

Risk Factors, Microbiological Spectrum, and Outcomes of Prosthetic Joint Infection After Total Knee ArthroplastyChintan P. Dave¹, Yash S. Shah², Krishnakant R. Sharma³¹Senior Resident, Department of Orthopaedic, Tibra Hospital, Sikar, Rajasthan²Senior resident, Department of Orthopaedic, Narendra Modi Medical College, LG hospital, Maninagar, Ahmedabad, Gujarat, India³Second Year Resident, Department of Orthopaedic, Narendra Modi Medical College, LG hospital, Maninagar, Ahmedabad, Gujarat, India

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Conflict of interest: Nil

Abstract:**Background:** Prosthetic joint infection (PJI) is one of the most serious complications following total knee arthroplasty, leading to significant morbidity, prolonged hospitalization, and increased healthcare costs. Despite advances in surgical techniques and infection control measures, the burden of PJI remains substantial, particularly in patients with associated comorbidities.**Objectives:** To study the clinico-demographic profile, microbiological spectrum, management strategies, and outcomes of prosthetic joint infection in patients undergoing total knee arthroplasty.**Methods:** A hospital-based observational study was conducted over a period of two years at a tertiary care hospital in Western India. A total of 50 patients diagnosed with prosthetic joint infection following total knee arthroplasty were included. Data regarding demographic characteristics, comorbidities, clinical presentation, microbiological findings, treatment modalities, and outcomes were collected using a structured proforma. Statistical analysis was performed using appropriate tests, and p-value < 0.05 was considered significant.**Results:** The majority of patients belonged to the elderly age group with a female predominance. Osteoarthritis (80.0%) was the most common indication for surgery. Diabetes mellitus and obesity were the most frequent comorbidities and showed a significant association with poor outcomes. Pain (100%) was the most common presenting symptom. Staphylococcus aureus (40.0%) was the predominant organism isolated. Debridement, antibiotics, and implant retention (DAIR, 40%) was the most commonly employed treatment modality, while two-stage revision (30.0%) was used in chronic cases. A favourable outcome was observed in the majority of patients; however, adverse outcomes were associated with delayed presentation, gram-negative infections, and presence of comorbidities.**Conclusion:** Prosthetic joint infection remains a challenging complication of total knee arthroplasty. Early diagnosis, appropriate surgical intervention, and optimization of risk factors are crucial for improving outcomes. Strengthening infection control practices and adopting standardized management protocols can further reduce the incidence and impact of PJI.**Keywords:** Infection Control, Outcome, Prosthetic Joint Infection, Revision Surgery, Staphylococcus aureus, Total Knee Arthroplasty.**DOI:** 10.25258/ijpqa.17.4.8This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**Introduction**

Total knee arthroplasty (TKA) is one of the most commonly performed orthopedic procedures worldwide for the management of advanced osteoarthritis and other degenerative joint diseases. It has been established that TKA significantly improves pain, mobility, and quality of life in patients with end-stage knee pathology, making it a highly successful surgical intervention with long-term functional benefits [1]. With increasing life expectancy and rising prevalence of osteoarthritis, the number of TKA procedures is steadily increasing

globally as well as in India [2]. Postoperative recovery following orthopedic procedures may be influenced by a range of complications, including both infectious and non-infectious conditions such as heterotopic ossification [3].

Despite its success, prosthetic joint infection (PJI) remains one of the most serious and devastating complications following total knee arthroplasty. It has been emphasized that PJI is associated with significant morbidity, repeated surgical

interventions, prolonged antibiotic therapy, and increased healthcare costs, thereby posing a major challenge in orthopedic practice. The reported incidence of PJI after TKA ranges from 1% to 2% in primary procedures and may rise up to 4% in revision surgeries [4]. Although relatively uncommon, its impact on patient outcomes and healthcare systems is disproportionately high.

The pathogenesis of prosthetic joint infection is complex and involves microbial colonization, biofilm formation on implant surfaces, and host immune response. It has been described that biofilm formation plays a crucial role in the persistence of infection, as bacteria within biofilms exhibit increased resistance to antibiotics and host defences [5]. The most commonly implicated organisms include *Staphylococcus aureus* and *Staphylococcus epidermidis*, along with gram-negative bacteria in certain settings [6]. Early diagnosis remains challenging due to nonspecific clinical presentation and limitations of diagnostic modalities.

In recent years, advancements in diagnostic criteria, including the Musculoskeletal Infection Society (MSIS) criteria and the incorporation of biomarkers such as CRP, ESR, and synovial fluid analysis, have improved the accuracy of diagnosis [7]. However, it has been noted that no single diagnostic test is sufficient, and a combination of clinical, laboratory, and microbiological parameters is essential for confirmation of PJI [8]. Similarly, treatment strategies including debridement, antibiotics, and implant retention (DAIR), one-stage revision, and two-stage revision arthroplasty are employed based on the timing and severity of infection [9].

In the Indian context, the burden of prosthetic joint infection is increasing due to the rising number of arthroplasty procedures, variability in infection control practices, and presence of comorbid conditions such as diabetes and malnutrition. Studies have reported that delayed diagnosis, inadequate follow-up, and antimicrobial resistance further complicate the management of PJI in developing countries [10]. Additionally, data from Western India remain limited, highlighting the need for region-specific research to understand the epidemiological and clinical profile of PJI.

Given the serious consequences of prosthetic joint infection, there is a need to systematically evaluate its clinical presentation, risk factors, microbiological profile, and outcomes in patients undergoing total knee arthroplasty. Such studies are essential for improving early detection, optimizing treatment strategies, and reducing morbidity associated with this complication. The findings will contribute to strengthening infection control protocols, guiding antibiotic policies, and enhancing patient care in tertiary care settings.

The present study aims to evaluate prosthetic joint infection in patients undergoing total knee arthroplasty in a tertiary care hospital setting. The objectives are to assess the sociodemographic and clinical profile of affected patients, identify common risk factors and comorbid conditions, analyze the microbiological spectrum and antibiotic sensitivity patterns, and evaluate the treatment modalities and outcomes associated with prosthetic joint infections.

Materials and Methods

This hospital-based observational study with a cross-sectional analytical design was conducted over a period of two years at a tertiary care hospital in Western India. The study included patients who underwent total knee arthroplasty and subsequently developed prosthetic joint infection during the study period. All eligible patients fulfilling the inclusion criteria were enrolled consecutively until the required sample size was achieved.

As prosthetic joint infection following total knee arthroplasty is a relatively infrequent but clinically significant complication, and this was a hospital-based observational study, a consecutive sampling method was adopted. All patients diagnosed with prosthetic joint infection after total knee arthroplasty and fulfilling the inclusion criteria during the 2-year study period were included in the study. Thus, the final sample size was 50 cases.

Patients of all age groups who underwent primary or revision total knee arthroplasty and were diagnosed with prosthetic joint infection based on standard diagnostic criteria, including clinical findings, laboratory parameters (ESR, CRP), microbiological culture, and radiological evidence, were included in the study. Patients with incomplete clinical records, those unwilling to participate, and cases of superficial wound infection not involving the prosthesis were excluded from the study.

Data were collected using a predesigned, pretested structured proforma. Detailed information regarding sociodemographic characteristics such as age, gender, residence, occupation, and socioeconomic status was recorded. Clinical variables including indication for total knee arthroplasty, comorbid conditions (such as diabetes mellitus, obesity, and immunosuppression), duration of symptoms, and time interval between surgery and onset of infection were documented. Laboratory investigations including ESR, CRP, total leukocyte count, and microbiological culture reports were recorded. The type of organism isolated and antibiotic sensitivity pattern were also noted. Treatment details including type of intervention (debridement, antibiotics and implant retention, one-stage or two-stage revision) and clinical outcomes were documented.

All patients were managed as per standard institutional protocols under strict aseptic

precautions. Follow-up data were collected from hospital records and outpatient visits to assess treatment response and complications. The primary outcome measures included clinical profile, microbiological pattern, and treatment outcomes of prosthetic joint infection.

The collected data were entered into Microsoft Excel and analyzed using Epi Info version 7.2.5.0 (Centers for Disease Control and Prevention, Atlanta, USA). Descriptive statistics were expressed as mean \pm standard deviation for continuous variables and frequency with percentage for categorical variables. Chi-square test or Fisher's exact test were applied to assess the association between categorical variables, while independent t-test was used for comparison of means. Multivariate logistic regression analysis was performed to identify independent risk factors associated with poor outcomes. A p-value of less than 0.05 was considered statistically significant.

Ethical approval was obtained from the Institutional Ethics Committee prior to commencement of the study. Informed written consent was obtained from all participants, and confidentiality of patient information was strictly maintained throughout the study.

Results

A total of 50 patients with prosthetic joint infection following total knee arthroplasty were included in this study. The majority of patients belonged to the age group of 61–70 years (36%), followed by 51–60 years (28%), indicating that prosthetic joint infection was more common in the elderly population. A female predominance was observed (60%), which correlates with the higher number of total knee arthroplasty procedures performed in females due to osteoarthritis. Most patients were from rural areas (64%) and belonged to the middle socioeconomic class (48%), reflecting the hospital's catchment population [Table 1].

Table 1: Demographic Profile of Patients (n = 50)

| Variable | Category | Frequency (%) |
|-----------------------------|----------|---------------|
| Age Group (years) | <50 | 8 (16.0) |
| | 51–60 | 14 (28.0) |
| | 61–70 | 18 (36.0) |
| | >70 | 10 (20.0) |
| Gender | Male | 20 (40.0) |
| | Female | 30 (60.0) |
| Residence | Rural | 32 (64.0) |
| | Urban | 18 (36.0) |
| Socioeconomic Status | Lower | 18 (36.0) |
| | Middle | 24 (48.0) |
| | Upper | 8 (16.0) |

Table 2: Clinical Profile and Risk Factors

| Variable | Category | Frequency (%) |
|---------------------------|-----------------------|---------------|
| Indication for TKA | Osteoarthritis | 40 (80.0) |
| | Rheumatoid arthritis | 6 (12.0) |
| | Others | 4 (8.0) |
| Comorbidities | Diabetes Mellitus | 22 (44.0) |
| | Hypertension | 18 (36.0) |
| | Obesity | 14 (28.0) |
| | None | 10 (20.0) |
| Time of Infection | Early (<3 months) | 18 (36.0) |
| | Delayed (3–12 months) | 14 (28.0) |
| | Late (>12 months) | 18 (36.0) |
| Clinical Features | Pain | 50 (100) |
| | Swelling | 42 (84.0) |
| | Fever | 28 (56.0) |
| | Sinus discharge | 16 (32.0) |

Regarding the clinical profile, osteoarthritis was the most common indication for total knee arthroplasty (80%), followed by rheumatoid arthritis (12%). Among comorbid conditions, diabetes mellitus was the most prevalent (44%), followed by hypertension

(36%) and obesity (28%), highlighting the role of metabolic and systemic factors in the development of infection. Based on the timing of infection, early infections (<3 months) and late infections (>12 months) were equally common (36% each), while

delayed infections (3–12 months) accounted for 28% of cases. Clinically, all patients presented with pain (100%), while swelling (84%), fever (56%),

and sinus discharge (32%) were also commonly observed features [Table 2].

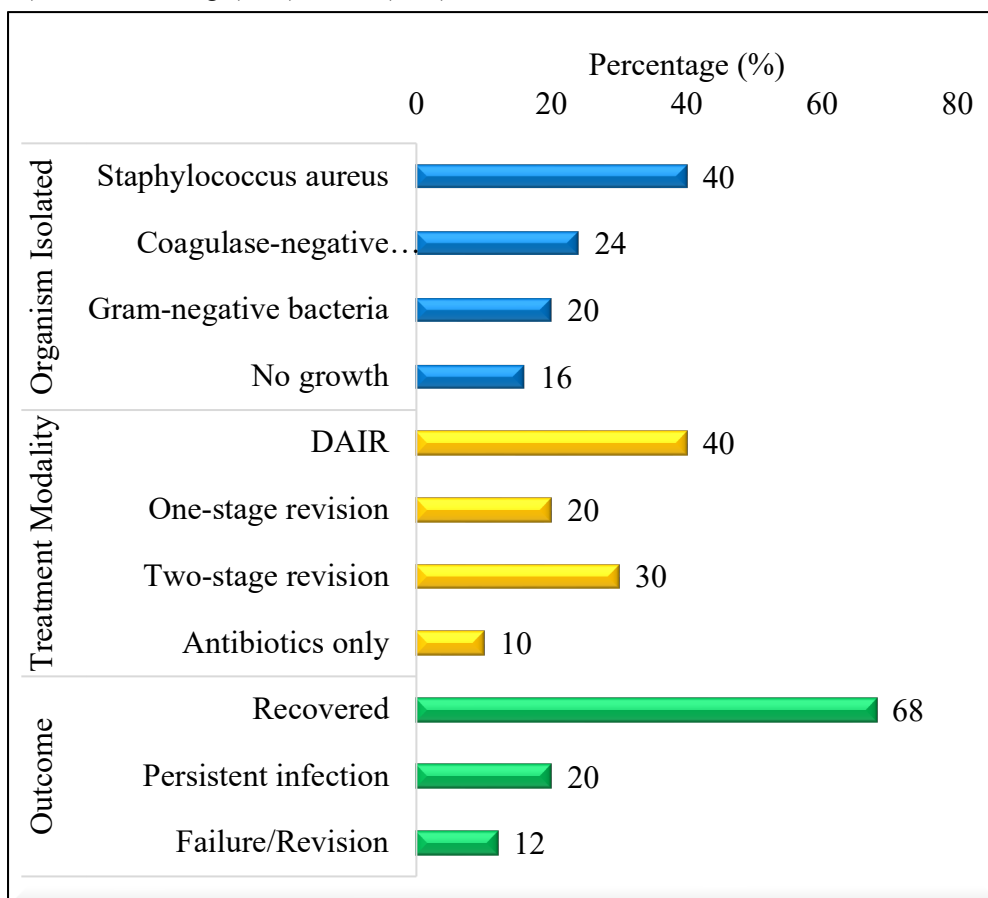


Figure 1: Microbiological Profile and Treatment Outcome

Microbiological analysis revealed that *Staphylococcus aureus* was the most commonly isolated organism (40%), followed by coagulase-negative staphylococci (24%) and gram-negative organisms (20%), while 16% of cases showed no growth. In terms of management, debridement, antibiotics, and implant retention (DAIR) was the most commonly employed treatment modality (40%), followed by two-stage revision (30%) and one-stage revision (20%). Antibiotic therapy alone was used in a smaller proportion of patients (10%). Outcome analysis showed that the majority of patients recovered (68%), while 20% had persistent infection and 12% required further revision or had treatment failure [Figure 1].

Figure 1: Microbiology, Treatment and Outcome Distribution

On statistical analysis, diabetes mellitus and obesity were found to be significantly associated with poor outcomes ($p < 0.05$), indicating their role as important risk factors. Additionally, infections caused by gram-negative organisms were significantly associated with adverse outcomes ($p < 0.05$). However, variables such as age, gender, and timing of infection did not show a statistically significant association. Overall, the findings suggest that prosthetic joint infection remains a significant complication following total knee arthroplasty, particularly in patients with metabolic risk factors and infections caused by virulent organisms [Table 3].

Table 3: Association of Risk Factors with Poor Outcome

| Variable | Poor Outcome (%) | Good Outcome (%) | p-value |
|-------------------------|------------------|------------------|---------|
| Diabetes (Present) | 12 (54.5) | 10 (45.5) | 0.03 |
| Obesity (Present) | 10 (71.4) | 4 (28.6) | 0.01 |
| Early Infection | 5 (27.8) | 13 (72.2) | 0.21 |
| Gram-negative infection | 8 (80.0) | 2 (20.0) | 0.02 |

Discussion

Age and Gender Distribution: In this study, the majority of patients belonged to the 61–70 years age

group with a female predominance. This finding aligns with the epidemiological pattern of total knee arthroplasty. Namba et al. reported that most patients undergoing TKA were elderly, with a mean age above 65 years and a higher proportion of females due to increased osteoarthritis prevalence [11]. Similarly, Kurtz et al. observed a female predominance in knee arthroplasty cases globally [12].

Indication for Surgery: Osteoarthritis was the most common indication (80%) in this study. Carr et al. reported that osteoarthritis accounts for more than 85% of total knee replacement cases worldwide [13]. Likewise, Singh et al. demonstrated that degenerative joint disease is the leading indication for arthroplasty procedures, supporting the present findings [14].

Comorbidities and Risk Factors: Diabetes mellitus and obesity were significant risk factors associated with prosthetic joint infection and poor outcomes. Krause et al. reported that diabetes increases infection risk due to impaired immunity and wound healing [15]. Similarly, Dowsey et al. identified obesity as an independent predictor of infection and postoperative complications in TKA patients [16].

Timing of Infection: The study showed a comparable distribution of early, delayed, and late infections. Ries et al. classified prosthetic joint infections into early, delayed, and late categories, with early infections linked to surgical contamination and late infections to hematogenous spread [17]. The present study findings are consistent with this classification.

Clinical Presentation: Pain was the most common presenting complaint, followed by swelling and fever. Tande et al. reported that pain is the most consistent symptom of prosthetic joint infection, while systemic symptoms like fever may not always be present [6]. The clinical profile observed in this study is therefore consistent with existing literature.

Microbiological Profile: *Staphylococcus aureus* was the most common organism isolated, followed by coagulase-negative staphylococci and gram-negative organisms. Zmistowski et al. reported *Staphylococcus aureus* as the predominant organism in prosthetic joint infections, accounting for a significant proportion of cases [18]. Gram-negative infections, though less frequent, were associated with more severe outcomes.

Treatment Modalities: DAIR was the most commonly used treatment modality in this study. Byren et al. demonstrated that DAIR is effective in early infections when timely intervention is performed [19]. Two-stage revision remains the gold standard for chronic infections, which is reflected in the treatment distribution of this study.

Incorporation of early and structured physiotherapy protocols may further enhance recovery and functional outcomes in patients treated for prosthetic joint infections [20,21].

Outcome and Prognostic Factors: The majority of patients recovered, while poor outcomes were associated with diabetes, obesity, and gram-negative infections. These findings are consistent with previous studies showing that comorbidities and resistant organisms significantly influence prognosis [6]. Early diagnosis and appropriate management play a crucial role in improving outcomes.

Conclusion

This study highlights that prosthetic joint infection following total knee arthroplasty remains a significant clinical challenge, particularly among elderly patients with comorbid conditions such as diabetes and obesity. The majority of infections were associated with *Staphylococcus aureus*, reaffirming its role as the predominant causative organism. Early diagnosis and timely intervention, especially using DAIR in selected cases, resulted in favorable outcomes in a substantial proportion of patients. However, delayed presentation, presence of resistant organisms, and systemic risk factors were associated with poorer prognosis and higher failure rates. The findings emphasize that a multidisciplinary approach, strict aseptic protocols, and risk factor optimization are essential to improve clinical outcomes and reduce the burden of prosthetic joint infections.

Limitations

This study had a relatively small sample size, which may limit the generalizability of the findings to a larger population. Being conducted at a single tertiary care center, the results may reflect regional practice patterns and microbiological profiles rather than a broader population-based trend. The duration of follow-up was limited, which may have underestimated late-onset infections and long-term complications. Additionally, variations in treatment protocols and surgeon preferences could have influenced the outcomes. Some potential confounding factors such as nutritional status, immunological profile, and detailed antibiotic sensitivity patterns were not extensively analyzed.

Recommendations

Future studies should be conducted with a larger sample size and multi-center involvement to improve the external validity of the findings. Long-term follow-up is recommended to better assess late infections and prosthesis survival rates. Early screening and optimization of modifiable risk factors such as diabetes control and obesity should be emphasized prior to surgery. Implementation of standardized treatment protocols and infection

control measures across centers can help reduce variability in outcomes. Further research focusing on antimicrobial resistance patterns and newer therapeutic strategies, including biofilm-targeted treatments, is essential to improve management outcomes in prosthetic joint infections.

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