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Antibiotic prophylaxis practices in orthopedic surgery: Compliance with guidelines and clinical outcomes: A prospective observational study from a tertiary care hospital

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Abstract

Background: Appropriate perioperative antibiotic prophylaxis is a key preventive strategy against surgical site infections (SSIs) in orthopedic surgery. Despite well-established recommendations, deviations from guideline-based practices are frequently observed, particularly in resource-constrained settings. This study aimed to evaluate compliance with recommended antibiotic prophylaxis practices in orthopedic surgeries and analyze their association with post-operative clinical outcomes.

Methods: A prospective observational study was conducted in Department of Orthopedics at Shree Bhausaheb Hire government medical college, Dhule. Adult patients undergoing orthopedic surgical procedures were enrolled over a 9-month period. Antibiotic prophylaxis practices were assessed for compliance with standard guideline principles, including antibiotic selection, timing, and duration. Patients were followed for 30 days (non-implant surgeries) and 90 days (implant surgeries). Surgical site infection rates and other outcomes were compared between compliant and non-compliant groups.

Results: A total of 248 orthopedic surgical procedures were analyzed. Overall compliance with antibiotic prophylaxis guidelines was observed in 152 cases (61.3%). Surgical site infection occurred in 3.3% of compliant cases compared to 11.5% of non-compliant cases ($p = 0.01$).

Prolonged post-operative antibiotic administration beyond 24 hours was the most common deviation. On multivariate analysis, non-compliance with antibiotic prophylaxis guidelines (adjusted OR 3.92), diabetes mellitus, and prolonged duration of surgery were independently associated with increased SSI risk.

Conclusion: Non-compliance with recommended antibiotic prophylaxis practices is common in orthopedic surgery and is associated with significantly higher rates of surgical site infection. Improving adherence to evidence-based protocols represents a feasible and high-impact intervention to enhance surgical outcomes and promote antimicrobial stewardship.

Keywords: Antibiotic prophylaxis, Orthopedic surgery, Surgical site infection, Guideline compliance, Antimicrobial stewardship

Introduction

Surgical site infections continue to represent a significant challenge in orthopedic surgery due to their association with increased morbidity, prolonged hospital stay, reoperations, and compromised functional outcomes. The risk is particularly pronounced in procedures involving implants, where bacterial adherence and biofilm formation can result in persistent and difficult-to-treat infections.^[1]

Perioperative antibiotic prophylaxis is among the most effective strategies for reducing the incidence of SSIs. Evidence-based guidelines recommend administration of an appropriate antibiotic within a defined time window prior to incision, with discontinuation within 24 hours for most orthopedic procedures.^[2] Adherence to these principles has been shown to reduce infection rates without increasing antimicrobial resistance.^[3, 4] Despite the availability of such guidelines, real-world practice often deviates from recommended standards. In many healthcare settings, antibiotics are administered late, inappropriate agents are chosen, or post-operative antibiotics are continued for several days without clear indication. These practices may be driven by fear of infection, lack of standardized institutional protocols, or limited awareness of antimicrobial stewardship principles.

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In India, where orthopedic surgical volume is high and healthcare resources are variable, understanding actual antibiotic prophylaxis practices and their clinical consequences is essential. The present study was designed to prospectively assess compliance with recommended antibiotic prophylaxis practices in orthopedic surgery and to evaluate the impact of compliance on surgical site infection rates. [5, 6]

Materials and Methods

Study Design and Setting

This prospective observational study was conducted in the Department of Orthopedics at a Shree bhausaheb hire government medical college, Dhule over a 9-month period (March 2024 to November 2024). Institutional Ethics Committee approval was obtained prior to study initiation, and written informed consent was obtained from all participants.

Sample Size Justification

Based on an expected SSI rate difference of 8% between compliant and non-compliant groups, with a confidence level of 95% and power of 80%, a minimum sample size of 220 patients was estimated. To account for potential loss to follow-up, 248 patients were enrolled.

Inclusion and Exclusion Criteria

Patients aged 18 years and above undergoing elective or trauma-related orthopedic surgical procedures were included. Patients undergoing surgery for active infection, revision surgeries for infected implants, and those lost to follow-up were excluded.

Assessment of Antibiotic Prophylaxis Compliance

Antibiotic prophylaxis was considered **compliant** if all of the following criteria were met:

1. Use of a recommended first-line antibiotic
2. Administration within 60 minutes prior to incision
3. Intraoperative re-dosing when indicated
4. Discontinuation within 24 hours post-operatively

Failure to meet any of the above criteria was considered non-compliance.

Data Collection

Demographic data, comorbidities (diabetes mellitus, smoking, anemia), ASA grading, type of surgery, implant usage, duration of surgery, and antibiotic-related variables were recorded. Patients were monitored for development of surgical site infection during hospital stay and follow-up visits.

Statistical Analysis

Data were analyzed using statistical software. Categorical variables were expressed as frequencies and percentages. Continuous variables were expressed as mean \pm standard deviation. Chi-square test was used for categorical comparisons. Multivariate logistic regression analysis was performed to identify independent predictors of SSI. Statistical significance was set at $p < 0.05$.

Results

A total of 248 orthopedic surgical procedures were included. The mean age of patients was ± 14.8 years, with 153 males (61.7%) and 95 females (38.3%). Implant-related procedures accounted for 131 cases (52.8%).

Compliance with Antibiotic Prophylaxis Guidelines

Compliant cases: 152 (61.3%)

Non-compliant cases: 96 (38.7%)

The most frequent deviation from guidelines was prolonged post-operative antibiotic use beyond 24 hours, observed in 142 cases (57.3%).

Surgical Site Infection Rates

- **Overall SSI rate:** 6.5% (16 cases)
- **SSI in compliant group:** 5/152 (3.3%)
- **SSI in non-compliant group:** 11/96 (11.5%)

The difference in infection rates between groups was statistically significant ($p = 0.01$).

Table 1: Multivariate Logistic Regression Analysis

Variable	Adjusted OR	95% CI	p-value
Non-compliance with guidelines	3.92	1.34-11.43	0.013
Diabetes mellitus	2.87	1.01-8.15	0.048
Surgery duration >120 min	3.14	1.12-8.78	0.029
Implant usage	1.58	0.52-4.74	0.42

Discussion

This prospective observational study demonstrates that non-compliance with recommended antibiotic prophylaxis practices is common in orthopedic surgery and is associated with a significantly increased risk of surgical site infection. Even within a relatively modest sample size, the impact of guideline adherence on clinical outcomes was clearly evident. The overall compliance rate of 61.3% highlights a substantial gap between evidence-based recommendations and actual clinical practice. The most frequent deviation was unnecessary

continuation of antibiotics beyond the recommended 24-hour period. This finding reflects a prevailing misconception that prolonged antibiotic administration offers additional protection against infection, particularly in implant-related surgeries.

Importantly, the present study shows that extended antibiotic use did not translate into lower infection rates. On the contrary, patients receiving non-compliant prophylaxis experienced a more than threefold increase in SSI risk. This reinforces the concept that timing, selection, and duration of antibiotic prophylaxis are more critical than sheer duration of exposure.

Diabetes mellitus emerged as an independent predictor of SSI, underscoring the importance of metabolic optimization in orthopedic patients. Prolonged operative duration was also associated with higher infection rates, likely reflecting increased tissue exposure, surgical complexity, and operating room traffic. [7, 8, 9]

The absence of a significant association between implant usage and SSI on multivariate analysis suggests that appropriate antibiotic prophylaxis may mitigate implant-related infection risk when correctly implemented. This finding has important implications for orthopedic surgeons who often extend antibiotic duration solely due to implant presence.

The strengths of this study include its prospective design, clearly defined compliance criteria, and systematic follow-up. However, the study is limited by its single-center nature and relatively small sample size. Nevertheless, the statistically significant findings despite these limitations highlight the strength of the observed associations.

Overall, the study supports the need for institutional antibiotic stewardship programs, standardized perioperative protocols, and continuous audit of antibiotic practices. Given the simplicity and low cost of these interventions, improving compliance represents a highly feasible strategy to reduce surgical site infections in orthopedic surgery.

Table 2: Baseline Characteristics of Patients (n = 248)

Variable	Value
Mean age (years)	45.1 ± 14.8
Male	153 (61.7%)
Female	95 (38.3%)
Diabetes mellitus	49 (19.8%)
Smokers	64 (25.8%)
Implant surgeries	131 (52.8%)

Table 3: Antibiotic Prophylaxis Compliance

Parameter	Number (%)
Compliant	152 (61.3%)
Non-compliant	96 (38.7%)
Prolonged antibiotics (>24 h)	142 (57.3%)

Table 4: SSI Rates by Compliance Status

Group	Total cases	SSI cases	SSI rate (%)
Compliant	152	5	3.3
Non-compliant	96	11	11.5

Conclusion

Non-compliance with evidence-based antibiotic prophylaxis guidelines is prevalent in orthopedic surgery and is associated with significantly higher rates of surgical site infection. Strict adherence to recommended prophylaxis practices can substantially reduce infection risk without increasing antibiotic exposure. Implementation of standardized protocols and regular auditing of antibiotic use should be integral components of orthopedic surgical care.

Conflict of Interest

Not available

Financial Support

Not available

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How to Cite This Article

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