

Post-Operative Antibiotic Prophylaxis Regimen in Total Joint Arthroplasty: Is Single Dose as Effective as Multiple Doses?

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DOI: <https://doi.org/10.5281/zenodo.23178350>

Received: 04 September 2026, Revised: 18 September, Accepted: 01 October 2026, Online First: 07 October 2026

ABSTRACT

Background: Periprosthetic joint infection (PJI) remains one of the most devastating complications following primary total joint arthroplasty (TJA). Although multiple-dose postoperative antibiotic prophylaxis is widely practiced, the role of single-dose antibiotic prophylaxis in preventing infection while minimizing antibiotic exposure remains controversial. **Objective:** To evaluate and compare the clinical outcomes of single-dose versus multiple-dose postoperative antibiotic prophylaxis in patients undergoing primary total knee replacement (TKR) and total hip replacement (THR). **Methods:** A prospective observational study was conducted between January 2023 and December 2024 at the Department of Orthopaedics, B.J. Medical College and Civil Hospital, Ahmedabad. Eighty patients undergoing primary total joint arthroplasty were included, of whom 30 received single-dose postoperative antibiotic prophylaxis and 50 received multiple-dose prophylaxis. Patients were followed for a minimum period of six months. Outcomes assessed included postoperative infection rate, readmission, adverse drug reactions, duration of hospital stay, Knee Society Score (KSS), and Harris Hip Score (HHS). **Results:** Both groups demonstrated comparable postoperative outcomes. The infection rate was 3.33% in the single-dose group and 4% in the multiple-dose group, with similar readmission rates (3.33% vs. 4%). The average hospital stay was 5.2 days and 5.34 days, respectively. Functional outcomes improved significantly in both groups, with comparable six-month KSS and HHS scores. No adverse drug reactions were observed in the single-dose group, whereas two patients in the multiple-dose group developed antibiotic-related complications. **Conclusion:** Single-dose postoperative antibiotic prophylaxis is a safe and effective alternative to multiple-dose regimens in primary total joint arthroplasty. It provides comparable infection prevention, hospital stay, and functional outcomes while reducing antibiotic exposure and the risk of antibiotic-related adverse.

Keywords: Primary total joint arthroplasty; Total knee replacement; Total hip replacement; Antibiotic prophylaxis; Periprosthetic joint infection; Knee Society Score; Harris Hip Score.

INTRODUCTION

Total joint arthroplasty (TJA), comprising total knee replacement (TKR) and total hip replacement (THR), is widely regarded as one of the most successful and frequently performed orthopedic procedures worldwide. It remains the standard of care for patients with end-stage degenerative joint diseases, aiming to relieve pain, restore joint function, and improve quality of life. However, prosthetic joint infection (PJI) continues to be one of the most serious postoperative complications, often leading to revision surgery,

prolonged hospitalization, extended antibiotic therapy, increased healthcare costs, and significant morbidity. To minimize this risk, perioperative antibiotic prophylaxis is routinely administered in TJA and has become an integral component of infection prevention protocols. Traditionally, multiple-dose antibiotic regimens extending into the postoperative period have been employed to provide prolonged microbial coverage. However, increasing concerns regarding antimicrobial resistance, adverse drug reactions, and unnecessary healthcare expenditure have questioned

the need for prolonged antibiotic administration. Antibiotic resistance has emerged as a major global public health challenge, driven partly by the overuse and misuse of antimicrobial agents, including those used for surgical prophylaxis. Recent evidence-based recommendations from the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) advocate limiting prophylactic antibiotics to the perioperative period, emphasizing that adequate tissue antibiotic concentrations during the critical intraoperative period are more important than prolonged postoperative administration. Several studies have demonstrated comparable infection rates between single-dose and multiple-dose antibiotic regimens following primary TKR and THR; however, prospective comparative data, particularly in the Indian population, remain limited. Therefore, the present study aims to compare single-dose and conventional multiple-dose postoperative antibiotic prophylaxis in patients undergoing primary total knee and total hip arthroplasty. By evaluating the incidence of prosthetic joint infection and other postoperative complications, this study seeks to provide evidence-based guidance regarding optimal antibiotic prophylaxis strategies while promoting rational antibiotic use and combating antimicrobial resistance.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of Orthopaedics, Civil Hospital, Ahmedabad, between June 2023 and June 2025 to evaluate and compare the effectiveness of single-dose versus multiple-dose postoperative antibiotic prophylaxis in preventing prosthetic joint infection (PJI) following primary total joint arthroplasty. A total of 80 patients undergoing elective primary total knee replacement (TKR) or total hip replacement (THR) were included according to predefined inclusion and exclusion criteria and were prospectively followed for one year. Patients aged 18–75 years with ASA grade I or II and no evidence of active local or systemic infection were included, while revision arthroplasties, ASA grade III or IV patients, immunocompromised individuals, poorly controlled diabetes (HbA1c >8%), renal failure, malnutrition, low serum albumin (<3.5 g/dL), recent corticosteroid injection, severe peripheral vascular disease, poor soft tissue envelope, chronic venous ulcers, substance abuse, psychiatric illness, and patients unable to comply with follow-up were excluded. Patients were allocated into two groups based on the postoperative antibiotic regimen implemented at the time of surgery: the single-dose group (n=30) and the multiple-dose group (n=50). All patients underwent detailed preoperative clinical evaluation and laboratory investigations including complete blood count, ESR, CRP, random blood sugar, liver and renal function tests, urine routine and culture, blood culture, serological screening for HIV, HBV, and HCV, and skin swab culture from the operative

site. Only patients with negative cultures and no evidence of active infection were included in the study. Standard radiographs of the involved joint and orthoroentgenograms were obtained in all cases, and ultrasonography of the operative joint was performed to exclude preoperative collections; CT or MRI was obtained when clinically indicated.

Surgeries were performed in laminar airflow modular operating theatres on the fourth-floor operation theatre complex of Civil Hospital, Ahmedabad, maintaining strict fumigation and sterilization protocols. All instruments and prosthesis sets were sterilized according to hospital infection-control policies using pre-vacuum autoclaving. Patients received preoperative skin preparation with chlorhexidine-alcohol and povidone-iodine solutions, and a single dose of Inj. Cefosulbactam 1.5 g IV was administered 30–60 minutes before skin incision. Standard medial parapatellar approaches were used for TKR and posterior or direct lateral approaches for THR according to surgeon preference. Implant fixation was performed using cemented or press-fit techniques as appropriate. In the single-dose group, Inj. Cefosulbactam 1.5 g IV and Inj. Gentamicin 80 mg IV were administered within six hours postoperatively with no further antibiotics, whereas the multiple-dose group received the same intravenous antibiotics for five postoperative days followed by oral antibiotics until suture removal.

Postoperative care included daily wound assessment, aseptic dressing changes, drain-site swab cultures, early mobilization, physiotherapy, and standardized rehabilitation protocols. Patients were followed at 15 days, 3 months, 6 months, and 1 year. The primary outcome measure was the incidence of early postoperative surgical site infection and prosthetic joint infection, assessed by clinical signs including erythema, warmth, discharge, wound dehiscence, fever, and elevated inflammatory markers. Secondary outcome measures included readmission rates, reoperation rates, duration of hospital stay, requirement for additional intravenous antibiotics, wound-healing complications, microbiological profile, antibiotic-related adverse effects, and functional outcomes assessed using the Harris Hip Score (HHS) for THR and Knee Society Score (KSS) for TKR. Data were recorded and analyzed using appropriate statistical methods. Continuous variables were expressed as mean $\pm$ standard deviation and categorical variables as frequencies and percentages. Intergroup comparisons were performed using Student's t-test or Chi-square test as appropriate, and a p-value of less than 0.05 was considered statistically significant. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants before enrolment.

RESULTS

This study included a total of 80 patients who underwent total joint arthroplasty, of whom 30 patients received single-dose postoperative antibiotic prophylaxis and 50 patients received multiple-dose antibiotic prophylaxis. The outcomes were assessed across demographic characteristics, operative parameters, infection rates, readmission, adverse drug reactions, hospital stay, and functional outcomes. The sex distribution showed no major variation between groups, with an overall nearly equal distribution of males (48.8%) and females (51.2%). The majority of procedures performed were total knee replacements (67.5%), while total hip replacements accounted for 32.5% of cases (Table 1). Age-wise analysis demonstrated that most TKR patients belonged to the fifth and sixth decades of life, whereas THR patients were comparatively younger, with the majority of patients in the single-dose group being between 31 and 40 years of age. Operative side distribution showed a relatively equal distribution of right- and left-sided procedures in both groups.

Preoperative risk factor assessment revealed no significant differences between the two groups, indicating comparable baseline characteristics. The mean duration of surgery was also comparable between groups. Among non-infected patients, the average operative time was 87.6 minutes in the single-dose group and 90.4 minutes in the multiple-dose group, while infected cases had slightly longer operative durations of 94.3 and 95 minutes, respectively (Table 2).

Postoperative infection rates were low in both groups.

One patient in the single-dose group developed infection, corresponding to an infection rate of 3.33%, whereas two patients in the multiple-dose group developed infection, corresponding to an infection rate of 4%. Similarly, readmission rates were 3.33% and 4%, respectively. Adverse drug reactions were observed only in the multiple-dose group, where two patients (4%) developed antibiotic-related complications, while no adverse drug reactions were noted in the single-dose group. The mean duration of hospital stay was 5.2 days in the single-dose group and 5.34 days in the multiple-dose group, showing no meaningful difference between the groups.

Functional outcomes assessed using the Knee Society Score (KSS) and Harris Hip Score (HHS) demonstrated significant improvement in both groups. In TKR patients, the mean KSS improved from 80.56 to 165.2 in the single-dose group and from 78.76 to 166.4 in the multiple-dose group at six months. Similarly, in THR patients, the mean HHS improved from 36.13 to 83.47 in the single-dose group and from 38.69 to 82 in the multiple-dose group. Most patients achieved good to excellent functional outcomes at final follow-up, with no significant difference between the two antibiotic regimens.

Overall, both single-dose and multiple-dose postoperative antibiotic prophylaxis regimens resulted in comparable infection rates, readmission rates, hospital stay, and functional outcomes.

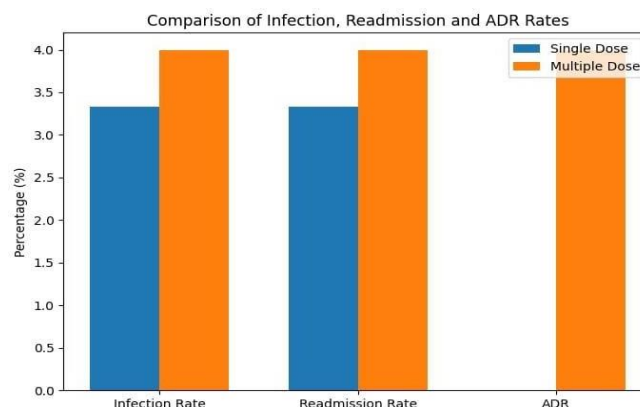
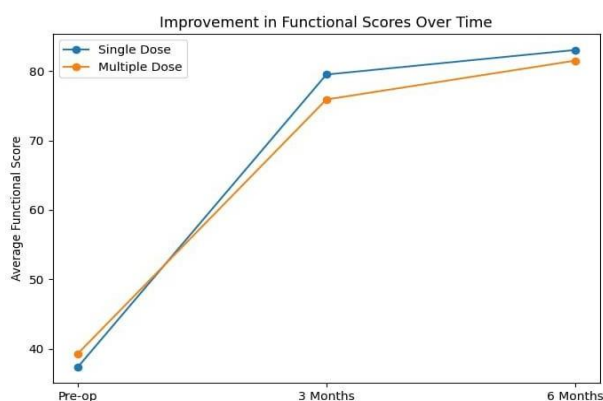
However, the absence of adverse drug reactions in the single-dose group suggests that a single-dose regimen is an effective and safe alternative to multiple-dose antibiotic prophylaxis in total joint arthroplasty.

Table 1. Baseline Demographic Characteristics of the Study Population

Variable	Single Dose (n=30)	Multiple Dose (n=50)	Total (n=80)
Sex Distribution			
Male	19	20	39
Female	11	30	41
Type of Arthroplasty			
TKR	15	39	54
THR	15	11	26
Clinical Outcomes			
Mean Hospital Stay (days)	5.20	5.34	5.29
Infection Rate (%)	3.33	4.00	3.75

Table 2. Clinical and Functional Outcomes

Outcome	Single Dose	Multiple Dose
Mean Surgery Duration (min)	87.60	90.40
Readmission Rate (%)	3.33	4.00
Adverse Drug Reactions (%)	0.00	4.00
Final Knee Society Score TKR	165.20	166.40
Final Harris Hip Score (THR)	83.47	82.00



DISCUSSION

This prospective comparative study evaluated the efficacy and safety of single-dose versus multiple-dose postoperative antibiotic prophylaxis in patients undergoing primary total joint arthroplasty. Eighty patients undergoing total knee replacement (TKR) and total hip replacement (THR) were assessed across multiple clinical parameters to determine whether a single postoperative antibiotic dose provides outcomes comparable to conventional multiple-dose regimens. Key domains discussed include demographic characteristics, preoperative risk factors, operative parameters, infection rates, readmission, adverse drug reactions, hospital stay, and functional outcomes.

Demographic and Clinical Profiles: The age and sex distribution in both groups reflected the typical demographics of patients undergoing primary arthroplasty. Most patients belonged to the fifth and sixth decades of life, corresponding to the peak incidence of degenerative joint diseases and osteoarthritis requiring surgical intervention.

Similarly, TKR was more common in females, whereas THR was predominantly performed in males, consistent with the known epidemiology of knee osteoarthritis and avascular necrosis of the hip. The nearly equal overall distribution of males and females and comparable baseline characteristics in both groups ensured the internal validity of the comparative analysis.

Preoperative investigations including white blood cell counts, erythrocyte sedimentation rate, C-reactive protein, urine culture, and chest radiographs showed no significant differences between the groups, indicating that both cohorts were clinically stable and suitable for comparison. These comparable baseline characteristics minimized selection bias and allowed a more reliable evaluation of the effect of antibiotic prophylaxis regimens on postoperative outcomes.

Operative Characteristics and Safety Profile: The mean duration of surgery was slightly longer in infected patients in both groups, suggesting that prolonged operative time may contribute to an increased risk of postoperative infection. The average operative duration in our study was slightly higher than that reported by the Dutch Arthroplasty Register Study (2020), but

remained within the accepted range for primary arthroplasty procedures. The average hospital stay was comparable between the two groups, although patients receiving a single-dose regimen demonstrated a marginally shorter duration of hospitalization. This finding suggests that limiting postoperative antibiotic administration does not adversely affect postoperative recovery or delay discharge.

Adverse drug reactions were observed only in the multiple-dose group, whereas no antibiotic-related complications occurred in the single-dose group. This finding highlights one of the potential advantages of reducing antibiotic exposure and supports the principles of antibiotic stewardship by minimizing unnecessary antibiotic use and reducing the risk of drug-related complications.

Infection Rates and Functional Outcomes: The incidence of postoperative infection was low in both groups and showed no meaningful difference between single-dose and multiple-dose antibiotic prophylaxis. The observed infection rates were comparable to those reported by the Dutch Arthroplasty Register Study, which also demonstrated no significant benefit of prolonged antibiotic administration. Interestingly, the single-dose group developed only an early superficial infection that resolved with treatment, whereas the multiple-dose group had one case of late prosthetic joint infection, suggesting that prolonged antibiotic administration may delay the clinical presentation of infection rather than completely prevent it.

Similarly, readmission rates were comparable between the groups, and all readmissions were related to infection. These findings further support the conclusion that single-dose antibiotic prophylaxis does not increase the risk of postoperative complications requiring rehospitalization.

Functional outcomes assessed using the Knee Society Score and Harris Hip Score demonstrated significant improvement in both groups at six months of follow-up, with no clinically significant differences between the two regimens. Most patients achieved good to excellent functional outcomes irrespective of the antibiotic protocol used. These findings reinforce the principle that postoperative functional recovery after arthroplasty depends primarily on successful surgical

reconstruction, rehabilitation, and infection prevention rather than the duration of postoperative antibiotic administration.

Clinical Implications and Literature Correlation: The findings of the present study are consistent with those of the Dutch Arthroplasty Register Study and other published literature demonstrating equivalent infection rates, readmission rates, and functional outcomes with single-dose and multiple-dose antibiotic prophylaxis. Although our cohort demonstrated slightly longer hospital stays and marginally higher infection rates, the overall outcomes remained comparable. These findings suggest that a single postoperative antibiotic dose is an effective and safe alternative to conventional multiple-dose regimens and may provide additional benefits by reducing antibiotic exposure, minimizing adverse drug reactions, lowering treatment costs, and supporting antibiotic stewardship programs.

Limitations

The present study has certain limitations, including a relatively small sample size, single-center design, and a limited follow-up period. The study was not randomized, and the number of infection events was small, limiting the ability to detect minor differences between the two groups. Further multicentric randomized studies with larger patient populations and long-term follow-up are required to evaluate implant survivorship, late prosthetic joint infection, antibiotic resistance patterns, and cost-effectiveness of single-dose antibiotic prophylaxis in primary total joint arthroplasty.

Strengths

The major strengths of this study include its prospective observational design and direct comparison of single-dose and multiple-dose postoperative antibiotic prophylaxis in patients undergoing primary total knee and total hip arthroplasty. The study evaluated clinically relevant outcomes, including postoperative infection, readmission, hospital stay, antibiotic-related adverse effects, and functional outcomes using the Knee Society Score and Harris Hip Score. Patients were followed systematically after surgery, allowing assessment of both early postoperative complications and functional recovery. The study also provides data from an Indian tertiary-care setting, where prospective comparative evidence regarding postoperative antibiotic duration remains limited. The findings may therefore contribute to antibiotic stewardship and support consideration of shorter prophylactic regimens in appropriately selected arthroplasty patients.

Future Directions

Future studies should include larger, multicenter, randomized controlled trials with longer follow-up periods to confirm the safety and effectiveness of single-dose postoperative antibiotic prophylaxis.

Further research should evaluate late prosthetic joint infections, implant survivorship, antimicrobial resistance patterns, antibiotic-related complications, healthcare costs, and patient-reported outcomes. Studies involving diverse patient populations and different arthroplasty settings would also help determine the generalizability of these findings and establish standardized evidence-based antibiotic prophylaxis protocols.

CONCLUSION

In patients undergoing primary total joint arthroplasty, both single-dose and multiple-dose postoperative antibiotic prophylaxis regimens are effective in preventing postoperative infection and achieving satisfactory functional recovery.

However, single-dose antibiotic prophylaxis demonstrates comparable infection rates, readmission rates, hospital stay, and functional outcomes, while offering potential advantages in reducing antibiotic exposure and avoiding antibiotic-related adverse reactions. For appropriately selected patients undergoing primary total knee and total hip arthroplasty, a single-dose postoperative antibiotic regimen offers a safe, effective, and cost-efficient alternative to conventional multiple-dose prophylaxis.

Declaration

Ethics Approval

The study was approved by the Institutional Ethics Committee of the participating institution.

Informed Consent

Written informed consent was obtained from all participants before enrolment in the study.

Conflict of Interest

The authors declare that they have no conflicts of interest related to this study.

Funding

No external funding was received for the conduct of this study.

Data Availability

The data generated and analyzed during the present study are available from the corresponding author on reasonable request, subject to institutional and ethical requirements.

Author Contributions

All authors contributed to the conception and design of the study, data collection, analysis and interpretation of the results, manuscript preparation, critical revision of the manuscript, and approval of the final version for publication.

Consent for Publication

Not applicable. No individually identifiable patient

information is presented in this manuscript.

AI Use Disclosure

The authors declare that no generative artificial intelligence tools were used to generate or substantially modify the scientific content of this manuscript.

Glossary of Abbreviations

ADR – Adverse Drug Reaction CRP – C-Reactive Protein

ESR – Erythrocyte Sedimentation Rate HHS – Harris Hip Score

IV – Intravenous

KSS – Knee Society Score LOS – Length of Stay

PJI – Prosthetic Joint Infection THR – Total Hip Replacement TJA – Total Joint Arthroplasty TKR – Total Knee Replacement

WBC – White Blood Cell count

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