p-value |
|---|---|---|---|---|---|
| Diabetes mellitus | 0.012 | Yes | 3.45 | 1.12–10.64 | 0.031 |
| Smoking | 0.023 | No | - | - | - |
| Duration of surgery >2 hrs | 0.008 | Yes | 4.12 | 1.45–11.72 | 0.008 |
| Inadequate antibiotic prophylaxis | 0.017 | No | - | - | - |

Microbiological cultures were obtained from all 8 SSI cases. The most isolated pathogens were *S. aureus* (50.0%, n=4), followed by *E. coli* (25.0%, n=2) and *P. aeruginosa* (12.5%, n=1). One case (12.5%) showed no growth in culture. All *S. aureus* isolates were methicillin-sensitive (MSSA).

The overall incidence of SSIs in the study population was 12.3%, with the highest rates observed in joint replacements (17.6%) and fracture fixations (14.7%). Diabetes mellitus and prolonged duration of surgery (>2 hours) were identified as independent risk factors for SSIs. *S. aureus* was the most common causative pathogen, accounting for 50% of SSI cases.

**DISCUSSION**

At a tertiary care hospital in eastern India, the current study examined the infection rates and risk variables related to surgical site infections (SSIs) in orthopedic procedures. The results showed a 12.3% total SSI rate, with diabetes mellitus and longer operation times (>2 hours) being recognized as independent risk factors. These findings support previous research while also drawing attention to issues unique to a certain area. We go over the ramifications of our results from both a local and global standpoint below.

The SSI rate of 12.3% observed in this study is higher than the rates reported in high-income countries, which typically range from 0.5% to 5% [3,4]. However, it is consistent with studies from other low- and middle-income countries (LMICs), where SSI rates in orthopedic surgeries often exceed 10% due to resource constraints and varying infection control practices [5,6]. The higher incidence in our setting may be attributed to factors such as overcrowding, limited infrastructure, and the high prevalence of comorbidities like diabetes mellitus among the patient population [7]. The highest infection rates were observed in joint replacements (17.6%) and fracture fixations (14.7%), which is consistent with previous studies showing that procedures involving implants are at greater risk of SSIs due to the creation of a foreign body environment conducive to bacterial colonization [8,9].

Diabetes mellitus and extended surgical length were found to be independent risk factors for SSIs in our research. Since hyperglycemia damages wound healing and immunological function, making a person more vulnerable to infections, diabetes mellitus is a known risk factor for SSIs [10,11]. Compared to individuals without diabetes, diabetics in our research had a 3.45-fold increased chance of acquiring SSIs. This result emphasizes how crucial it is to optimize glycemic control before surgery for diabetic patients having orthopedic procedures.

Prolonged duration of surgery (>2 hours) was also significantly associated with SSIs, consistent with previous studies [12,13]. Longer surgical durations increase the exposure of tissues to potential contaminants and are often associated with more complex procedures,

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which may compromise tissue viability and increase the risk of infection. These findings highlight the need for efficient surgical planning and adherence to aseptic techniques to minimize operative time and reduce infection risk.

While smoking and inadequate antibiotic prophylaxis were significant in univariate analysis, they did not emerge as independent risk factors in multivariate analysis. This may be due to the relatively small sample size or confounding factors. However, the role of smoking in impairing wound healing and increasing infection risk is well-documented [14], and the importance of appropriate antibiotic prophylaxis in preventing SSIs cannot be overstated [15].

The microbiological analysis revealed *S. aureus* as the most common causative pathogen, accounting for 50% of SSI cases. This is consistent with global data showing *S. aureus* as the predominant pathogen in orthopedic SSIs [16]. All *S. aureus* isolates in our study were methicillin-sensitive (MSSA), which contrasts with studies from high-income countries where methicillin-resistant *S. aureus* (MRSA) is a significant concern [17]. This difference may reflect variations in antibiotic prescribing practices and the prevalence of resistant strains in different settings. Other pathogens isolated included E. coli and P. aeruginosa, which are commonly associated with healthcare-associated infections in resource-limited settings [18].

The study's conclusions have several significant ramifications for clinical practice. First, especially in environments with limited resources, the high SSI rates that have been noted highlight the necessity of strict infection control methods. To lower the risk of infection, diabetic patients' preoperative optimization, including glycemic management and nutritional support, should be given priority [19]. Second, infection risk can be reduced by attempting to reduce surgery time through effective planning and the employment of skilled surgical teams. Third, SSIs can be avoided by following evidence-based antibiotic prophylaxis guidelines, which include prompt administration and suitable agent selection [20].

This study has several strengths, including its prospective design, detailed data collection, and focus on a tertiary care hospital in eastern India, a region with limited existing data on SSIs in orthopedic surgeries. However, the study also has limitations. The sample size of 65, while adequate for preliminary analysis, may limit the generalizability of the findings. Additionally, the follow-up period of 30 days (or one year for implant cases) may have missed late-onset infections. Future studies with larger sample sizes and longer follow-up periods are needed to validate these findings.

## CONCLUSIONS

In conclusion, this study highlights the significant burden of SSIs in orthopedic surgeries at a tertiary care hospital in eastern India. The high infection rates and identified risk factors underscore the need for targeted interventions, including preoperative optimization of comorbidities, efficient surgical planning, and stringent infection control measures. By addressing these challenges, healthcare providers can reduce the incidence of SSIs and improve outcomes for orthopedic patients in resource-limited settings.

## CONTRIBUTION OF AUTHORS

**Research concept-** Priyaranjan Acharya, Satya Ranjan Acharya
**Research design-** Satya Ranjan Acharya, Alok Kumar Meher
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**Data analysis and Interpretation-** Deshish Kumar Panda
**Literature search- S**atya Ranjan Acharya, Alok Kumar Meher
**Writing article-** Priyaranjan Acharya, Satya Ranjan Acharya
**Critical review-** Deshish Kumar Panda
**Article editing-** Satya Ranjan Acharya, Alok Kumar Meher
**Final approval-** Deshish Kumar Panda

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