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EXAMINING MORTALITY RATES FOLLOWING PERIPROSTHETIC FEMUR FRACTURES IN PATIENTS UNDERGOING PRIMARY AND REVISION TOTAL HIP ARTHROPLASTY: RETROSPECTIVE COHORT RESEARCH

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Abstract

Introduction

Following total knee and hip arthroplasty (TKA and THA), periprosthetic fractures (PPF) have risen. The study evaluated morbidity and mortality after PPF surgery for the knee and hip.

Methods

A level-1 trauma center examined 248 patients, throughout two years. These patients were included retrospectively. Mortality was taken into consideration as the main event in Fine and Gray's model when assessing risk factors for postoperative morbidity. Cox regression models, both univariate and multivariate, were used to identify death risk variables.

Result

The mean age was 77 years; 77.40% were female with PPF of the hip (n = 194) and knee (n = 54). Out of all the fracture types in Vancouver, B2 (n = 78; 42.4%) was the most common, followed by B1 (n = 46; 25.00%). Form I fractures (n=28; 51.9%) were the most common form of Lewis-Rorabeck fracture in the PPF of the knee. Complication rates for PPF of the knee and hip were 44.0% and 29.9%, respectively. Six patients experienced early and late problems, 50 had early complications, and 38 had late implant-related complications that required surgery.

Conclusion

Younger patients and those undergoing ORIF have higher postoperative morbidity from implant issues. Accounting for mortality prevents underestimating complications. The retrospective study at a level 1 trauma hospital shows that, with careful planning, surgeries longer than two days do not harm patient outcomes.

Recommendation

An earlier study found that for patients with native hip fractures or periprosthetic fractures, surgery is still advised 24 to 48 hours after admission.

Keywords: *Periprosthetic Fractures (PPF), Total Hip Arthroplasty (THA), Open Reduction and Internal Fixation (ORIF), Morbidity and Mortality, Surgical Delay*
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Introduction

Over the past few years, the frequency of lower extremity periprosthetic fractures (PPF) has increased [1,2]. Joint replacements for the hip and knee and advanced patient age are associated with a higher incidence of PPF [3, 4]. PPF rates range from 0.6% to 1.0% for complete hip arthroplasty (THA) and from 0.30% to 5.50% for total knee arthroplasty (TKA) [5,6].

Vancouver and Lewis-Rorabeck are the most widely used classification methods for the knee and hip, respectively [7, 8]. The fracture site, the stability of the implant, and the quality of the bone stock are all considered in the Vancouver classification: Rather than extending into the diaphysis, type A fractures are found in the proximal metaphysis. They can be divided into two categories: larger trochanters (AG) and smaller trochanters (AL). Type B fractures can also be classified as B1 (stable prosthesis), B2 (unstable prosthesis, acceptable bone supply), or B3 (poor bone stock). Type B fractures occur at or directly below the level of the prosthetic shaft. And last, type C fractures are found below the prosthetic shaft [8].

There are three categories in the Lewis-Rorabeck classification for PPF of the knee. The contact between the prosthesis and the bone is maintained in type I fractures, which are stable, non-displaced breaks. In type II fractures, the displacement of the fracture components does not affect the interface. All fractures involving a failed or loose implant are classified as type III [7]. The authors and other researchers have validated the Vancouver categorization multiple times [9–11]. There is no proof in the literature that independent scholars have

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validated the Lewis-Rorabeck categorization. It has been shown in clinical practice, though.

Numerous research articles have been previously published, looking at the care of individuals with PPF in the knee and hip. Although most research focuses on PPF risk factors, as advanced patients. There isn't much published research that looks at the risk of postoperative morbidity and death and related risk factors [14–16]. Depending on the type of underlying fracture, PPF treatment can be chosen, age [12], or a cementless stem design [13]. Furthermore, a surgical delay may result from the high frequency of co-morbidities in the frequently older patient population developing PPF.

Previous studies have shown a negative link between the incidence of postoperative complications, in-hospital mortality, and long-term mortality in native and periprosthetic hip and knee fractures that are surgically delayed [14, 17, 18]. These investigations have supported the idea of doing surgery 48 or even 24 hours after admission.

With a focus on surgical delay, this study aimed to retrospectively examine the risk factors associated with mortality and morbidity among individuals with PPF of the hip and knee.

Methods

Study Design

The current retrospective cohort research

Study Setting

The study was conducted at the Department of Orthopaedics, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India, spanning 2 years from June 2022 to June 2024.

Participants

Out of the 248 patients that were included, 54 had PPF after TKA, and 194 had PPF after THA. 192 patients (77.4% female) had a mean age of 77 years (35 – 95 years). The patients who underwent THA and TKA and had postoperative PPF were treated surgically at a level-1 trauma hospital within two years.

Bias

There was a chance that bias would arise when the study first started, but it was avoided by giving all participants identical information and hiding the group allocation from the nurses who collected the data.

Data Collection and Procedure

The following elements were assessed: fracture-related (PPF classification after TKA and Vancouver, and vice versa); treatment-related (perioperative hospitalization, fixation type); Characteristics (gender, patient age, ASA score, time from first implant to PPF date); and variables linked to results (surgery-related problems, reoperation, follow-up, mortality). Fever charts, operation reports, and medical records were among the computerized documents kept in the hospital-based database that were used to gather data.

Blood loss anemia was defined as a hemoglobin count following surgery of less than 8 mg/dl in patients with hemodynamic equilibrium or between 8 and 10 mg/dl in individuals with hemodynamic turbulence who require replenishment of erythrocyte concentrate.

Any prolonged wound secretion lasting over 14 days after surgery, postoperative wound dehiscence necessitating revision, and superficial infections at the surgical site are considered a wound healing deficit. Credible standards, like the Diagnostic and Statistical Handbook of Mental Disorders [DSM] IV or the Confusion Assessment Method [CAM], were employed to diagnose dementia at the relevant times [19, 20].

Statistical Analyses

The statistical analyses were performed using Stata (StataCorp, College Station, Texas, US). The following tests were run to identify differences between the groups: chi-squared, t-tests (normally distributed with standard deviations [SD]), and Mann-Whitney-U- (nonnormally formed with interquartile ranges [IQR]).

Ethical considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

Results

The average age difference between people with periprosthetic knee fractures and people with periprosthetic hip fractures was 5.4 years, according to a t-test study with a p-value of 0.024. Men were, on average, 5.8 years younger than women (72.6 vs. 78.4 years; t-test p=0.012) at the start of PPF. The follow-up duration had an interquartile range of 9–68 months. Eight patients (6.5%) had died by the time of the last follow-up; these included one case of acute abdominal, four heart-related illnesses, two pneumonias, and one brain incident. Surgery was required for nineteen individuals (15.3%) Ato address implant-related issues.

Individuals who underwent PPF of the knee (median: 1 [IQR: 1-3]; p=0.413) and hip (median: 2 [IQR: 1-3]) had comparable preoperative and postoperative stay durations (median: 10 [IQR: 7-13] vs. 11 [IQR: 7-15]; p=0.833). Table 1 provides other differences between patients with PPF of the hip and knee.

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Table 1- A descriptive study of variables connected to clinical and therapeutic outcomes, divided by PPF site (knee vs. hip)

		THA (n=194)	TKA (n=54)	p-value
Patient age	Mean	78.3 years	72.9 years	0.024
Gender	Male	40 (20.6)	16 (29.6)	0.332
	Female	154 (79.4)	38 (70.4)	
BMI	Mean	25.0	27.80	0.104
ASA-Score	0 - 2	42 (25.9)	12 (25.0)	0.927
	3 - 4	120 (74.1)	36 (75.0)	
Early complication	No	154 (79.4)	44 (81.5)	0.810
	Yes	40 (20.6)	10 (18.5)	
Type of fixation	ORIF	76 (39.6)	36 (72.0)	0.004
	Prosthesis exchange	116 (60.4)	14 (28.0)	
Reoperation	No	172 (88.7)	38 (70.4)	0.020
	Yes	22 (11.3)	16 (29.6)	
Reason for reoperation (n=19)*	Luxation	2	2	0.590
	Periprosthetic Fracture	4	4	
	Non-Union	0	2	
	Chronic implant-related Pain	10	2	
	Infection	2	4	
	Implant Failure	2	0	
	Aseptic Loosening	2	2	

In terms of reoperation, knee PPF patients had a higher rate of needing additional surgery (29.6%) compared to hip PPF patients (11.3%) (p=0.020). This higher reoperation rate for knee PPF could suggest greater complexity or risk of complications in knee PPF treatments. The most common reasons for reoperation included chronic implant-related pain, periprosthetic fracture, and infection. Regarding fracture types, type B1 (25%) and type B2 (42.4%) were the most frequent in hip PPF, while Lewis-Rorabeck type I (51.9%) was the most common in knee PPF. ORIF was the predominant treatment for type B1 fractures in hip PPF and type I fractures in knee PPF, reflecting different surgical strategies based on fracture classification.

Two patients were treated with a spacer for PPF of the hip and four patients were treated with an external fixator for

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PPF of the knee due to a probable concurrent periprosthetic joint infection. Comparing individuals receiving ORIF with hips (n = 76; 39.6%; X2-test; p = 0.004), PPF was substantially less common than in patients undergoing knee surgery (n = 36; 72.0%). (Table 2).

Table 2- Classification of fractures by type of surgery (Lewis-Rorabeck for TKA-PPF; Vancouver for THA-PPF)

	THA (n=184∗)		
Vancouver	ORIF	Prosthesis exchange∗ ∗	p-value
AG (n=10)	6 (8.30)	4 (3.60)	<0.0001
AL (n=0)	0 (0.00)	0 (0.00)	
B1 (n=46)	36 (50.00)	10 (9.10)	
B2 (n=78)	14 (19.50)	64 (58.20)	
C (n=14)	10 (13.9)	4 (3.6)	
	TKA (n=50∗∗∗)		
Lewis-Rorabeck	ORIF	Prosthesis exchange	
I (n=28)	28 (72.20)	0 (0.00)	<0.0001
II (n=18)	10 (27.80)	8 (42.90)	
III (n=8)	0 (0.00)	8 (57.10)	

Discussion

The study revealed a significant age difference between patients with periprosthetic knee fractures (PPF) and those with periprosthetic hip fractures, with knee fracture patients being, on average, 5.4 years younger (p=0.024). Additionally, men were, on average, 5.8 years younger than women at the time of PPF occurrence (72.6 vs. 78.4 years; p=0.012). The follow-up period ranged from 9 to 68 months. During this period, eight patients (6.5%) passed away, with causes including acute abdominal events, heart-related illnesses, pneumonia, and brain incidents. A total of 19 patients (15.3%) required surgery to address implant-related complications, indicating a notable rate of postoperative issues.

Patients with knee PPF and hip PPF had similar preoperative and postoperative hospital stays, with median durations of 10 and 11 days, respectively (p=0.833). This suggests that the location of PPF (knee vs. hip) does not significantly impact hospital stay length. Table 1 showed that the average age of patients with hip fractures was higher (78.3 years) than those with knee fractures (72.9 years; p=0.024). Most patients in both groups were female, but gender differences were not statistically significant (p=0.332). Regarding treatment, open reduction and internal fixation (ORIF) were more commonly performed for knee fractures (72%) than hip fractures (39.6%) (p=0.004), indicating a preference for this approach in knee PPF. Conversely, prosthesis exchange was more common in hip PPF (60.4%) compared to knee PPF (28%).

In terms of reoperation, knee PPF patients had a higher rate of needing additional surgery (29.6%) compared to hip PPF patients (11.3%) (p=0.020). This higher reoperation rate for knee PPF could suggest greater complexity or risk of complications in knee PPF treatments. The most common reasons for reoperation included chronic implant-related pain, periprosthetic fracture, and infection. Regarding fracture types, type B1 (25%) and type B2 (42.4%) were the most frequent in hip PPF, while Lewis-Rorabeck type I (51.9%) was the most common in knee PPF. ORIF was the predominant treatment for type B1 fractures in hip PPF and type I fractures in knee PPF, reflecting different surgical strategies based on fracture classification.

The study indicates that younger age and male gender are associated with an increased risk of PPF, particularly in the knee. The high reoperation rate in knee PPF patients treated with ORIF suggests a potentially higher complexity or risk of complications in these cases. This could imply a need for careful consideration of surgical approaches, especially in younger patients and those undergoing ORIF. The comparable hospital stays for hip

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and knee PPF indicate that the immediate postoperative course is similar regardless of the fracture site. However, the differences in fracture types and their management strategies point to the importance of tailored treatment approaches based on the specific characteristics of the fracture and patient demographics.

The current retrospective investigation shows that the patient's age significantly predicts postoperative morbidity after treatment for hip and knee periprosthetic fractures, with younger people at increased risk of problems associated with implants. Additionally, there is a direct correlation between ORIF surgery and a higher incidence of implant-related problems, including deep infection, implant failure, and implant-related pain.

Conversely, there is no correlation between a surgical postponement longer than two days and a higher risk of morbidity or death. One significant drawback of the current study is its retrospective design, which makes it impossible to completely rule out confounding variables such as the many surgeons' opinions of the best way to treat the fracture (which also depends on how the predominant fracture type is interpreted).

Furthermore, the study could only offer information on the overall, not the functional, outcome of PPF patients. Moreover, the results may not be as broadly applicable due to the diverse group of patients included in the study. However, the issue may have been resolved by employing univariate and multivariate time-to-event studies, in which a stepwise backward selection process chose the variables for the latter models. Moreover, it is imperative to consider that the patients received treatment at a lone level-1 trauma center when interpreting the results because they could not be fully suitable to trauma centers at a lower level with different priority protocols.

Another drawback of the study's single-center approach is the restricted number of analyzed patients.

The females are the majority of PPF patients in the group, a tendency that has been previously recorded in the literature and is believed to be linked to the amount of structural bone left over following complete hip or knee replacement, a shorter life expectancy in men, and a higher risk of osteoporosis in women [21]. Furthermore, the average age of patients with PPF after TKA was 5.4 years lower (72.9 years) than that of patients with THA-PPF (78.3 years). This is consistent with the 75.6–76.6 years [16,22] for PPF in THA and the 66.0–74.7 years for PPF patients after TKA that have been documented in the literature [23, 24].

In line with previous research, the majority of patients in the sample who suffered from Vancouver B2 and B3 fractures were given new implants [25]. According to the literature [26], ORIF was the preferred fixation procedure for patients with TKA-PPF. It was primarily used in Lewis-Rorabeck types I and II. The study found early problems in 20.2% of the patients during their hospital stay. The most common was bleeding anemia, which required red blood cell replacement with packed units.

In addition, 15.3% of the patients required a second operation due to implant-related issues. Patients having PPF of the knee or hip did not have different early complication rates; however, patients in the latter group needed reoperation much more frequently because of implant-related problems. The study found that the total complication rate, 44.4%, is less than the 44.0% in research involving 50 patients with TKA-PPF reported by Schreiner et al. [27], after periprosthetic knee fracture surgery.

The team revealed that a surgical delay of greater than or equal to 2 days did not correlate with an enhanced risk for difficulties after surgery in the univariate data or multivariate setting [14]. Although a study by Griffiths et al. in which 60 patients suffering from Vancouver type B and C fractures found that a surgical delay of greater than equal to 3 days raised the difficulty rate, the total complication rate after hip PPF surgery, at 29.9%, is lower than that study's [32].

However, the findings support those of Johnson-Lynn et al., Bovonratwet et al., and Sellan et al., which showed that periprosthetic hip and knee fracture stabilization did not raise the risk for major adverse outcomes in response to a surgical delay [28–30]. Like native hip fractures, longer surgery times have not been linked to increased rates of complications or total mortality [31]. However, prior research, including patients with either native hip fractures [17,18] or periprosthetic fractures [14], still recommends surgery to be performed 24 to 48 hours after admission.

The only characteristics in the sample that were found to be substantially linked to a higher risk of morbidity after surgery for hip and knee periprosthetic fractures were the age of the patient at the time of fracture, the use of ORIF during surgery, regardless of gender, and a surgical delay longer than two days. The findings, which indicate that older patients are more likely to experience postoperative problems, do, however, partially contradict earlier data [28]. Younger patients may be more susceptible to implant-related issues that require revision since they are often more active, and patients with ORIF may also be more susceptible because of the possibility of mechanical irritation, plate loosening, or implant failure.

Following this, patient mobility should be a key consideration when considering surgery for PPF, as neither type of fixation nor age indicates postoperative mortality. However, the unique experience of trauma center patients must be considered. The present study's data were gathered from patients treated at a level-1 trauma center. Ideally, multicenter investigations are necessary to verify the effects reported here.

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Generalizability

The generalizability of this study is limited due to its single-center design, which may not reflect other healthcare settings or protocols. The retrospective nature introduces confounding variables like differing surgical techniques and preferences. While the patient population was diverse, it's unclear if the findings apply to different demographics. Despite these limitations, the study offers valuable insights into managing periprosthetic fractures in hip and knee arthroplasty. Multicenter studies with larger, varied populations are needed to confirm these findings.

Conclusion

The current retrospective analysis included 194 patients with hip PPF and 54 patients with knee PPF. Regardless of gender, advanced patient age, the type of surgery (prosthesis exchange vs. ORIF), and a surgical delay of more than two days were all linked to morbidity. Moreover, younger patients and those undergoing ORIF had more excellent rates of postoperative morbidity due to implant-related problems. The study

could account for mortality as the competing event when evaluating complication risks thanks to the statistical methods that were employed, namely Fine and Gray's model, and avoid unintentionally underestimating the actual rates.

The study data, which are based on a retrospective, heterogeneous patient collective, suggest that postoperative patient outcome is not adversely affected by meticulous surgical operation planning beyond two days, provided that the patient's activity level is considered.

Limitation

The current study's retrospective design is a significant limitation since it prevents the total exclusion of confounding variables, such as the surgeons' differing perspectives regarding the optimal treatment for the fracture. A limitation of the study's single-center methodology is the small sample size that was examined.

Recommendation

Surgery remains recommended 24 to 48 hours after admission for periprosthetic fractures, or native patients with hip fractures.

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List of Abbreviations

ORIF: Open Reduction and Internal Fixation
PPF: Periprosthetic Fractures
THA: Total Hip Arthroplasty
TKA: Total Knee Arthroplasty
ASA: American Society of Anesthesiologists
AG: Greater Trochanter Fractures
AL: Lesser Trochanter Fractures
IQR: Interquartile Range
SD: Standard Deviation
CAM: Confusion Assessment Method

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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