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Primary vs Conversion Total Hip Arthroplasty: A Cost Analysis

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Abstract

Introduction—Increasing hip fracture incidence in the United States is leading to higher occurrences of conversion total hip arthroplasty (THA) for failed surgical treatment of the hip. In spite of studies showing higher complication rates in conversion THA, the Centers for Medicare and Medicaid services currently bundles conversion and primary THA under the same diagnosis-related group. We examined the cost of treatment of conversion THA compared with primary THA. Our hypothesis is that conversion THA will have higher cost and resource use than primary THA.

Methods—Fifty-one consecutive conversion THA patients (*Current Procedure Terminology* code 27132) and 105 matched primary THA patients (*Current Procedure Terminology* code 27130) were included in this study. The natural log-transformed costs for conversion and primary THA were compared using regression analysis. Age, gender, body mass index, American Society of Anesthesiologist, Charlson comorbidity score, and smoker status were controlled in the analysis. Conversion THA subgroups formed based on etiology were compared using analysis of variance analysis.

Results—Conversion and primary THAs were determined to be significantly different ($P < .05$) and greater in the following costs: hospital operating direct cost (29.2% greater), hospital operating total cost (28.8% greater), direct hospital cost (24.7% greater), and total hospital cost (26.4% greater).

Conclusions—Based on greater hospital operating direct cost, hospital operating total cost, direct hospital cost, and total hospital cost, conversion THA has significantly greater cost and resource use than primary THA. In order to prevent disincentives for treating these complex surgical patients, reclassification of conversion THA is needed, as they do not fit together with primary THA.

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Keywords

conversion total hip arthroplasty; revision total hip arthroplasty; primary total hip arthroplasty; cost; implant cost

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Hip fractures are a common occurrence in the United States, and their incidence is projected to continue growing with the aging population over the next several decades up to a predicted 580000 cases in 2040 [1,2]. Hip fractures among elderly patients are a major burden to the US Healthcare System[3]. Common treatments for hip fractures include surgical fixation, hemiarthroplasty, and total hip arthroplasty (THA) [4–6]. Failed hip fracture fixation may lead to a conversion THA procedure in order to restore ambulation and function.

Medicare hospital reimbursement for THA is paid as a fixed amount based on diagnosis-related groups (DRGs), which aim to classify patients and procedures into homogenous units based on diagnosis and level of hospital resource use. Prior to 2005, all THA procedures were reimbursed equally under DRG 209. However, several studies demonstrating significant cost differences between primary and revision THA eventually led the Centers for Medicare and Medicaid Services (CMS) to divide DRG 209 into DRGs 544 and 545 to reflect differing levels of resource use for primary and revision procedures, respectively [7–9]. Among the driving factors leading to this change were concerns that certain hospitals including academic and tertiary care centers were bearing an “undue financial burden” associated with relatively high proportions of undercompensated revision procedures as a result of referrals from surrounding hospitals [10].

After implementation of Medicare-Severity DRGs (MS-DRGs) in 2007 for hospital inpatient claims, DRG 544 was separated into MSDRGs 469 (primary THA with major complication/comorbidity [MCC]) and 470 (primary THA without MCC) in order to capture differences in severity of illness [11]. Similarly, MS-DRGs 466, 467, and 468 replaced DRG 545 for revision THA with MCC, revision THA with a complication/comorbidity, and revision THA without complication/comorbidity or MCC, respectively [11]. This classification system enables a higher reimbursement rate for cases of greater severity based on complications and comorbidities. However, conversion THA and primary THA of the same severity remain bundled together under MS-DRGs 469 and 470 and still yield the same revenue regardless of differences in complexity, or actual financial cost and resource use. Although efficient for Medicare cost control, this system has not solved the negative externality of hospitals using this information to possibly “cherry-pick” the less costly primary THA, while referring conversion THAs to other care centers. This is similar to what had occurred with revision THAs before their reclassification in 2005.

Currently, there are independent MS-DRG classifications for revision THA, but primary THA and conversion THA remain categorized under the same MS-DRG classifications. Aside from studies showing that conversion THAs have a higher complication rate than do primary THAs [12–14], there has been a dearth of research to distinguish differences between conversion and primary THA. This lack of clarity has made it difficult for the CMS to justify a change to the current convention of bundling conversion THA and primary THA under the same MS-DRGs.

As cost containment moves to the forefront in the national discussion on health care expenditures [15], proper classification of procedures becomes paramount. For conversion THAs, there is growing concern that they may require a different mix of resources than primary THAs. As demonstrated in previous studies of primary and revision THAs, the continued bundling of conversion THA under the same MS-DRGs as primary THA may be leaving hospitals and physicians undercompensated. This mismatch in treatment and compensation creates a potential disincentive for treating the more complex conversion THA cases, which will only worsen over time.

The expected increase in hip fractures will likely be followed by a corresponding increase in the incidence of conversion THA. Conversion THA is a salvage treatment of failed primary hip fracture fixations [14,16,17]. Such failures have numerous different causes including hardware failure, osteonecrosis, infection, or posttraumatic osteoarthritis [18–23]. Furthermore, conversion THA procedures are used for many other hip pathologies that underwent corrective surgery in the past, such as developmental dysplasia of the hip and slipped capital femoral epiphysis (SCFE). The wide range of applications for conversion THA also contributes to its increasing incidence.

This study seeks to determine cost differences between conversion THA and primary THA. This may serve as a starting point for the CMS in reevaluating the classification of conversion THA. Our hypothesis is that conversion THA will pose a significantly higher cost and resource use to the hospital compared with primary THA. Ultimately, more appropriate reimbursement, budgeting, and physician evaluation are likely to limit disincentives for performing conversion THA, thereby ensuring continued access to care for patients requiring these procedures.

Methods

The study population was drawn from all patients who underwent THA at our Medical Center from October 2012 to March 2015. Identification was done by *Current Procedure Terminology* codes: 27130 for primary THA and 27132 for conversion THA. A total of 51 consecutive conversion THAs and 105 primary THAs were identified. Inclusion criteria for primary THA in this study were as follows: (1) age at time of surgery (≥18 years), (2) negative history of previous hip surgery in the same joint, (3) negative history of current periarticular joint infection, and (4) no primary THA for acute fracture. These restrictions excluded 11 patients for acute hip fracture and 1 patient for periarticular hip infection from the initial group of 105 patients to establish a control group of 93 primary THAs. Cases affected by fracture were identified by patient history and admission diagnosis. Cases affected by infection were identified by *Current Procedure Terminology* code 27091. The control group consisted of primary THA caused by osteoarthritis (n = 81), avascular necrosis (AVN; n = 10), and developmental pathology (n = 2: 1 patient with hip dysplasia and 1 patient with SCFE).

Conversion THA inclusion criteria were as follows: (1) age at time of surgery (≥18 years), (2) positive history of previous hip surgery, and (3) nonrevision THA. Fifty-one consecutive conversion THA patients were identified, including conversion THA with a history of periprosthetic joint infection (PJI; n = 6). A separate group of 45 conversion THAs was designated by excluding the 6 cases of conversion THA with a history of PJI.

Conversion THA Subgroups

Conversion THAs were then divided into subgroups based on etiology of the principal hip surgery. There were 5 conversion THA subgroups: failed femoral neck fracture fixation (n = 12), failed acetabular fracture fixation (n = 11), failed subtrochanteric/intertrochanteric/ proximal femur fracture fixation (n = 7: subtrochanteric fracture [n = 2] + intertrochanteric fracture [n = 2] + proximal femur fracture [n = 3]), history of hip joint infection (n = 9: history of PJI [n = 6] + history of resection arthroplasty [n = 3]), and other causes (n = 12: SCFE [n = 6] + developmental hip dysplasia [n = 3] + AVN [n = 3]). Three cases of conversion THA for history of resection arthroplasty were combined with 6 conversion THAs with a history of PJI to form a larger group of 9 conversion THAs with a history of hip joint infection.

Fracture Subgroups

Two additional subgroups were created from our study population based on fracture history and etiology of conversion THA. First was the conversion THA for failed femur-related fracture fixation subgroup (n = 19: femoral neck fracture [n = 12] + subtrochanteric fracture [n = 2]+ intertrochanteric fracture [n = 2] + proximal femur fracture [n = 3]); this group contains all conversion THAs caused by failed fracture fixation of the femur. Second was the conversion THA for all failed fracture fixation subgroup (n = 30: acetabular fracture [n = 11], femoral neck fracture [n = 12], subtrochanteric fracture [n = 2], intertrochanteric fracture [n = 2], proximal femur fracture [n = 3]); this group contains all conversion THAs caused by failed fracture fixation (femur + acetabulum).

Variables

Cost variables evaluated for this study were implant direct cost, implant total cost, hospital operating direct cost, hospital operating total cost, direct hospital cost, total hospital cost, and cost-price cost. Implant direct cost is the cost directly associated with the THA implant components themselves. Implant total cost is the sum of implant direct cost and any indirect cost associated with the implant components, such as shipping or storage. Hospital operating direct cost is the cost of the services provided by all the health care providers who contributed to completing the THA surgery. Hospital operating total cost is the sum of the hospital operating direct cost and indirect operating cost associated with the surgery, such as administration cost of using the hospital's operating room. Direct hospital cost is all the costs that are directly associated with patient care and is the sum of implant direct cost and hospital operating direct cost. Total hospital cost is the sum of the implant total cost and hospital operating total cost, which includes implant direct cost and hospital operating direct cost. Cost-price cost is the hospital's cost of providing the implant and health care services to the patient.

Controlled Variables

Six variables were controlled for in each comparison group including: age, gender, body mass index (BMI), American Society of Anesthesiologists (ASA) Physical Status Classification, smoker status, and Charlson comorbidity score. Preoperative risk factors and comorbidities were summarized by the Charlson comorbidity score [24].

Comparison Groups

Nine total comparisons were performed against the same control group of 93 primary THAs: (1) all conversion THAs including patients with a history of PJI, (2) all conversion THAs excluding patients with a history of PJI, (3) conversion THA for failed femoral neck fracture fixation, (4) conversion THA for failed acetabular fracture fixation, (5) conversion THA for failed subtrochanteric/intertrochanteric/proximal femur fracture fixation, (6) conversion THA for other causes (history of previous surgery for AVN, SCFE, or developmental dysplasia of the hip), (7) conversion THA for patients with a history of hip joint infection, (8) conversion THA for failed femur-related fracture fixations, and (9) conversion THA for all failed fracture fixations.

Statistical Analysis

Nine total comparisons were performed against primary THA. The natural log of all cost variables was taken and used in place of raw cost. Multivariable linear regression was performed for the natural log of all cost variables. Age, gender, BMI, ASA, smoker status, and Charlson comorbidity score were controlled in all regression analyses (Table 1). Ninety-five percent confidence intervals were calculated for all regressions. Adjusted R^2 was calculated for linear regressions.

One-way ANOVA was performed for intersubgroup comparison between the 5 conversion THA subgroups, and homogeneity of variance was tested with Levene statistic. Tukey and Bonferroni post hoc tests were performed between the 5 conversion THA subgroups. Cases with missing variables were excluded on a pairwise basis. Control was not needed for analysis of variance because intersubgroup analysis compared conversion subgroups to one another.

All statistical analyses were executed with SPSS Statistics 23 software (IBM, Armonk, NY)

Results

Conversion THA vs Primary THA

After the 7 cost variables were compared between conversion THA (excluding conversion THA for patients with a history of PJI) and primary THA, 4 of 7 cost variables were found to be significantly different and greater than primary THA ($P < .05$), including hospital operating direct cost ($P = .005$, 29.2% greater)), hospital operating total cost ($P = .007$, 28.8% greater), direct hospital cost ($P = .009$, 24.7% greater), and total hospital cost ($P = .005$, 26.4% greater; Tables 3 and 4). The same 4 cost variables were even more significantly different when conversion THA procedures in patients with a history of PJI were included ($P \leq .001$; Tables 3 and 4).

Conversion THA Subgroups vs Primary THA

Conversion THA subgroup analysis for the 7 cost variables showed significant difference between conversion THA subgroups and primary THA. Implant direct cost was significantly different and greater when conversion THA for failed femoral neck fracture fixation was compared with primary THA ($P = .047$, 20.7% greater; Table 2). Implant total cost was significantly different and greater when conversion THA in patients with a history of hip joint infection was compared with primary THA ($P = .036$, 73.0% greater; Table 2). Hospital operating direct cost was significantly different and greater in conversion THA for failed acetabular fracture fixation ($P = .002$, 60.9% greater) and conversion THA for patients with a history of hip joint infection ($P = .002$, 44.6% greater; Table 3). Hospital operating total cost was also significantly different and greater in conversion THA for failed acetabular fracture fixation ($P = .003$, 60.6% greater) and conversion THA for patients with a history of hip joint infection ($P = .002$, 44.1% greater; Table 3). Direct hospital cost was significantly different and greater in conversion THA for failed femoral neck fracture fixation ($P = .013$, 22.1% greater), conversion THA for failed acetabular fracture fixation ($P = .007$, 43.4% greater), and conversion THA in patients with a history of hip joint infection ($P < .001$, 54.0% greater; Table 4). Total hospital cost was also significantly different and greater in conversion THA for failed femoral neck fracture fixation ($P = .020$, 21.7% greater), conversion THA for failed acetabular fracture fixation ($P = .006$, 46.8% greater), and conversion THA in patients with a history of hip joint infection ($P < .001$, 58.1% greater; Table 4).

Both the conversion THA for failed subtrochanteric/intertrochanteric/proximal femur fracture fixation subgroup and the conversion THA for other causes subgroup did not have statistically significant difference when compared with primary THA in any of the 7 cost variables that were tested in this study.

Conversion THA for Failed Fracture Fixation Subgroups vs Primary THA

Analysis of the subgroups for conversion THA for failed fracture fixation for the 7 cost variables showed significant difference between fracture THA subgroups and primary THA. The conversion THA for all failed fracture fixation subgroups was significantly different and greater in hospital operating direct cost ($P = .021$, 37.0% greater) and hospital operating total cost ($P = .028$, 36.7% greater; Table 4). Direct hospital cost was significantly different and greater in the conversion THA for failed femur-related fracture fixation subgroup ($P = .040$, 19.2% greater) and the conversion THA for all failed fracture fixation subgroups ($P = .016$, 28.1% greater; Table 4). Total hospital cost was also significantly different and greater when the conversion THA for failed femur-related fracture fixation subgroup ($P = .035$, 20.5% greater) and the conversion THA for all failed fracture fixation subgroups ($P = .013$, 30.1% greater) were compared with primary THA (Table 4).

Cost-price cost was not statistically significantly different among any of the different comparison groups (Table 4).

Discussion

The purpose of this study was to determine whether costs of surgery for primary THA and conversion THA were different enough to warrant a separate classification for conversion THA procedures. Conversion THA is currently bundled under the same MS-DRG classifications as primary THA, which has important implications in institutional reimbursements for the hospital.

Our results show that conversion THAs have greater total financial cost than primary THAs, suggesting that the 2 groups should be classified separately for more accurate reimbursement. Further sub-classification may be possible based on the differences in cost variables that were observed when primary THAs were compared with conversion THA subgroups.

In spite of the current focus on the cost of health care in the United States, there are still many unanswered questions about hip arthroplasty in current health care models. Lower extremity arthroplasty has traditionally been the focus for cost analysis in orthopedics; however, there has yet to be a study evaluating the cost-effectiveness of conversion THA. As the incidence of hip fractures rises with the aging US population, conversion THA numbers will inevitably rise as well. Therefore, it is important to study the cost burden created by conversion THA and to understand how they contrast with primary THA and revision THA.

This study is the first to evaluate the cost of conversion THA, although other studies have found an increased complication rate among conversion THAs compared with primary THAs [12–14,25]. Combined with the results of previous studies, the cost differences that we have identified in this study raise the question that conversion THA may be fundamentally different from primary THA. At the minimum, our findings indicate that further investigation into the differences between the 2 types of THA procedures may be warranted to understand the extent of the dissimilarity.

Just as revision THAs were bundled under the same DRG as primary THAs until they were proven to be different, conversion THA may need to be studied in a similar manner to prove that reclassification is needed. Revision THAs were studied by multiple research groups who analyzed their preoperative characteristics, postoperative outcomes, and costs in a concerted effort to achieve reclassification. Barrack [26] attempted to quantify the difference between primary THA and revision THA and found higher hospital length of stay (LOS), operative time, blood loss, and incidence of complication in revision THA. Iorio et al [7] compared resource use, costs, and reimbursements and found longer LOS, operative time, and higher cost associated with revision THA than primary THA. Crowe et al [8] used cost-charge analysis and found that revision THA had significantly higher cost than did primary THA. Lavernia et al [27] analyzed billing records and found higher LOS, operative time, and total cost in revision THA when compared with primary THA. These differences resulted in higher consumption of hospital resources and actually caused hospitals to suffer from significant losses from treating revision THA [28,29]. Before the reclassification of revision THA, there was a real financial disincentive that drove hospitals to consider limiting the number of referrals for revision THA, which would have ultimately limited access to care for patients in need of such services [30]. Even after reclassification, a study has shown that Medicare still fails to reimburse the extra operating time and effort needed to treat revision THA [31].

Efforts must be taken to avoid similar disincentives for conversion THA. Before the reclassification of revision THA, many studies comparing them to primary THA independently identified significant statistical differences in the same key variables including LOS, operative time, total cost, and complication rate [32]. Between the higher costs found in our study and previous studies showing higher complication rates in conversion THA, 2 of 4 of the most common differences between revision and primary THA have already been identified in conversion THA. If the blueprint used by revision THA to gain reclassification is to be followed, future studies should focus first on hospital LOS and operative time differences between conversion THA and primary THA. Given the discovery of further evidence, we suggest that the CMS strongly considers reclassification of conversion THA based on the precedent established by revision THA.

Although THA is one of the most cost-effective interventions in health care, its large volume due to the aging US population makes it a prime candidate for cost cutting by the CMS [33,34]. This is worrisome for physicians and hospitals that treat a greater number of conversion THAs because Medicare reimbursements for primary THA have been decreasing, whereas their cost of treatment has been increasing [35]. Based on the findings of our study that conversion THAs have a greater cost than primary THAs, the shortfall will be even worse for conversion THAs because current MS-DRG coding has them reimbursed at the same level as the relatively less complicated primary THAs. Therefore, the higher costs associated with conversion THAs may have already created a financial disincentive to treat them.

It should be noted that the 2015 Medicare Physician Fee Schedule reimburses physicians at a higher rate for conversion THA than primary THA. Specifically, physicians are reimbursed 4.97 relative value units (RVU) more for conversion THA compared with primary THA [36]. Facility/nonfacility RVU and Malpractice RVU are also higher for conversion THA. This suggests that the CMS has some understanding of the greater resource use of conversion THA; however, under the same MS-DRGs, conversion THA reimbursements remain pegged to the less costly primary THA. This would likely lead to continued institutional undercompensation for conversion THA. Furthermore, separate MS-DRGs for conversion THA provide benefits beyond financial reimbursement including better understanding of the failure mechanisms of different types of THA and more accurate data for the American Joint Replacement Registry Project. The many utilities of separate MS-DRGs for conversion THA would ultimately promote quality improvement and lead to better patient care and outcomes.

Because MS-DRG coding is also used to evaluate physician quality of care, an additional disincentive may also arise from the bundling of primary THA and conversion THA in the form of physician quality of care ratings. As our study has demonstrated that conversion THA has higher costs than primary THA, an evaluation of physicians who treat more conversion THAs may conclude that they are using more resources and having a higher rate of complications than other surgeons treating mainly primary THAs. In a climate of health care reform that is increasingly focusing on evaluating physicians, the risk of a lower rating may result in physicians refusing conversion THA cases in order to protect their ratings.

Although there have not been many studies investigating conversion THAs, results that have been published are reminiscent of the evidence that ultimately led to a separate classification for revision THA apart from primary THA [5,12,14,18–22,37]. We hope that the results of this study will provide the impetus for the medical community and the CMS to collaborate in removing any barriers preventing patients in need of a conversion THA from getting the care that they need.

This study had several limitations stemming from the reporting of surgery costs and the small sample size of several of the conversion THA subgroups. Although cost data were obtained for 7 data points, many products and services were lumped under a single summarizing cost number. A more detailed breakdown of the cost of surgery would allow for a more granular examination of the variation in cost between conversion THA and primary THA. The aggregate number of conversion THAs included in this study was comparable to the number used in other studies; however, when separated into subgroups based on etiology, some of the conversion THA subgroups were left with relatively small sample sizes. Larger subgroup sample sizes would be more representative of the population and curtail the influence of outliers. In spite of these limitations, the study had many strengths including a complete set of cost data, a single provider, and a single institution for all procedures and perioperative care.

Conclusions

This study demonstrates that conversion THAs are more costly than primary THAs. Hospital operating direct cost, hospital operating total cost, direct hospital cost, and total hospital cost are all greater in conversion THA than in primary THA. However, conversion THAs and primary THAs are currently classified under the same MS-DRGs, which means that they are reimbursed at the same level. We recommend development of a separate classification for conversion THA.

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Table 1

Patient Population Demographics.

	Age, Average (SD)	Gender (Male, Female)	BMI, Average (SD)	Charlson, Average (SD)	ASA, Average (SD)	Smoker Status (Smoker, Nonsmoker)
Primary THA (control; n = 93)	61 (14)	35 (58)	29 (7.3)	0.5 (1.1)	2.8 (0.5)	7 (86)
All conversion THAs (excluding patients with history of PJI; n = 45)	61 (17)	17 (28)	28.5 (6.4)	1.4 (2.4)	3 (0.5)	10 (35)
All conversion THAs (including patients with history of PJI; n = 51)[a]	61 (16)	20 (31)	28 (6.3)	1.4 (2.3)	3 (0.5)	13 (38)
Conversion THA for failed femoral neck fracture fixation (n = 12)	72 (11)	2 (10)	24.8 (4.7)	2 (2.3)	3.1 (0.3)	2 (10)
Conversion THA for failed acetabular fracture fixation (n = 11)	60 (17)	5 (6)	28.3 (4.4)	1.3 (2.7)	3 (0.6)	3 (8)
Conversion THA for failed subtrochanteric, intertrochanteric, and proximal femur fracture fixation (n = 7)[b]	73 (11)	3 (4)	28.4 (9.4)	1.3 (1.3)	3.1 (0.7)	2 (5)
Conversion THA for other causes (AVN, developmental hip dysplasia, or SCFE; n = 12)[c]	46 (13)	4 (8)	32.1 (6)	0.5 (0.8)	2.8 (0.5)	1 (11)
Conversion THA for patients with history of hip joint infection (pji + history of resection; n = 9)[d]	57 (8)	5 (4)	26.1 (6)	1.9 (3.6)	3.1 (0.3)	5 (4)
Conversion THA for failed femur-related fracture fixation (n = 19)[e]	72 (11)	5 (14)	26.1 (6.8)	1.7 (1.9)	3.1 (0.5)	4 (15)
Conversion THA for all failed fracture fixations (n = 30)[f]	68 (14)	11 (19)	26.9 (6)	1.6 (2.2)	3.1 (0.5)	7 (23)

[a] Conversion THA patients with history of PJI (n = 6).

[b] Subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

[c] SCFE (n = 6), developmental hip dysplasia (n = 3), and AVN (n = 3).

[d] Conversion THA patients with history of PJI (n = 6) and history of resection (n = 3).

[e] Femoral neck fracture (n = 12), subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

[f] Acetabular fracture (n = 11), femoral neck fracture (n = 12), subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

Table 2

Implant Costs.

	Implant Direct Cost			Implant Total Cost		
	$, Average (SD)	% Difference[a]	*P*	$, Average (SD)	% Difference[a]	*P*
Primary THA (control; n = 93)	11307 (3026)	–	–	14578 (3958)	–	–
All conversion THAs (excluding patients with history of PJI; n = 45)	13677 (7017)	21.0%	.472	18061 (9642)	23.9%	.375
All conversion THAs (including patients with history of PJI; n = 51)[b]	14275 (7122)	26.2%	.212	18972 (9906)	30.1%	.150
Conversion THA for failed femoral neck fracture fixation (n = 12)	13642 (6432)	20.7%	.047	17583 (8503)	20.6%	.051
Conversion THA for failed acetabular fracture fixation (n = 11)	14526 (8536)	28.5%	.495	19283 (12185)	32.3%	.435
Conversion THA for failed subtrochanteric, intertrochanteric, and proximal femur fracture fixation (n = 7)[c]	12157 (4753)	7.5%	.663	16554 (6957)	13.6%	.488
Conversion THA for other causes (AVN, developmental hip dysplasia, or SCFE; n = 12)[d]	12878 (5870)	13.9%	.611	16808 (7333)	15.3%	.461
Conversion THA for patients with history of hip joint infection (pji + history of resection; n = 9)[e]	18324 (8872)	62.1%	.054	25213 (12610)	73.0%	.036
Conversion THA for failed femur-related fracture fixation (n = 19)[f]	13095 (5775)	15.8%	.116	17204 (7783)	18.0%	.079
Conversion THA for all failed fracture fixations (n = 30)[g]	13620 (6806)	20.5%	.229	17966 (9478)	23.2%	.172

[a]Percent difference calculation: [(average of conversion THA subgroup − average of primary THA)/(average of primary THA)] * 100%.

[b]Conversion THA patients with history of PJI (n = 6).

[c]Subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

[d]SCFE (n = 6), developmental hip dysplasia (n = 3), and AVN (n = 3).

[e]Conversion THA patients with history of PJI (n = 6) and history of resection (n = 3).

[f]Femoral neck fracture (n = 12), subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

[g]Acetabular fracture (n = 11), femoral neck fracture (n = 12), subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

Table 3

Hospital Operating Costs.

	Hospital Operating Direct Cost			Hospital Operating Total Cost		
	$, Average (SD)	% Difference[a]	*P*	$, Average (SD)	% Difference[a]	*P*
Primary THA (control; n = 93)	9589 (2685)	–	–	15409 (4448)	–	–
All conversion THAs (excluding patients with history of PJI; n = 45)	12385 (6512)	29.2%	.005	19841 (10560)	28.8%	.007
All conversion THAs (including patients with history of PJI; n = 51)[b]	12624 (6295)	31.7%	.001	20236 (10206)	31.3%	.001
Conversion THA for failed femoral neck fracture fixation (n = 12)	11866 (5261)	23.7%	.099	18920 (8450)	22.8%	.134
Conversion THA for failed acetabular fracture fixation (n = 11)	15433 (11219)	60.9%	.002	24742 (18239)	60.6%	.003
Conversion THA for failed subtrochanteric, intertrochanteric, and proximal femur fracture fixation (n = 7)[c]	11722 (4494)	22.2%	.337	18953 (7502)	23.0%	.342
Conversion THA for other causes (AVN, developmental hip dysplasia, or SCFE; n = 12)[d]	10403 (1319)	8.5%	.228	16700 (2138)	8.4%	.219
Conversion THA for patients with history of hip joint infection (PJI + history of resection; n = 9)[e]	13864 (3630)	44.6%	.002	22198 (5789)	44.1%	.002
Conversion THA for failed femur-related fracture fixation (n = 19)[f]	11813 (4863)	23.2%	.128	18932 (7899)	22.9%	.147
Conversion THA for all failed fracture fixation (n = 30)[g]	13140 (7825)	37.0%	.021	21062 (12710)	36.7%	.028

[a]Percent difference calculation: [(average of conversion THA subgroup − average of primary THA)/(average of primary THA)] * 100%.

[b]Conversion THA patients with history of PJI (n = 6).

[c]Subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

[d]SCFE (n = 6), developmental hip dysplasia (n = 3), and AVN (n = 3).

[e]Conversion THA patients with history of PJI (n = 6) and history of resection (n = 3).

[f]Femoral neck fracture (n = 12), subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

[g]Acetabular fracture (n = 11), femoral neck fracture (n = 12), subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

Table 4

Direct Hospital Cost, Total Hospital Cost, and Cost-Price Cost.

	Direct Hospital Cost			Total Hospital Cost			Cost-Price Cost		
	$, Average (SD)	**% Difference[a]**	***P***	**$, Average (SD)**	**% Difference[a]**	***P***	**$, Average (SD)**	**% Difference[a]**	***P***
Primary THA (control; n = 93)	20896 (4158)	–	–	29987 (6212)	–	–	18099 (2130)	–	–
All conversion THAs (excluding patients with history of PJI; n = 45)	26062 (10926)	24.7%	.009	37902 (16567)	26.4%	.005	18473 (1969)	2.1%	.397
All conversion THAs (including patients with history of PJI; n = 51)[b]	26899 (10655)	28.7%	.001	39209 (16216)	30.8%	<.001	18525 (1938)	2.4%	.276
Conversion THA for failed femoral neck fracture fixation (n = 12)	25508 (9644)	22.1%	.013	36503 (14200)	21.7%	.020	18179 (2168)	0.4%	.890
Conversion THA for failed acetabular fracture fixation (n = 11)	29958 (16818)	43.4%	.007	44025 (26304)	46.8%	.006	18446 (2057)	1.9%	.675
Conversion THA for failed subtrochanteric, intertrochanteric, and proximal femur fracture fixation (n = 7)[c]	23879 (7758)	14.3%	.364	35506 (12340)	18.4%	.264	19018 (1664)	5.1%	.429
Conversion THA for other causes (AVN, developmental hip dysplasia, or SCFE; n = 12)[d]	23281 (5952)	11.4%	.220	33508 (7249)	11.7%	.140	18546 (1991)	2.5%	.463
Conversion THA for patients with history of hip joint infection (pji + history of resection; n = 9)[e]	32188 (7707)	54.0%	<.001	47412 (11643)	58.1%	<.001	18669 (1942)	3.1%	.302
Conversion THA for failed femur-related fracture fixation (n = 19)[f]	24908 (8806)	19.2%	.040	36136 (13199)	20.5%	.035	18488 (1992)	2.1%	.531
Conversion THA for All failed fracture fixations (n = 30)[g]	26760 (12321)	28.1%	.016	39028 (19018)	30.1%	.013	18473 (1980)	2.1%	.502

[a]Percent difference calculation: [(average of conversion THA subgroup − average of primary THA)/(average of primary THA)] * 100%.

[b]Conversion THA patients with history of PJI (n = 6).

[c]Subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

[d]SCFE (n = 6), developmental hip dysplasia (n = 3), and AVN (n = 3).

[e]Conversion THA patients with history of PJI (n = 6) and history of resection (n = 3).

[f]Femoral neck fracture (n = 12), subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).

[g]Acetabular fracture (n = 11), femoral neck fracture (n = 12), subtrochanteric fracture (n = 2), intertrochanteric fracture (n = 2), and proximal femur fracture (n = 3).