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Rates and Risk Factors of Conversion Hip Arthroplasty After Closed Reduction Percutaneous Hip Pinning for Femoral Neck Fractures—A Population Analysis

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ABSTRACT

Background: Closed reduction with percutaneous pinning (CRPP) for nondisplaced or valgus impacted femoral neck fractures is a relatively low-risk operation that can produce excellent union rates in some patients; however, failure can occur in selected patients requiring conversion to arthroplasty. The primary aim of this study was to perform a population-level analysis to determine the rate and timeframe of conversion from CRPP to total hip arthroplasty (THA) or hemiarthroplasty.

Methods: The PearlDiver database was queried from 2007–2015 for all patients who underwent CRPP for a femoral neck fracture. Survival analysis was used to evaluate the rate of conversion of CRPP to hemiarthroplasty or THA. Risk factors for conversion arthroplasty were identified using a multivariable cox proportional hazards model that included patient demographics and comorbidities.

Results: There were 5122 patients in the Humana database and 4840 patients in the Medicare database that were included in analysis. At 5 years after CRPP, the conversion rate was 10.0% in the Medicare patients and 10.8% in the Humana patients. Risk factors for undergoing conversion from CRPP to arthroplasty in the Medicare cohort included preexisting diagnoses of pulmonary and/or circulatory comorbidities, peripheral vascular disease, hypertension, hypothyroidism, and metastatic cancer. In the Humana cohort, the only risk factors were male gender and acute blood loss anemia.

Conclusion: Although CRPP remains a successful operation in elderly patients and patients with certain comorbidities, failure of CRPP for the treatment of a femoral neck fracture is high at approximately 10%–11%, which is much higher than reported failure rates for THA in the same population. Patients with femoral neck fractures being considered for CRPP should be counseled about the possibility of further surgery.

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Approximately 300,000 hip fractures occur in the United States yearly at an annual cost of \$12 billion, which is predicted increase in the coming decades [1–3]. Femoral neck fractures account for 50% of hip fractures, and nondisplaced or valgus impacted fractures, classified as Garden I or II, account for 20% of femoral neck fractures [4–6]. Closed reduction with percutaneous pinning (CRPP) using

cannulated screws has been the conventional treatment for non-displaced or valgus-impacted femoral neck fractures [2,7,8].

Although CRPP for femoral neck fractures can produce excellent results, known complications include the development of osteonecrosis, failure of fixation, screw cutout, and nonunion; all of which can be devastating complications and may require return to the operating room. Numerous studies have described outcomes of patients who underwent closed reduction and internal fixation for nondisplaced hip fractures [6,9–12], reporting failure rates of CRPP of 5%–19%. Studies currently available in the literature are limited to smaller cohorts and do not address the comorbidities associated with CRPP failure (or the patient's characteristics that may lower the risk of failure).

The primary aim of this study was to perform a population-level analysis to determine the rate and timeframe of conversion from

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CRPP to total hip arthroplasty (THA) or hemiarthroplasty. The secondary aim was to determine risk factors for undergoing conversion and protective patient characteristics that would reduce the risk of failure of CRPP. We hypothesized that there would overall be a low rate of conversion from CRPP to arthroplasty and that younger patients would be more likely to undergo conversion to a THA.

Materials and Methods

Data Source

This retrospective, population level study was performed using an administrative database; the PearlDiver patient records database (www.pearldiverinc.com, Fort Wayne, IN) was queried for all patients who underwent CRPP for a femoral neck fracture between 2007 and 2015. The PearlDiver database includes insurance claim administrative data from 20.9 million Humana (private payer) and Medicare patients. For this study, the Humana database and the Medicare Standard Analytical File 5% were queried. Both databases were included because they may represent distinct patient populations, with more working patients in the Humana database and more retired patients in the Medicare database. The Medicare Standard Analytical File 5% was used instead of the full Medicare database as it includes physician billing that contain Current Procedural Terminology (CPT) codes with associated laterality codes. Laterality was required in this study to ensure that the hip that had undergone CRPP was the same hip to undergo a subsequent arthroplasty procedure.

Patient Selection

We identified patients who underwent unilateral CRPP using the CPT code 27235 (percutaneous skeletal fixation of femoral fracture, proximal end, neck). CPT codes 27125 (hip hemiarthroplasty), 27130 (THA), and 27132 (conversion of previous hip surgery to THA, with or without autograft or allograft) following a previous code of 27235 (CRPP) were used to capture conversion from CRPP to hip arthroplasty. The laterality of the 2 procedures were matched to ensure that the index and revision surgeries were performed on the same hip. Patients under the age of 20 years were excluded as this code may inadvertently represent percutaneous fixation of slipped capital femoral epiphysis in younger age groups. Laterality of the CRPP was confirmed using CPT code laterality modifiers. Removal of CRPP hardware without an arthroplasty procedure was not included as an end point.

Outcomes

The primary outcome was the revision rate of CRPP to either a hip hemiarthroplasty (CPT 27125) or THA (CPT 27130, 27132). Secondary outcomes included risk factors for failure and patient characteristics and/or comorbidities which lowered the risk of conversion.

Statistical Analysis

The primary outcome was evaluated using a Kaplan-Meier survival analysis up to 5 years after CRPP. Patients were censored from analysis if they sustained failure of the CRPP or if they left the insurance plan and were thus not available for follow-up. Risk factors were evaluated using a multivariable cox proportional hazards model. Comparisons were performed using a chi-squared test or *t* test for categorical or continuous variables, respectively.

Table 1
Baseline Demographics.

Characteristic	Humana Percentage of Patients	Medicare Percentage of Patients	P Value
Number of patients	5122	4840	
Age, y			
Under 40	0.59		
40-49	0.98	5.72 ^b	<.001 ^a
50-59	4.49		
60-64	3.96		
65-69	10.23	8.49	
70-74	15.13	11.03	
75-79	16.09	17.00	
80-84	18.68	22.07	
85 and over	29.89	35.68	
Gender (F)	71.89	71.43	.531
Mean hospital charges for CRPP	\$11,455	\$11,456	.995
Mean length of stay for CRPP	5.0	5.2	.016 ^a
Comorbidities			
Congestive heart failure	26.43	36.01	<.001 ^a
Heart valve disease	29.93	37.91	<.001 ^a
Pulmonary/circulatory disease	11.71	12.52	.197
Peripheral vascular disease	36.72	45.00	<.001 ^a
Hypertension	81.92	87.40	<.001 ^a
Paralysis	7.71	8.66	.079
Neurologic disease	39.14	44.30	<.001 ^a
Pulmonary disease	43.50	49.44	<.001 ^a
Diabetes mellitus	33.95	38.14	<.001 ^a
Hypothyroidism	38.15	48.35	<.001 ^a
Chronic kidney disease	27.22	24.38	.002 ^a
Liver disease	5.31	5.37	.859
Peptic ulcer disease	0.59	1.10	.006 ^a
Lymphoma	2.01	2.64	.033 ^a
Cancer, metastatic	4.53	5.60	.013 ^a
Cancer, no metastatic	17.57	22.09	<.001 ^a
Rheumatoid or collagen disorder	13.37	16.71	<.001 ^a
Coagulation deficiency	13.55	16.18	<.001 ^a
Obesity	9.00	6.40	<.001 ^a
Weight loss	23.76	29.98	<.001 ^a
Electrolytes abnormality	45.35	55.29	<.001 ^a
Acute blood loss anemia	5.53	9.57	<.001 ^a
Deficiency anemia	43.13	55.99	<.001 ^a
Alcoholism	4.45	4.17	.554
Drugs abuse	5.58	2.85	<.001 ^a
Psychosis	22.24	24.52	.005 ^a
Depression	32.16	34.59	.006 ^a
Smoking	7.50	6.30	.024 ^a

CRPP, closed reduction with percutaneous pinning.

^a Statistically significant P values.

^b Age breakdown under 65 y not available for Medicare cohort.

Statistical significance was set at $P < .05$. Analyses were performed using the PearlDiver software as well as Stata, version 14.2 (Stata-Corp, College Station, TX).

Results

Demographics

There were 5122 patients in the Humana database and 4840 patients in the Medicare database that were included in analysis. Demographic information and comorbidities are displayed in [Table 1](#). Nearly all medical comorbidities were significantly more common in the Medicare population compared with the Humana population ($P < .05$). No gender difference existed between the 2 groups, but over 70% of both cohorts were female. The largest proportion of patients in each database was in the age 85 years and over category, but patients in the Humana group were significantly younger than patients in the Medicare group ($P < .001$).

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