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Differences in Post-Operative Outcome Between Conversion and Primary Total Hip Arthroplasty

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ABSTRACT

Background: The demand for conversion of prior hip surgery to total hip arthroplasty (conversion THA) is likely to increase as a function of increasing US hip fracture burden in addition to its application in managing other conditions. Thus, outcome analysis is warranted to better inform value-based reimbursement schemes in the era of bundled payments.

Methods: Via Current Procedural Terminology codes, the National Surgical Quality Improvement Project data files were queried for all patients who underwent primary THA and conversion of previous hip surgery to THA from 2005 to 2014. To better understand the isolated effect of procedure type on adverse outcomes, primary and conversion cohorts were then propensity-score matched via logistic regression modeling. Comparisons of the study's primary outcomes were drawn between matched cohorts. Statistical significance was defined by a *P*-value less than or equal to .05.

Results: Relative to the primary THA group, the conversion THA group had statistically greater rates of Center Medicare and Medicaid Services (CMS) complications (7.5% vs 4.5%), non-home bound discharge (19.6% vs 14.7%), and longer length of hospital stay. Conversion THA was associated with increased likelihood of CMS complications (odds ratio 1.68, confidence interval 1.39–2.02) and non-home bound discharge (odds ratio 1.41, confidence interval 1.25–1.58). No statistically significant differences in mortality and readmission were detected.

Conclusion: The elevated risk for CMS-reported complications, increased length of hospital stay, and non-home bound discharge seen in our study of conversion THA indicates that it is dissimilar to elective primary THA and likely warrants consideration for modified treatment within the Comprehensive Care for Joint Replacement structure in a manner similar to THA for fracture.

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Hip fracture care represents a significant strain on the American healthcare system with 340,000 emergency department admissions for hip fracture in 2008 and projections as high as 580,000 by 2040 as the United States population continues to age [1,2]. Hip fractures are typically treated with percutaneous fixation, open reduction with internal fixation, intramedullary fixation, hemiarthroplasty, or total hip arthroplasty (THA). While outcomes are

generally successful, complications including non-union, migration of hardware, osteonecrosis of the femoral head, post-traumatic arthritis, infection, and hardware failure can occur [3–6]. Failure of surgical fixation of the hip has been reported to occur at a rate of 6.7% for intramedullary nail fixation and 3.7% for sliding hip screw after which conversion THA is often the only option remaining [7,8]. The demand for conversion of prior hip surgery to THA (conversion THA) is likely to increase as a function of increasing US hip fracture burden in addition to its application in managing other conditions such as arthritis following proximal femoral and peri-acetabular osteotomy, acetabular fracture fixation, slipped capital femoral epiphysis, and Legg-Calve-Perthes disease [7–10].

The movement toward bundled payments for hip arthroplasty as part of the Comprehensive Care for Joint Replacement (CJR) initiative attempts to transform Central Medicare and Medicaid Services (CMS) from a passive payer of volume into an active payer

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of quality by transferring risk to providers and their institutions. The local provision of care is thus redesigned and focused on managing total cost by preventing complications and unplanned readmissions [11–13]. Concern, however, exist among providers and institutions that current risk adjustment models within CJR do not accurately reflect the complexity and cost of care related to conversion THA and unfairly reimburse institutions for the assumption of additional risk in caring for these patients [8].

Past initiatives have focused on re-classifying THA performed as a revision and for hip fracture given that they are associated with poorer outcomes. However, there is a paucity of literature that has evaluated the baseline comorbidity and demographic characteristics of patients undergoing conversion THA and their outcomes following surgery [8,9,14,15]. In particular, there is an absence of multi-center analyses that properly eliminate selection bias when drawing comparisons between conversion THA and other types of THA.

Via the National Surgical Quality Improvement Project (NSQIP) dataset, a previously validated multi-intuitional registry, we aim to shed light on post-operative outcomes following conversion THA in relation to elective primary THA, and better understand the isolated effect of these procedure types on outcomes through propensity score matching. We hypothesize that conversion THA is associated with increased risk of adverse outcomes relative to primary THA for patient groups with closely similar demographic factors and comorbidity burden.

Methods

Study Cohort and Outcomes

Data collection methods of NSQIP have previously been described in detail and validated [16,17]. Trained surgical nurses collect NSQIP data in 8-day cycles with weekly monitoring to ensure appropriate sampling with a 1.96% inter-observer disagreement rate across tracked variables. Via Current Procedural Terminology codes, the NSQIP data files were queried for all patients who underwent primary THA (27130) and conversion of previous hip surgery to THA (27132) from 2005 to 2014.

Demographics (ie, gender, race, age), lifestyle factors (ie, smoking, alcohol use), comorbidities (ie, body mass index, chronic obstructive pulmonary disease, hypertension, steroid use, congestive heart failure, ischemic heart disease, diabetes, kidney failure), American Society of Anesthesiologists class, functional status, and operative characteristics (ie, anesthesia type) were queried in our study and compared among the 2 study groups.

The primary outcomes analyzed in our study included CMS-reportable complications (pneumonia, myocardial infarction, death, pulmonary embolism, surgical site infection, catheter-associated urinary tract infection), mortality, non-home bound discharge, unplanned readmission, and post-surgical hospital stay. All outcomes occurred within 30 days of the index case.

Statistical Analysis

In total, 74,257 cases of primary THA and 2213 cases of conversion THA were identified in our study. Comparisons were conducted between multiple pairs of the study groups using χ^2 tests, for categorical variables, and 2-tailed Student's t test, for continuous variables, to calculate the level of statistical significance. To better understand the isolated effect of procedure type on adverse outcomes, primary and conversion THA groups were propensity-score matched via logistic regression modeling. This methodology has been successfully applied to the investigation of outcomes following total joint arthroplasty using the NSQIP

dataset. Propensity scores were derived for each case and were used to establish pairs in a 1:5 fashion [18]. The ratio was determined based on the relative number of cases in each cohort, with the goal of minimizing the number of cases that had to be eliminated to achieve a matched study. Cases with similar propensity scores are likely to be similar in their baseline demographic and comorbidity profiles [19,20]. All pre-operative and peri-operative factors queried in our study were included in the matched model and a case for which no match was found was discarded. In the end, 10,621 cases of primary THA were matched with 2145 cases of conversion THA (Table 1).

Comparisons of primary outcomes listed above were drawn for the matched pairs and multivariate regression models were created for all outcomes of interest. In all studies, statistical significance was defined as $P < .05$. For all outcomes studied, we sought to identify clinically meaningful differences by looking at the difference in risk seen in a previous study of THA patients with insulin dependent diabetes mellitus compared to non-diabetic patients who utilized NSQIP data [21]. We calculated odds ratios (ORs) for CMS complications, mortality, readmission, and non-home bound discharge and effect size for hospital length of stay that would be considered to be clinically meaningful as well as the minimum sample size required to detect these differences assuming a 1:5 matched design, a correlation of 0.2 between outcomes of the matched pairs, a type I error of 0.05, and power of 80% [22].

Results

Relative to the primary THA group, the conversion THA group had statistically greater rates of CMS complications (7.5% vs 4.5%), non-home bound discharge (19.6% vs 14.7%), and longer length of hospital stay (4.4 vs 3.5 days). The P -values for 30-day mortality and readmission were greater than .05 (Table 2). The most common complications in both groups were urinary tract infection followed by surgical site infections and pneumonia. Finally, multivariate regression models were used to determine the effect of procedure type on our study's primary outcomes (Table 3). Conversion THA was associated with increased likelihood of CMS complications (OR 1.67, confidence interval 1.39-2.02) and non-home bound discharge (OR 1.41, confidence interval 1.25-1.58) (Table 4). These results were statistically significant.

Table 1

Demographics and Comorbidities of Primary and Conversion THA (Matched).

Pre-Operative Factors	Primary THA (10,621)	Conversion THA (2145)
Male Gender	4796 (45.2%)	977 (45.5%)
Black	1032 (9.7%)	209 (9.7%)
Hispanic	230 (2.2%)	42 (2.0%)
Asian	741 (7.0%)	137 (6.4%)
White	8618 (81.1%)	1757 (81.9%)
Smoker	2204 (20.8%)	433 (20.2%)
Functionally independent	9599 (90.4%)	1920 (89.5%)
Functionally dependent	1022 (9.6%)	225 (10.5%)
Non-insulin dependent diabetes	990 (9.3%)	198 (9.2%)
Insulin dependent diabetes	607 (5.7%)	137 (6.4%)
Hypertension	5959 (56.1%)	1206 (56.2%)
Steroid use	688 (6.5%)	138 (6.4%)
Severe COPD	517 (4.9%)	110 (5.1%)
Bleeding disorder	221 (2.1%)	52 (2.4%)
Ischemic heart disease	69 (0.6%)	32 (1.5%)
ASA >2	5982 (56.3%)	1209 (56.4%)
BMI ^a	28.5 ± 6.1	28.5 ± 7.0
Age ^a	64 ± 13	64 ± 16

COPD, chronic obstructive pulmonary disease; ASA, American Society of Anesthesiologists; BMI, body mass index.

^a Data are expressed as mean ± standard deviation.

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