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Periprosthetic Fractures: A Common Problem with a Disproportionately High Impact on Healthcare Resources

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ABSTRACT

The present study evaluated the frequency of periprosthetic fractures and tested the hypothesis that this population's demographics and outcomes are unique as compared with other arthroplasty patients. The National Hospital Discharge Survey provided the raw data. Individuals admitted with a primary TKA, primary THA, or revision TJA were selected. Annual rates were then calculated and demographics and outcomes compared. 30,624 patients were reviewed. The proportion of admissions for periprosthetic fractures ranged from 4.2% to 7.4% annually. As compared to patients admitted for other TJA diagnoses, individuals admitted with periprosthetic fracture were older, were more often female, were more often admitted emergently/urgently, had longer lengths of stay, had higher rates of discharge to places other than home, and had a significantly elevated mortality.

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Total joint arthroplasty (TJA) is a common, highly efficacious procedure with numerous mid-term and long-term studies demonstrating predictable pain relief and functional improvement with acceptably low revision rates amongst individuals suffering from hip and knee arthritis [1–10]. Due to the success of the procedures, increases in average life expectancy, and expansion of the indication to younger and more active individuals the volume of primary TJA continues to rise steadily [11]. As the prevalence of primary TJA rises so too does the expected need for revision, including for periprosthetic fracture (PPX) [11].

Prior studies have suggested rates of PPX after total hip arthroplasty (THA) ranging from 0.1% to 18% and after total knee arthroplasty (TKA) ranging from 0.3% to 5.5% [12–19]. Many of these reports include incidental fractures associated with stem insertion, and therefore do not provide a clear picture of revision or reoperation rates associated with PPX. Given the complexity associated with surgical treatment of PPX cases, which often require the expertise of both the fracture and joint reconstructive surgeon, and prior literature suggesting different patient characteristics in the PPX population [20–22], defining the likely incidence, demographics, and outcomes becomes essential in preparing the necessary resources to care for this population in the near future.

The purposes of the present study were thus to 1) evaluate the annual incidences of primary and revision TJA, 2) for revision TJA, evaluate the annual incidence of the various reasons for revision, 3) for revision for PPX, evaluate the annual incidence of the various procedures performed for this revision diagnosis, 4) test the hypothesis that patients admitted for PPX are demographically different (age, gender, race, geographic region, hospital size where procedure was performed) from other patients undergoing primary or other revision procedures, 5) test the hypothesis that patients admitted for PPX have different, less favorable outcomes (admission type, length of stay, discharge type) as compared to other patients undergoing primary or other revision procedures.

Materials and Methods

The National Hospital Discharge Survey (NHDS) provided the raw data for this analysis. This survey is conducted annually by the National Center for Health Statistics and collects medical and demographic information from a sample of inpatient discharge records selected from a national probability sample of non-Federal, short-stay hospitals. Each record represents one patient admission. The complete data set from the NHDS from 2006 to 2010 was obtained for this study. 2006 was chosen as the start point for this time range as it represented the first full year that ICD-9 incorporated codes specific to the diagnosis and treatment of re-operative total joint arthroplasty [23]. 2010 was chosen as the end point as this was the most up-to-date data available from the NHDS at the time of this study. Individuals admitted with a primary procedure code of primary TKA (ICD-9 8154), primary THA (ICD-9 8151),

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Table 1
ICD-9 Diagnosis Codes for Revision TJA, Introduced October 1st 2005.

Code	Description
996.41	Mechanical loosening
996.42	Dislocation
996.43	Implant failure/breakage
996.44	Periprosthetic Fracture
996.45	Osteolysis
996.46	Articular bearing surface wear
996.47	Other mechanical complication of prosthetic joint implant
996.49	Other mechanical complication of other internal orthopaedic devise, implant, or graft
996.66	Prosthetic joint infection

or primary diagnosis code related to revision of a TJA for all reasons including fracture (Table 1) were selected as the population for this study.

Annual rates of all TJA (primary + revision), primary TJA, primary TKA, primary THA, and each type of revision TJA were calculated for each year to examine for trends within and between each category. For those admissions with a primary diagnosis code of PPX (ICD-9 996.44), annual rates of the various primary procedure codes associated with that admission were also calculated and compared (Table 2). All available demographic (age, gender, race, region, hospital bed size) and outcome data (type of admission, length of stay, type of discharge) were similarly calculated and compared amongst the various procedures.

Comparisons between groups were performed using an analysis of variance for continuous variables with parametric data (e.g., age), multiple Chi-squared tests for categorical variables with parametric data (e.g., gender, race, region, hospital bed size, type of admission, and type of discharge), and Mann–Whitney Tests for continuous variables with non-parametric data (length of stay). To reduce the chance of a type-2 error, the significance chosen for the multiple Chi-squared tests was set as 0.007 (0.05/7, where 7 is the number of comparisons made).

Table 2
ICD-9 Procedure Codes for Revision TJA and Annual Frequencies.

Codes	Description	Annual Frequency
00.80	Revision tibia, femur, and patella	
00.81	Revision tibia	
00.82	Revision femur	
00.83	Revision patella	
00.84	Revision articular insert	
80.06	Removal of prosthesis	
81.55	Revision NOS	
00.80, 00.81, 00.82, 00.83, 00.84, 80.06, 81.55	**All Revision TKA**	5.6%–12.5%
00.70	Revision femur and acetabulum	
00.71	Revision acetabulum	
00.72	Revision femur	
00.73	Revision head/liner	
81.53	Revision NOS	
80.05	Removal of prosthesis	
00.70, 00.71, 00.72, 00.73, 81.53, 80.05	**All Revision THA**	17%–22.5%
79.05	Closed reduction no fixation, femur	
79.15	Closed reduction internal fixation, femur	
79.25	Open reduction without internal fixation, femur	
79.35	Open reduction internal fixation, femur	
78.55	Internal fixation without reduction, femur	
79.05, 79.15, 79.25, 79.35, 78.55	**All femur fixation**	28.3%–52.4%
79.36	Open reduction internal fixation, tibia-fibula	0%–3.13%, 3 cases
77.86	Partial patellectomy	0%–3.3%, 2 cases

Results

26,234 primary TJAs (17,706 primary TKAs and 8528 primary THAs), and 4390 revision TJAs were available for review, for a total of 30,624 patient admissions. The annual proportion of hospital admissions for all categories appeared to increase steadily on an annual basis, though such small percentage increases over such a short time line could not establish a true statistical trend (Fig. 1).

The 4390 admissions for revision TJA were examined to determine the primary procedure codes associated with these admissions; presumably the patient's reason for revision. When evaluated as an annual rate the proportion of revisions for each diagnosis code remained nearly constant over time (Table 3).

The 259 admissions for PPX were also separately evaluated to determine the annual frequency of the various primary procedure codes associated with these admissions. Given the relatively small numbers of admissions for each procedure code, similar codes were grouped into those related to fracture fixation of the femur, fracture fixation of the tibia, revision of a THA, revision of a TKA, and procedures involving the patella (Table 2). The most common procedure codes associated with an admission diagnosis of PPX were those involving reduction and/or fixation of the femur, followed by revision THA, and revision TKA. Codes involving fixation of the tibia and partial patellectomy were uncommon.

Demographic variables were compared between patients admitted with a diagnosis code of PPX and those admitted for primary and the other revision procedures (Table 4). Individuals admitted with a diagnosis of PPX were significantly older than those admitted for any other primary or revision procedure ($P < 0.001$). Specifically, the mean age for the PPX was 9.8 years older than the primary THA group, 8.4 years older than the primary TKA group, and 9.6 years older than all other revisions as a combined group.

Comparing the proportion of males and females, individuals presenting with a diagnosis of PPX were noted to be female more than twice as frequently as male. The PPX category also contained the highest proportion of females of any category and this percentage was statistically significantly greater ($P < 0.007$) than every other category except primary TKA and revision for dislocation. Differences amongst groups based on race and region were calculated, but found not to be significantly different.

Comparisons between the PPX and other groups were also made based upon hospital bed size. Specifically, the PPX group was less likely to have had their procedures performed at hospitals with < 99 beds and more likely to have had their procedures performed at hospitals with > 300 beds than primary THA, primary TKA, and revision for bearing wear ($P < 0.007$). There was not a significant difference based on hospital bed size between PPX and the other revision categories.

Available outcome variables were also compared between patients admitted with a diagnosis code of PPX and those admitted for primary and the other revision procedures (Table 5). Individuals admitted with a PPX were significantly more likely to be admitted on an emergent and/or urgent basis and less likely to be admitted on an elective basis than any other category ($P < 0.001$).

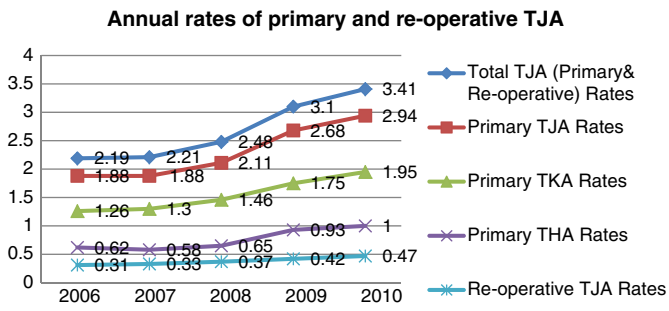

Fig. 1. Annual rates of primary and revision total joint arthroplasty.

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