

# Surgical Site Infection among the Patient with Prophylactic Antibiotics in Elective Orthopedic Surgery

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## ABSTRACT

**Introduction:** The routine use of prophylactic antibiotics has long been acknowledged to have preventive benefits in cases of clean orthopaedic surgeries. Although the duration of prophylactic medication has been shortened, the ideal time frame is still unknown. The majority of the surgeons in this country are quite hesitant to employ prophylactic antibiotics for only 24 hrs due to the surrounding environment and theatre conditions, which leads to serious concerns for the risk of antimicrobial resistance and super-infections. The main aim of the study was to determine the prevalence of surgical site infection among patients who received intravenous antibiotics in elective orthopaedic surgery.

**Methods:** The descriptive cross-sectional study was conducted among a total of 90 closed long bone fractures that underwent elective orthopaedic surgeries. They had been given prophylactic intravenous antibiotic 'Cefuroxime' for 24 hrs, 3 days, or 5 days, followed by oral Cefuroxime for total antibiotic coverage of 10 days. The patients were followed up on 3rd, 7th, 15th and 30th post-operative days and evaluated for features of surgical site infections. The point estimate at a 95% Confidence Interval was calculated.

**Results:** Out of the 90 patients, there were 4 (4.4%) (0.18% to 8.7% at 95% Confidence Interval) cases of surgical site infection. Among them, 1 (3.3%) infection occurred in each 24 hrs group and 1 (3.3%) in the 3 days group and 2 (6.7%) infections occurred in the 5 days group.

**Conclusions:** The surgical site infection among patient presenting to orthopaedic surgery was lower compared to study done in similar settings. This suggests that a shorter duration of antibiotic prophylaxis, specifically 24 hours, may be just as effective as longer courses in preventing Surgical site infection while reducing the potential risks and costs associated with extended antibiotic use.

**Keywords:** antibiotics; cross-sectional study; infection; orthopaedics.

## INTRODUCTION

Surgical site infection (SSI) is one of the most dreaded complications faced by an orthopaedic surgeon.<sup>1</sup> Postoperative infections have been shown to significantly increase morbidity, extend hospital stay, increase medical expense and cause physical limitations that diminish the quality of life.<sup>2</sup> The burden of SSI is higher in low- and middle-income countries (LMICs), affecting one third of patients who undergo surgery.<sup>3</sup> To prevent infections, the World Health Organisation (WHO) has advised a 19-item surgical safety checklist before any surgical treatment and preventive antibiotics are included.<sup>4</sup> There is still considerable discussion in the current literature

as to the duration of prophylactic antibiotics, and no consensus has yet been reached.<sup>5</sup> This study aims to determine the prevalence of surgical site infection among the patient undergoing elective orthopaedic surgery.

## METHODS

A descriptive cross-sectional study was conducted in the Department of Orthopaedics and Trauma Surgery, National Trauma Center from July 2023 to November 2023. Ethical approval was obtained from the Institutional Review Committee before starting the study (Reference number:

). Inclusion criteria were patients of all age groups with closed long bone fractures undergoing elective surgery with either open or closed methods, and patients providing informed consent. Patients with chronic medical illnesses like diabetes, hypertension, COPD, malignancy and patients with open injuries and penicillin allergies were excluded. The convenience sampling technique was used. Using the value of prevalence of infection of 6.1% in clean orthopaedic surgeries in a study by Kalawar, et al. in BP Koirala Institute of Health Sciences.<sup>6</sup>

The sample size was calculated using the following formula:

$$n = Z^2 \times p \times q / e^2$$

$$= 1.962 \times 0.061 \times 0.939 / 0.05^2$$

$$= 88$$

Where,

n = minimum required sample size

Z = 1.96 at 95% Confidence Interval (CI)

p = prevalence of infection, 0.061

q = 1 - p

e = margin of error, 5%

The minimum required total sample size is 88. However, since we had three groups of patients, it was equally divided into three groups. Thus, there were a total of 90 patients with 30 patients in each group, categorised as Group A, Group B and Group C of 24 hours, 3 days and 5 days, respectively.

Antibiotics doses generally used in National Trauma Centre was as follows: Inj Cefuroxime 1.5g 30 minutes to 1 hour before skin incision before tourniquet inflation were used followed by Inj Cefuroxime 750 mg BID for 1, 3 or 5 days. They are followed by Tab Cefuroxime 500mg BD for total antibiotic coverage of 10 days.

For Pediatric population < 30kg, dose was modified as Initial dose 50mg/kg, then 20 mg/kg BID followed by 30 mg/kg/day orally divided 12 hourly. Operating surgeons were unaware about the patients being included in the study so that this wouldn't bias the duration of iv antibiotics to the patient. Patient identification was done and data were collected using data collection form (proforma) during the time of discharge by myself. It was made sure that the patient had received Cefuroxime for perioperative prophylaxis and was being discharged on the same. The patients were recorded as case numbers. Date of enrollment, age, gender, address

and diagnosis were recorded. The patients were stratified into three groups based on the duration of prophylactic antibiotic administration: 24 hours (Group A), 3 days (Group B), and 5 days (Group C). The wound was inspected on 3rd, 7th, 15th and 30th days for any signs of infection by any of the equally qualified physicians in our center and any positive findings were reported.

Our criteria for judging whether or not a wound infection occurred were as follows which has been modified from that of Alan et al.<sup>7</sup> It was considered Surgical Site Infection if a wound drained purulent material irrespective of whether an organism was cultured or not, when the wound became red, painful, or tender, swollen and warm for more than 48 hours, when the patient had fever for more than 48 hours plus criteria 2.

Wound swabs were taken from all infected wounds. Based on the judgement by the treating physician whether the wound infection was superficial or deep, further management was done. This included a simple prolonged antibiotic course to local debridement of the wound and analysis of acute inflammatory markers.

Collected data were entered in Microsoft Excel and analyzed by means of Statistical Package for the Social Science for windows to get final interpretation. The data were represented diagrammatically in various groups for age distribution, gender distribution, limbs involved (upper limb or lower limb), and the number of infections in each group. This visual representation would help provide insights into the patterns and relationships in the data.

## RESULTS

Out of a total of 90 patients, the surgical site infection among the patients undergoing orthopaedic elective surgery receiving prophylactic antibiotics is 4 (4.4%) (0.18-8.7 at 95% Confidence Interval). The demographic distribution of the patients was organised across the groups, as illustrated in Table 1.

**Table 1. Patient Demographics (n= 90).**

| Sex         | n (%)                           |
|-------------|---------------------------------|
| Female      | 34 (37.77)                      |
| Male        | 56 (62.22)                      |
| Age (years) | 2.42 - 91 years (average 36.36) |

In our study, the majority of patients, i.e., 43 (47.47%) patients, belonged to the age group 21-40 years, followed by the age group of 41-60 years with 18 (20%) patients, with only 3 (3.33%) patients in 81-100 group and

the mean age of the patients was 36.36 years (Figure 1).

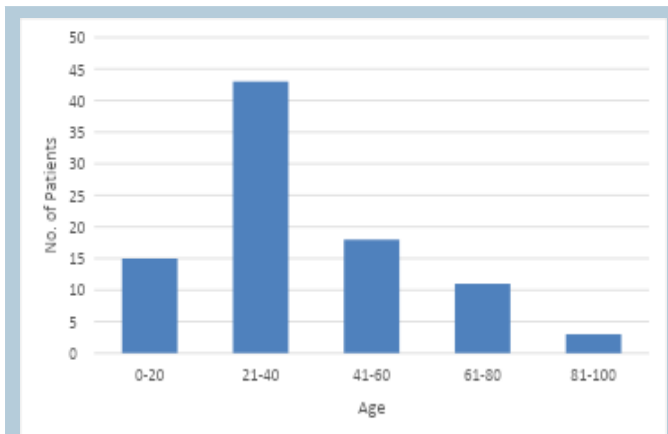


Figure 1. Bar Diagram showing the Age distribution.

In the study, out of 90 cases, 33 (36.67%) cases were fractures of the upper limb, whereas 57 (63.33%) cases were fractures of the lower limb (Figure 2).

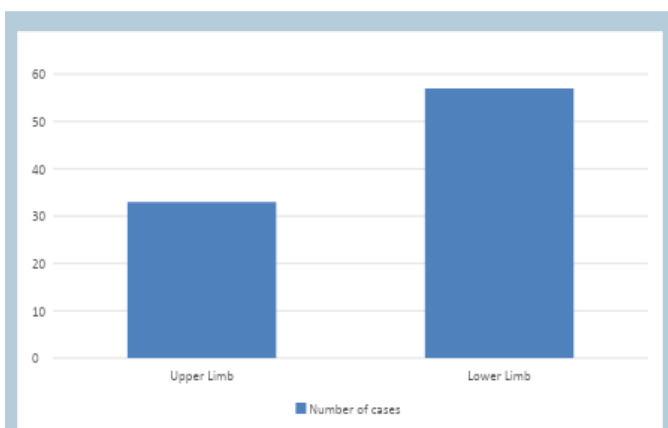


Figure 2. Bar diagram showing distribution on the basis of limb involved.

Table 2 provides an overview of the number of infections observed in each group, further categorized by the duration of antibiotic administration.

Table 2. Total Case Summary

|        | Infected | Non-in-fected | Total |
|--------|----------|---------------|-------|
| 24hr   | 1        | 29            | 30    |
| 3 days | 1        | 29            | 30    |
| 5 days | 2        | 28            | 30    |

Culture swabs were sent from the infected wounds. Regular dressings and prolonged antibiotics for two weeks were

done for three cases. They had no growth in culture and sensitivity. The culture showed the growth of *Escherichia coli* in one case. The wound was thoroughly irrigated and secondarily closed with prolonged course of antibiotic for a total of four weeks until the infective markers were normal.

## DISCUSSION

In recent times, there has been a growing emphasis on reducing the duration of antibiotic use, supported by compelling evidence suggesting that shorter antibiotic courses can be equally effective. This approach has gained particular attention in the context of Orthopedics trauma and arthroplasty, where antibiotic administration is a well-established practice substantiated by existing literature.

This study, conducted at the National Trauma Center in Kathmandu, Nepal, focused on patients undergoing Orthopedics procedures. Notably, in cases where antibiotics were administered prior to the initiation of the skin incision, the timing was meticulously adhered to, with an average administration occurring approximately 30 minutes before the actual incision was made.

Shrestha, et al. study,<sup>8</sup> conducted in a different healthcare setting, mirrors the findings of the current study. There were 240 patients in their study and they had followed up for three months. Both studies advocate for the limited advantage of extending prophylactic antibiotic use beyond 24 hours in clean elective surgeries. In both cases, longer durations of antibiotic administration did not significantly reduce surgical site infection rates. The mean prevalence of rate of infection was 5.3% which was found to be 4.4% in our study. This consistency in results emphasizes the efficacy and safety of a 24-hour antibiotic regimen in preventing infections. These findings support the adoption of shorter antibiotic durations to reduce costs and minimize antibiotic exposure while maintaining patient safety.

In another study, the findings of the current study. The original study emphasized that different antibiotics, specifically cefazolin and ceftriaxone, exhibit comparable efficacy in preventing surgical site infections in the context of clean elective Orthopedic surgeries. This consensus highlights the flexibility available in antibiotic choices for prophylactic purposes, enabling healthcare providers to select antibiotics based on factors such as patient allergies, local antimicrobial resistance patterns, and cost considerations. This was one of the limitations in our study that this study included the single antibiotic. The aim of our study was actually to compare the duration rather than the choice of antibiotics. They found the prevalence of rate of infections to be 6.1% which was 4.4% in our study.<sup>6</sup>

The research conducted by Purva Mathur et al<sup>9</sup> in the context of open reduction and internal fixation procedures aligns closely with the findings of the current study in Orthopedic surgery. Both studies were done in Level 1 Trauma Center. Both studies emphasize the efficacy and cost-effectiveness of a shorter (24-hour) perioperative antibiotic prophylactic treatment in preventing surgical site infections. Despite the different surgical contexts, the consistency in results suggests a broader applicability of shorter antibiotic regimens in surgical practice. Moreover, both studies underscore the potential benefits of shorter regimens, including reduced healthcare costs and minimized antimicrobial resistance. They had found MRSA as the organism causing infection, which was *Escherichia coli* in our case. The cost analysis in Purva Mathur et al's study, revealing a substantial cost difference between the short course and conventional regimen, highlights the economic advantages associated with shorter antibiotic durations. This was one of the limitations in our study, that we didn't analyze the actual cost difference. However, limiting the duration ultimately has economic advantages.

Ziranu et al<sup>10</sup> implemented a preventive antibiotic policy for Orthopedic oncological surgery, focusing on a "one-shot" intravenous dose of Cefazolin 2g, administered 30 minutes before surgery. This preoperative antibiotic prophylaxis strategy was associated with a significant decrease in the rate of surgical site infections in their environment. Importantly, their findings concur with the results of the current study, emphasizing that prophylaxis administered more than 24 hrs after surgery is not more effective and may even harm the patient's bacterial flora and foster antibiotic-resistant pathogens. These parallel findings suggest that a single, well-timed preoperative dose of antibiotics can be highly effective in preventing SSI in Orthopedic surgery, while prolonged post-surgical prophylaxis may have limited additional benefits and potential drawbacks.

In 2015, Sheng-Gen Xu, et al<sup>11</sup> conducted a study evaluating antibiotic prophylaxis during open reduction and internal fixation in low-risk patients, introducing an SSI risk scorecard. We didn't, however, use such a scorecard in our study. Also, they had followed up for a duration of 13-17 months which was far more than our study which followed up for only one month. Their findings, which align with the current study, demonstrated that routine antibiotic prophylaxis did not significantly reduce SSI rates in low-risk patients. While patients with high SSI risk scores saw substantial benefits from prophylactic antibiotics, those with low-risk scores did

not experience a significant reduction in infections.

The Dutch Trauma Trial<sup>12</sup> was a prospective randomized double-blind placebo-controlled study assessing ceftriaxone prophylaxis. The study enrolled 2,195 patients who sought care for closed fractures and were assigned to receive either a single preoperative dose of ceftriaxone 2g or a placebo. They had followed up for four months. The ceftriaxone group showed significantly lower rates of wound infections (3.6% vs. 8.3%) and early nosocomial infections (2.3% vs. 10.2%) compared to the placebo group. These results resonate with the current study that SSI rate in our study is 4.4%.

Nepal's National Antibiotic Treatment Guidelines (NATG)<sup>13</sup> were introduced in 2014, covering surgical antibiotic prophylaxis. According to NATG, all surgical patients except those with clean wounds should receive intraoperative prophylaxis, with a repeat dose if the procedure exceeds two hours. This reference, however, didn't provide empirical data like the other studies.

Fahad Al-Mulhim et al's<sup>14</sup> study assessed the prevalence of SSI in Orthopedics cases and identified associated risk factors. They found a relatively high occurrence of SSI in Orthopedics practice, particularly in emergency cases, underscoring the need for comprehensive infection control measures. Our study complements this by focusing on antibiotic prophylaxis in Orthopedic surgery, highlighting the importance of not solely relying on antibiotics and reinforcing the significance of a multifaceted approach to infection prevention.

The limitation of the study was the number of enrolled patients was small due to the short time period of the study. Secondly, the patients were not stratified according to age and sex and there was no control group. Third, the duration of follow up was shorter due to the time limitation of a thesis, so there were chances to miss late surgical site infections which could have occurred until there was implant.

## CONCLUSIONS

The surgical site infection in our study is lower compared to the study done in similar settings. The findings of the current study support the adoption of a 24-hour antibiotic regimen as an effective and cost-efficient approach to prevent SSI. Shorter antibiotic courses align with antimicrobial stewardship principles, and minimize antibiotic exposure without compromising patient safety.

**Conflict of Interest:** None.

## REFERENCES

1. Fletcher N, Sofianos D, Berkes MB, Obremskey WT. Prevention of perioperative infection. *J Bone Joint Surg Am*. 2007 Jul;89(7):1605-18. [PubMed | Full Text | DOI]
2. Whitehouse JD, Friedman ND, Kirkland KB, Richardson WJ, Sexton DJ. The Impact of Surgical-Site Infections Following Orthopedic Surgery at a Community Hospital and a University Hospital Adverse Quality of Life, Excess Length of Stay, and Extra Cost. *Infect Control Hosp Epidemiol* [Internet]. 2002 Apr [cited 2023 Nov 18];23(4):183-9. Available from: <https://www.cambridge.org/core/journals/infection-control-and-hospital-epidemiology/article/abs/impact-of-surgical-site-infections-following-orthopedic-surgery-at-a-community-hospital-and-a-university-hospital-adverse-quality-of-life-excess-length-of-stay-and-extra-cost/A458159DB34D8E8732490EB49FE14100>
3. Allegranzi B, Bischoff P, de Jonge S, Zeynep Kubilay N, Gomes MS SM, Abbas M, et al. New WHO recommendations on preoperative measures for surgical site infection prevention: an evidence-based global perspective. *Lancet Infect Dis*. 2016;16(12):276-87. [PubMed | Full Text | DOI]
4. WHO | WHO guidelines for safe surgery: safe surgery saves lives. WHO [Internet]. 2017 [cited 2023 Nov 19]; Available from: <http://www.who.int/patientsafety/topics/safe-surgery/guidelines/en/>
5. Dhammi IK, Rehan-Ul-Haq, Kumar S. Prophylactic antibiotics in orthopedic surgery. *Indian J Orthop* [Internet]. 2015 Jul 1 [cited 2023 Nov 18];49(4):373-6. [PubMed | Full Text | DOI] Available from: <https://link.springer.com/article/10.4103/0019-5413.159556>
6. Kalawar RPS, Shrestha B, Khanal G, Chaudhary P, Rijal R, Maharjan R, et al. Randomized controlled trial comparing cefazolin with ceftriaxone in perioperative prophylaxis in orthopaedic surgeries. *Journal of BP Koirala Institute of Health Sciences*. 2018 May 3;1(1):36-43. [Full Text | DOI]
7. Pavel A, Smith RL, Ballard A, Larson IJ. Prophylactic antibiotics in elective orthopedic surgery: a prospective study of 1,591 cases. *South Med J* [Internet]. 1977 Oct 1 [cited 2023 Nov 18];70 Suppl 1(10):50-5. [PubMed | DOI]
8. Shrestha B, Niraula S, Nepal P, Khanal G, Karn N, Chaudhary P, et al. Preoperative prophylactic antibiotics in orthopaedic surgery: duration of antibiotic administration. *Health Renaissance*. 2013 Feb 10;11(1):62-7. [Full Text]
9. Mathur P, Trikha V, Farooque K, Sharma V, Jain N, Bhardwaj N, et al. Implementation of a short course of prophylactic antibiotic treatment for prevention of postoperative infections in clean orthopaedic surgeries. *Indian Journal of Medical Research*. 2013 Jan;137(1):111-6. [PubMed]
10. Ziranu A, Lillo M, Fantoni M, Maffulli N, Maccauro G. Single dose cefazolin is safe and effective for pre-operative prophylaxis in orthopaedic oncology. *J Biol Regul Homeost Agents* [Internet]. 2018 Nov 1 [cited 2023 Nov 19];32(6 Suppl. 1):45-9. Available from: <https://europepmc.org/article/med/30644281>
11. Xu SG, Mao ZG, Liu BS, Zhu HH, Pan HL. Evaluating the use of antibiotic prophylaxis during open reduction and internal fixation surgery in patients at low risk of surgical site infection. *Injury* [Internet]. 2015 Feb 1 [cited 2023 Nov 18];46(2):184-8. [PubMed]
12. Boxma H, Broekhuizen T, Patka P, Oosting H. Randomised controlled trial of single-dose antibiotic prophylaxis in surgical treatment of closed fractures: The Dutch Trauma Trial. *Lancet* [Internet]. 1996 Apr 27 [cited 2023 Nov 18];347(9009):1133-7. [Full Text]
13. National Antibiotic Treatment Guideline-2014 [Internet]. [cited 2023 Nov 18]. Available from: <https://publichealthupdate.com/national-antibiotic-treatment-guideline-2014/>
14. Al-Mulhim FA, Baragbah MA, Sadat-Ali M, Alomran AS, Azam MQ. Prevalence of surgical site infection in orthopedic surgery: a 5-year analysis. *Int Surg* [Internet]. 2014 [cited 2023 Nov 18];99(3):264-8. [PubMed]

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