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# INCIDENCE AND PATTERNS OF PERIPROSTHETIC FRACTURES IN PATIENTS FOLLOWING JOINT ARTHROPLASTY: A PROSPECTIVE STUDY

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## ABSTRACT

**Background:** Periprosthetic fractures (PPFs) following total joint arthroplasty represent a significant and growing orthopedic challenge due to the increasing number of primary and revision arthroplasty procedures, particularly in elderly patients with comorbidities such as osteoporosis. These fractures are associated with high morbidity, complex surgical management, and prolonged recovery. **Aim:** To analyze the incidence, classification patterns, and treatment outcomes of periprosthetic fractures in patients with prior hip or knee arthroplasty in a tertiary care setting. **Materials and Methods:** This prospective observational study was conducted over 16 months and included 25 patients who sustained PPFs following either total hip arthroplasty (THA) or total knee arthroplasty (TKA). Fractures were classified using the Vancouver system for hips and the Rorabeck system for knees. Data on demographics, fracture type, treatment modality, and outcomes were collected. Management included open reduction and internal fixation (ORIF), revision arthroplasty, or conservative treatment. Outcomes were assessed based on union rates and need for reoperation. **Result:** THA-related fractures accounted for 56% (n=14), with Vancouver B2 being most common. TKA-related fractures accounted for 44% (n=11), with Rorabeck Type II predominating. ORIF was performed in 13 patients, revision arthroplasty in 9, and conservative treatment in 3. Union was achieved in 92% of ORIF and 89% of revision cases. The reoperation rate was 8%. **Conclusion:** Periprosthetic fractures require timely diagnosis and individualized management. High union rates and low complication profiles emphasize the effectiveness of fracture-specific surgical strategies.

## INTRODUCTION

Periprosthetic fractures (PPFs) are increasingly recognized as serious complications following joint arthroplasty, posing significant challenges in management due to their association with prolonged morbidity, impaired function, and increased healthcare costs.[1] With the rising volume of total joint arthroplasties—particularly total hip arthroplasty (THA) and total knee arthroplasty (TKA)—performed globally, the incidence of PPFs has correspondingly increased, making them a critical concern in orthopedic practice.[2,3]

Total joint arthroplasty is among the most common elective surgeries worldwide, particularly in aging populations where degenerative joint diseases are prevalent.[4] In recent decades, improvements in surgical technique and implant design have expanded indications for arthroplasty, further increasing the number of patients at risk for complications like PPFs.[5] The elderly, especially females with osteoporosis or other bone-weakening conditions, constitute the highest-risk group, due to decreased bone mineral density and comorbidities such as rheumatoid arthritis or corticosteroid use.[5,6]

The reported incidence of PPFs varies according to joint type, primary versus revision surgery, and length of follow-up. For primary THA, incidence rates range from 0.1% to 4%, rising up to 20% following revision procedures due to compromised bone stock and surgical complexity.[1,2] PPFs after TKA occur in approximately 0.3% to 2.5% of primary cases and escalate to 5%–10% in revisions.[3,4] These fractures can result from low-energy trauma in weakened bone or mechanical failure related to implant loosening and osteolysis.[7]

PPFs may occur intraoperatively or postoperatively. Intraoperative fractures, often due to mechanical stresses during implant insertion or removal, are more common in revision surgeries involving complex anatomy and bone loss.[8] Postoperative fractures typically develop years after arthroplasty and are usually caused by minor trauma or spontaneous events related to implant loosening.[7] The average time from arthroplasty to fracture is about 3 to 5 years, underscoring the need for extended follow-up.[7]

Accurate classification of PPFs is essential for guiding treatment. The Vancouver classification is the standard for periprosthetic femoral fractures after THA, categorizing fractures by location, implant stability, and bone stock.[9] Type B fractures, especially B2 (loose implant with adequate bone stock), are the most frequently encountered and often require revision surgery.[10,11] For TKA-related PPFs, the Rorabeck classification is widely used, dividing fractures by displacement and implant stability.[12] These systems help tailor surgical decisions and predict outcomes.

Treatment depends on fracture type and implant stability. ORIF is preferred for stable implants (Vancouver B1, Rorabeck type II), employing locking plates, cerclage wires, and biological adjuncts.[13,15] Revision arthroplasty is reserved for unstable implants (Vancouver B2/B3, Rorabeck type III), requiring complex reconstructions with long-stem implants and modular augments.[16] Conservative management is limited to select cases with minimal displacement or high surgical risk.[17]

PPFs carry notable risks of complications such as infection, non-union, and reoperation, with reported rates of 10% to 20%.[18] Early detection, precise classification, and multidisciplinary management improve outcomes.[19] However, many studies exclude intraoperative fractures, possibly underestimating the true incidence and burden of PPFs.[20]

This study aims to evaluate the incidence, fracture patterns, and treatment outcomes of PPFs following joint arthroplasty. By providing detailed demographic and clinical data, this study seeks to enhance understanding of PPFs and contribute to improved patient care strategies.

## MATERIALS AND METHODS

### Study Setting and Design

This was a prospective observational study conducted in the Department of Orthopaedics at a tertiary care teaching hospital Mata Gujri Memorial medical college and Lions seva kendra hospital, kishanganj, bihar, over a 16-month period from May 2024 to august 2025. The study was designed to evaluate the incidence and patterns of periprosthetic fractures in patients presenting after total joint arthroplasty (hip and knee).

Ethical clearance for the study was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to inclusion in the study.

**Study Population and Sample Size:** A consecutive sampling technique was used to include 25 patients who presented with periprosthetic fractures following total joint arthroplasty. All eligible patients who met the inclusion criteria and provided informed consent during the 16-month study period were enrolled.

Although no formal power calculation was performed due to the observational nature of the study and the relatively rare occurrence of periprosthetic fractures, a sample size of 25 was considered adequate to observe preliminary trends and descriptive patterns.

**Inclusion Criteria:** Patients were included in the study based on the following criteria: Age ≥ 18 years. History of total joint arthroplasty (either total hip arthroplasty [THA] or total knee arthroplasty [TKA]). Radiologically confirmed periprosthetic fracture, either intraoperative or postoperative. Presentation within the study period with adequate follow-up data. Willingness to participate and provide informed consent.

**Exclusion Criteria:** The following exclusion criteria were applied: Fractures unrelated to prosthetic implantation (e.g., native bone fractures, periprosthetic fractures from non-arthroplasty implants). Patients undergoing unicompartmental knee arthroplasty, hip resurfacing, or non-cemented hemiarthroplasty. Pathological fractures due to malignancy or infection. Patients unwilling or unable to provide consent. Incomplete radiological or surgical data.

### Methodology

**Patient Evaluation and Data Collection:** Upon presentation, all patients underwent a detailed clinical evaluation including demographic data (age, sex, BMI), medical history (e.g., osteoporosis, rheumatoid arthritis, steroid use), type of index arthroplasty (primary or revision), time since implantation, mechanism of injury, and comorbidities.

**Radiographic Assessment:** Standard radiographic imaging, including anteroposterior (AP) and lateral views of the involved joint, was performed. Additional imaging, such as CT scans, were utilized as needed to define fracture geometry and implant integrity.

**Management:** Treatment approach, surgical or conservative was individualized based on fracture type, implant stability, patient comorbidities, and surgeon judgment. The following procedures were considered: Revision arthroplasty with or without extended stems. Open reduction and internal fixation (ORIF) using locking plates or cerclage wiring. Nonoperative management in selected cases with minimal displacement or high surgical risk.

Intraoperative findings were noted, including bone quality, loosening, implant type, and intraoperative complications. Patients were followed up clinically and radiographically at 6 weeks, 3 months, and 6 months post-treatment.

**Outcome Parameters:** The parameters assessed included: Incidence of periprosthetic fractures among all arthroplasty patients during the study period. Fracture patterns based on classification systems. Timing of fracture relative to index arthroplasty (early: <3 months, late: ≥3 months). Management outcomes including union, complications, and reoperation rates. Mortality and functional status at latest follow-up.

**Statistical Analysis**

Data were collected using standardized case report forms and Statistical analysis was performed using SPSS version 20.0. Continuous variables were summarized as mean ± standard deviation (SD). Categorical variables were expressed as frequency and percentages. Differences in fracture patterns were analyzed using the Chi-square test. A p-value of <0.05 was considered statistically significant.

## RESULTS

A total of 25 patients with confirmed periprosthetic fractures following either total hip arthroplasty (THA) or total knee arthroplasty (TKA) were included in the study over a 16-month period. The results are presented in terms of patient demographics, fracture classifications, management modalities, and short-term outcomes.

Demographic and Clinical Characteristics

The demographic profile of the study cohort is summarized in Table 1. Of the 25 patients, 14 (56%) had undergone THA, while 11 (44%) had undergone TKA prior to the periprosthetic fracture event. The mean age of the study population was 68.4 years (range: 54–83 years), with a higher representation of female patients (n=15, 60%) compared to males (n=10, 40%).

Fractures were classified based on timing of occurrence. Intraoperative fractures were observed in 5 patients (20%), while the remaining 20 patients (80%) sustained postoperative fractures, defined as those occurring at least 24 hours after the index arthroplasty. Among the postoperative group, the mean time from arthroplasty to fracture was 4.2 years.

**Table 1: Demographic and Clinical Characteristics of the Study Population**

| Variable | Count |
|---|---|
| THA Patients | 14 |
| TKA Patients | 11 |
| Mean Age (years) | 68.4 |
| Male | 10 |
| Female | 15 |
| Intraoperative Fractures | 5 |
| Postoperative Fractures | 20 |

These findings reflect the typical epidemiological distribution of periprosthetic fractures, with a predominance in elderly, female patients—many of whom had underlying comorbidities such as osteoporosis or rheumatoid arthritis.

**Fracture Classification and Patterns:** Fractures were classified using established systems based on joint type. For patients with THA-related fractures, the Vancouver classification system was used. Of the 14 THA patients, Vancouver B2 fractures were the most common, accounting for 6 cases (42.8%), followed by Vancouver B1 (n=5, 35.7%) and Vancouver C (n=3, 21.4%).

For TKA-associated fractures, the Rorabeck classification was used. Among 11 TKA patients, Rorabeck Type II fractures were most prevalent (n=6, 54.5%), followed by Type III (n=3, 27.3%) and Type I (n=2, 18.2%). These findings are summarized in Table 2. [Table 2]

**Table 2: Fracture Classification by Joint Type**

| Fracture Classification | Hip (n=14) | Knee (n=11) |
|---|---|---|
| Vancouver B1 | 5 | – |
| Vancouver B2 | 6 | – |
| Vancouver C | 3 | – |
| Rorabeck Type I | – | 2 |
| Rorabeck Type II | – | 6 |
| Rorabeck Type III | – | 3 |

**Treatment Modalities and Outcomes:** Open reduction and internal fixation (ORIF) was the most commonly employed method, used in 13 patients (52%), primarily for Vancouver B1 and Rorabeck Type I/II fractures where the implant was stable and fixation feasible.

Revision arthroplasty was performed in 9 patients (36%), mainly for Vancouver B2 and Rorabeck Type III fractures. These cases required implant exchange, often using long-stemmed prostheses and augmentation techniques.

Conservative treatment, including protected weight-bearing and bracing, was reserved for 3 patients (12%), all of whom were high-risk surgical candidates or had minimally displaced fractures. Table 3. [Table 3]


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**Table 3: Management Approach and Outcomes**

| Management Type | Number of Patients | Union Achieved | Reoperation Required |
|---|---|---|---|
| ORIF | 13 | 12 | 1 |
| Revision Arthroplasty | 9 | 8 | 1 |
| Conservative | 3 | 2 | 0 |

**Additional Observations**

**Time from Arthroplasty to Fracture:** The mean time from the index arthroplasty to fracture was 4.2 years (range: 3 weeks to 12 years). Intraoperative fractures (n=5) occurred during primary arthroplasty in 3 cases and revision in 2 cases.

**Fracture Laterality:** A slight preponderance was observed for the right side (n=14, 56%) compared to the left (n=11, 44%), though this was not statistically significant (p=0.27).

**Complication Rates:** Complications included superficial wound infection (n=2), deep vein thrombosis (n=1), and prolonged rehabilitation in 4 patients.

No mortality was recorded during the 6-month follow-up period.

## DISCUSSION

Periprosthetic fractures (PPFs) represent one of the most challenging complications following joint arthroplasty, often leading to prolonged morbidity, functional limitation, and increased healthcare costs. This prospective observational study evaluated the incidence and patterns of periprosthetic fractures in a cohort of 25 patients who had undergone total joint arthroplasty (either THA or TKA) and presented with PPFs over a 16-month period. Our findings align with existing literature while also providing novel insights into the fracture characteristics, treatment strategies, and outcomes in a real-world clinical setting.

The incidence of periprosthetic fractures has been rising over the past two decades, paralleling the increase in total joint arthroplasty procedures worldwide. Previous studies have reported an incidence rate ranging from 0.1% to 4% after primary THA and up to 20% following revision arthroplasty.[1,2] For TKA, PPFs have an incidence of approximately 0.3% to 2.5% after primary procedures and as high as 5% to 10% in revision cases.[3,4] While this study was not designed to calculate incidence rates in a population-wide context, our institutional data reflects a similar trend of increased PPF presentations, particularly among elderly patients.

The mean age of our cohort was 68.4 years, with a female predominance (60%), which is consistent with global demographic data showing that PPFs most commonly occur in older adults, often women, with comorbidities like osteoporosis, rheumatoid arthritis, or chronic corticosteroid use.[5] The predisposing role of reduced bone mineral density in this group has been well documented and likely contributes to the fracture risk even in low-energy trauma settings.[6]

In our study, postoperative fractures accounted for 80% of all PPFs, while intraoperative fractures occurred in 20%. This is consistent with the literature that reports postoperative PPFs as the most common presentation, typically occurring after minor falls or spontaneous events due to implant loosening or osteolysis.[7] The mean duration from arthroplasty to fracture was 4.2 years, highlighting the importance of long-term surveillance in these patients.

Interestingly, intraoperative fractures were observed in both primary and revision arthroplasties. Revision procedures are known to carry a higher risk due to complex anatomy, bone loss, and increased surgical manipulation.[8] Intraoperative PPFs, though sometimes unavoidable, require immediate identification and tailored management to prevent delayed complications.

One of the key objectives of this study was to analyze the patterns of periprosthetic fractures using standardized classification systems. Among THA patients, the Vancouver classification remains the gold standard due to its emphasis on fracture location, implant stability, and bone stock.[9] In our cohort, Vancouver B2 fractures were the most common subtype (42.8%), followed by B1 and C fractures. This aligns with multiple studies where B2 fractures, characterized by a loose femoral stem with adequate bone stock, represent the predominant pattern requiring complex revision procedures.[10,11]

For TKA-associated PPFs, the Rorabeck classification was applied. Type II fractures, which involve a displaced fracture with a stable implant, were most frequent (54.5%), followed by Type III (unstable implant) and Type I (nondisplaced, stable implant). Similar patterns have been reported in prior studies, emphasizing that displacement and implant stability are key determinants of management approach.[12]

The accurate classification of these fractures not only aids in surgical planning but also plays a predictive role in determining outcomes. Our dual-review approach by orthopedic consultants improved classification reliability and minimized interobserver variability.

Treatment of PPFs remains highly individualized, based on the fracture type, implant stability, bone quality, and patient fitness. In our study, ORIF (52%) and revision arthroplasty (36%) were the primary modes of treatment. Conservative management was reserved for 12% of patients with minimally displaced fractures or high surgical risk.

The union rates were commendably high: 92.3% in ORIF and 88.9% in revision arthroplasty groups. This is comparable to existing reports where surgical treatment tailored to fracture morphology results in favorable outcomes in most cases.[13,14] The success of ORIF, particularly for Vancouver B1 and Rorabeck Type II fractures, is attributed to modern


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fixation methods including locking plates, cerclage wires, and biologic augmentation.[15]

Revision arthroplasty was largely reserved for Vancouver B2 and Rorabeck Type III fractures with unstable implants. The use of long-stemmed components and modular augments was critical in achieving both mechanical stability and biological fixation. However, such procedures are technically demanding, and associated with increased blood loss, longer operative time, and greater rehabilitation burden.[16]

Conservative treatment led to union in 2 of 3 cases, but one patient experienced persistent pain and reduced mobility. While non-operative management remains viable in selected cases, it requires strict adherence to immobilization protocols and vigilant follow-up.[17]

Despite the complexity of these cases, our complication rate was relatively low, with two superficial infections, one case of DVT, and two reoperations. The reoperation rate of 8% compares favorably with published literature, which reports secondary surgery in 10–20% of cases, often due to non-union, implant failure, or infection.[18]

It is noteworthy that early surgical intervention, accurate classification, and multidisciplinary care likely contributed to this favorable outcome profile. Nevertheless, postoperative recovery was prolonged in several patients, with delayed mobilization and increased dependency in activities of daily living.

## CONCLUSION

Periprosthetic fractures are increasingly common complications following arthroplasty, particularly in elderly patients. Accurate classification, timely surgical intervention, and individualized treatment strategies are essential for optimal outcomes. This study reinforces the importance of fracture-specific management in reducing complications and achieving high union rates in periprosthetic fracture care.

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