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Survivorship After Periprosthetic Femur Fracture: Factors Affecting Outcome

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ABSTRACT

Background: Data addressing risk factors predictive of mortality and reoperation after periprosthetic femur fractures (PPFxs) are lacking. This study examined survivorship and risk ratios for mortality and reoperation after surgical treatment for PPFx and associated clinical risk factors.
Methods: A retrospective review was performed for 291 patients treated surgically for PPFx between 2004 and 2013. Primary outcomes were death and reoperation.
Results: Mortality at 1 year was 13%, whereas the rate of reoperation was 12%. Greater span of fixation and revision arthroplasty (vs open reduction internal fixation) trended toward a lower likelihood of reoperation.
Conclusion: After PPFx, patients have a 24% risk of either death or reoperation at 1 year. Factors contributing to increased mortality are nonmodifiable. Risk of reoperation is minimized with greater span of fixation and performance of revision arthroplasty.

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Previous research has demonstrated that periprosthetic fractures (PPFxs) occur in 0.7%-4.2% of total hip arthroplasty (THA) patients and 0.3-2.5% for total knee arthroplasty (TKA) patients [1-3]. These figures represent an estimated 15,000 PPFxs per year in the United States. In most instances, these devastating injuries require surgical treatment in the form of either open reduction internal fixation (ORIF), revision arthroplasty, or both [4-8]. Unfortunately, such procedures impart a substantial physiological stress to patients who are often elderly and have significant medical comorbidities. The mortality rate after femoral PPFx is reported to be as high as 10% within the first 30 postoperative days [9] and up to 27% at 1 year [9-13]. Survivors face significant risk of reoperation, which occurs in 12%-33% of cases [11,14-18], frequently within the first year [16]. Some have suggested that revision arthroplasty offers improved chance of both survival and avoidance of reoperation compared to fracture fixation alone [10, 12, 19].

Patients and surgeons discussing elective THA and TKA have the benefit of incorporating well-established risk data to guide surgical decision-making and patient expectations. For nonelective procedures with increased likelihood and severity of risk, such as the treatment of a femoral PPFx, the communication between the surgeon and the patient can be even more critical. Unfortunately, reliable data to guide patients in this scenario are lacking. With contemporary advances in anesthetic and surgical techniques, one might expect improvement in previously reported dismal mortality rates and reoperation rates after PPFx.

Although previous studies have reported mortality and others have reported complication rates after PPFx, a comprehensive assessment of factors predictive of each of these outcomes is not yet available as a reference [10,12,13,17,19]. Knowledge of such associations has potential not only to educate patients but also to guide treatment selection.

The primary goal of this study was to determine the survivorship probability and hazard risk ratios of death and/or reoperation after surgery for a femoral PPFx. In addition, we ask what patient

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and surgical characteristics are associated with increased rates of 1-year mortality and reoperation.

Materials and Methods

After protocol approval by the institutional review board, we performed a retrospective clinical and radiographic review at a high-volume, single-specialty orthopedic clinic. Between January 1, 2004 and May 1, 2013, we identified 492 patients from our institutional registry with International Classification of Diseases, Ninth Edition code 996.44 (PPFx) listed as the first, second, or third diagnosis, from which 291 were ultimately included in the study. A total of 201 were excluded from the analysis with the intent of identifying a cohort of those patients treated operatively for a periprosthetic femur fracture adjacent to a THA or TKA. Patients with nonfemur fractures, those who had not undergone prior arthroplasty involving the affected femur, and those who were treated nonsurgically, among others, were therefore excluded (Table 1).

Indications for surgery and the type of surgical procedure performed were at the discretion of the surgeon and were not standardized; however, well-accepted algorithms were generally followed [20]. At our institution, we do not have a dedicated trauma service, and PPFxs are typically treated by hip and knee arthroplasty subspecialists. Aftercare and follow-up routine were also at the discretion of the treating surgeon and were not standardized, although it is our general practice for most PPFx patients to have restricted weight-bearing for 6 weeks on the affected extremity.

A clinical chart review was performed and the following variables were collected: date of birth, date of admission, date of surgery, gender, body mass index (BMI), clinical comorbidities, reoperation, and reason for reoperation. From these data, age at the time of surgery was calculated. The age-adjusted Charlson Comorbidity Index (aaCCI) was calculated using the previously described formula [21]. Patient mortality data were obtained via the publicly available Social Security Death Index (SSDI), queried by patient name, date of birth, and social security number [10, 13].

Radiographic review was performed by a single author who was a fellow in adult reconstruction at the time of this project (JD). Radiographic variables collected included arthroplasty type and fracture location (distal, mid-, and proximal 1/3 relative to the overall length of the femur). Each fracture was described as simple (2 major fragments), multifragment (3 or 4 major fragments), or comminuted. Type of revision surgery and the preoperative fracture stem type (cemented, uncemented diaphyseal-fit, uncemented metaphyseal-fit) were both assessed on radiographs and confirmed via a chart review, when possible. Those PPFxs adjacent to a THA were classified according to the Vancouver system [20], whereas those adjacent to a TKA were classified as described by Rorabeck and Taylor [22].

Table 1
Reason for Exclusion.

Reason for exclusion	N
Acetabular fracture (Fx)	10
Infection	9
Intraoperative Fx	6
No arthroplasty	5
No Fx	38
No records available	10
No operative Fx	72
Nonunion	4
Other	11
Patella Fx	10
Peri-implant Fx	9
Tibia Fx	3
Upper extremity Fx	14
Total	201

Standard descriptive statistics were reported, including measures of central tendency, variance, frequencies, and proportions. The normality of all continuous data was assessed before analysis and was found to violate the assumptions of normal distribution. Therefore, the median and interquartile range (IQR) were reported, and a Wilcoxon test was used to evaluate the difference in medians between groups. The differences in proportions were assessed using a chi-square test. Unadjusted relative risks (RRs) were calculated, and a multiple logistic regression was used to calculate the adjusted RR. The primary independent variable was PPFx surgical treatment (ORIF vs revision). Patient age, sex, aaCCI, Vancouver classification, and the time from total joint arthroplasty to fracture were included as covariates in the regression model. Survivorship or cause-specific hazards were evaluated using the Fine-Gray model [23]. Two survival curves were generated with mortality and revision as end points. Finally, the Fine-Gray model was used to assess the competing risk of mortality to revision, and a cumulative incidence function curve was generated. We performed an unadjusted and adjusted hazard model. We included the same variables in the hazard model as we defined in the logistic regression model. An apriori significance level of .05 was used for statistical tests.

Of the 291 subjects meeting criteria for inclusion in the study, 232 (79.8%) were female, and the mean age was 76.0 years (standard deviation [SD]: 12.5). The mean BMI of all subjects was 27.7 (SD: 7.0; range: 15.1-60.3). aaCCI between 3 and 6 was noted in 70.1% subjects (range: 0-9, median: 4, mean: 4.3). PPFx occurred at a mean of 64.4 months (SD: 78.0) after previous arthroplasty procedure. Of the 291 PPFxs, 132 (45.4%) occurred at the proximal third, 62 (21.3%) in the middle third, and 92 (31.6%) at the distal third of the femur. Of the 291 PPFxs, 188 (64.6%) patients had hip prostheses, 85 (29.2%) had knee prostheses, and 18 (6.2%) had both before the PPFx. Mortality status was able to be determined for all of the 291 patients (Patients not identified in the social security database were presumed to be living.)

Results

The mortality rate after surgery for a PPFx at 1 year was 13.1% (38 of 291), whereas the reoperation rate at 1 year was 12.0% (35 of 291). At 18 months, the mortality rate was 15.8% (46 of 291) and the rate of reoperation was 13.8% (40 of 291). Overall, patients had a 24% chance of either death or reoperation at 1 year (70 of 291). For hip patients, the chance of either death or reoperation at 1 year was 25% (47 of 188), whereas for knee patients, the chance of either was 33% (28 of 85; $P = .1891$). Death occurred at a median of 20.9 months (IQR: 2.4-39.3) after PPFx. Reoperation, when necessary, occurred at a median of 6.4 months (IQR: 2.6-15.0) after initial surgery for PPFx. Overall, mortality at any given postoperative time interval was 32.3% (94 of 291) and risk of reoperation was 16.8% (49 of 291) over a range of follow-up 1-10 years (Figs. 1 and 2).

The mortality rate at 1-year was 14.2% (33 of 232) among females and 8.5% (5 of 59) among males ($P = .242$). Those who died had a mean age of 84 years compared to a mean age of 75 for those still living ($P < .0001$). One-year survivors had a significantly higher BMI (28 vs 25, $P = .002$). The time from previous arthroplasty to fracture was similar for survivors and nonsurvivors with a median of 49.4 months (IQR: 4.2-110.0 months) for survivors and 54.8 months (IQR: 24.9-153.0 months) for nonsurvivors ($P = .34$). Mortality rates did not vary by fracture type, location, span of fixation, or fracture classification. Mortality rates were similar among those treated with ORIF (14.8%, 26 of 176) as with revision arthroplasty

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