

RESEARCH ARTICLE

Comparison of Differences in Complications and Revision After Conversion to Total Hip Arthroplasty from Plating vs. Nailing vs. Hemiarthroplasty

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Abstract

Background: Total hip arthroplasty (THA) after previous hip surgery increases the procedure complexity and complication rate. We investigated the complication rates following conversion to total hip arthroplasty from three hip surgeries, namely plate fixation of the intertrochanteric fracture, nailing of the trochanteric fracture, and hemiarthroplasty of the hip.

Methods: This retrospective study was conducted using the PearlDiver database (www.pearliverinc.com, Colorado Springs) and identified all patients undergoing THA between 2010 and 2019. Among this group, we included all patients who had received one of the three procedures, hip hemiarthroplasty (CPT 27125), fixation of the intertrochanteric fracture with plates and screws (CPT 27444), or fixation of hip fracture with nail (CPT 27445) within two years of THA. We analyzed complications in these patients and compared it to the complication rate in primary THA patients. The complications analyzed were 30-day transfusion risk, 90-day surgical site infection (SSI) risk, 90-day periprosthetic fracture risk, 1-year dislocation risk, and 2-, 5-, and 10-year revision risk.

Results: A total of 118,209 patients underwent THA between 2010 and 2019. A total of 9,173, 48,326, and 31,632 patients underwent fixation with plates and screws, nailing, and hemiarthroplasty respectively. We identified 71, 42, and 160 patients with hemiarthroplasty, plates & screws, and nailing, respectively, within two years of THA. 117,936 primary THA patients were used as a comparison group. The nailing group had the highest rate of transfusion risk (OR=2.34, 95% CI=1.32, 4.13, $P<0.05$). Furthermore, the hemiarthroplasty group had highest rate of SSI risk (OR=9.25, 95% CI=4.86, 17.63, $P<0.05$) and highest revision risk at 2 years (OR=10.532, 95% CI= 6.09, 18.19, $P<0.05$).

Conclusion: Conversion of hemiarthroplasty to THA was associated with a higher risk of infection and revision. Hence, surgeons considering primary hip hemiarthroplasty for severely comminuted intertrochanteric fracture should exercise caution, especially for active elderly patients.

Level of evidence: III

Keywords: Cephalomedullary nailing, Complication, Conversion hip, Hemiarthroplasty, Plating, Revision

Introduction

Proximal femoral fracture is one of the most common fractures encountered in orthopedic practice. The type of fixation depends on the location of the fracture (extracapsular versus intracapsular), age of the patient, and degree of displacement. Excluding

the undisplaced intracapsular fractures especially in young patients, most fractures require extensive surgery in the form of a dynamic hip screw (DHS), cephalomedullary nailing, or hip hemiarthroplasty. Different modes of failure have been described for

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each of these management options. The failed cases often require total hip arthroplasty (THA) using a standard or revision implant as a salvage option. Several researchers have reported the outcomes of conversion of hemiarthroplasty.¹⁻¹⁴ There are also some reports regarding the conversion of cephalomedullary nails and DHS.¹⁵⁻¹⁹ However, most of the studies are a noncomparative and single institution, involving a small cohort of patients. Moreover, there is no large database study comparing the risks associated with the conversion of these three procedures. Accordingly, the present study was conducted to compare the risk of systemic complications, infection, dislocation, and re-revision in patients undergoing conversion THA as a salvage procedure for failed DHS, cephalomedullary nail, or hip hemiarthroplasty using a large database population.

Materials and Methods

This retrospective study was performed using the PearlDiver patient record database (www.pearliverinc.com, Colorado Springs, CO, USA). The PearlDriver is a commercially available database, which contains data from Medicare and several different private insurers. The data in PearlDiver have been extensively used in orthopedic research. The database is compliant with the Health Insurance Portability and Affordability Act and contains more than 30 million patient records. In the present study, we used the Humana subset (MSOrtho30) of the database to include all patients undergoing THA between 2010 and 2019. Among this group, we included all patients who had received one of the three procedures of hip hemiarthroplasty (CPT 27125), Fixation of IT fracture with plates and screws (CPT 27444), or fixation of hip fracture with nail (CPT 27445) within two years before the total hip arthroplasty.

We analyzed the risk of various complications in the first two years following total hip arthroplasty in these patients and compared it with the complication rate of total hip arthroplasty in patients who had not undergone any of these three procedures. The complications that were analyzed included 30-day transfusion risk, 90-day SSI risk, 90-day periprosthetic fracture risk, 1-year dislocation risk, and 2-, 5-, and 10-year revision risk.

Statistical Analysis

Statistical analysis was performed using the R statistical program (Version 3.6.2) and IBM SPSS version 27.0 (IBM; Armonk, NY, USA). We used descriptive statistics for the analysis of baseline demographic variables, including age, gender distribution, the incidence of complications, and revision in each group. The alpha level at 0.05 was considered statistically significant for both numerical and binomial data. The Chi-square analysis was used to find out the significance of complications and revision in the conversion group, compared to the primary THA group. Associations between independent variables and dichotomous outcome variables were examined using an odds ratio

(OR) with a 95% confidence level.

Results

Demographics

The database search led to the identification of 118,209 patients who underwent THA between 2010 and 2019. Out of these patients, a total of 9,173, 48,326, and 31,632 cases had undergone fixation with plates/screws (CPT-27244), nailing (CPT-27245), and hemiarthroplasty (CPT-27125), respectively. Among these three groups, 71, 42, and 160 patients had respectively received hemiarthroplasty, plates/screws, and nailing within 2 years of their THA. Excluding the patients undergoing these three procedures, we used a cohort of 117,939 THA patients as a comparison group.

Transfusion Risk

A total of 4,285 (3.63%) patients undergoing primary THA required transfusion within 30 days. Transfusion risk was at the highest level in the nailing group, with 13 (8.12%) patients requiring transfusion within 30 days. In the hemiarthroplasty and plates group, fewer than 11 patients needed a transfusion, but the exact number was unavailable [Table 1].

Surgical Site Infection Risk

Surgical site infection (SSI) was noted in 2,290 (1.94%) patients within 90 days following primary THA. The hemiarthroplasty group had 11 (15.4%) patients with SSI. However, the other two groups had fewer than 11 cases, and hence the exact number was not reported.

Dislocation Risk

There were 1,724 (1.45%) patients with dislocation in the primary THA group. In all three groups, there were fewer than 11 patients with dislocation and hence the exact number was not reported. (comment)

Revision Risk

The primary THA groups had 3,487, 4,155, and 4,332 cases of revision within 2, 5, and 10 years, respectively. All revisions had occurred within two years of THA, except for one case in the hemiarthroplasty group that happened between 2 and 5 years. Furthermore, 18 patients in this group had a stable revision rate at 5 and 10 years. Furthermore, fewer than 11 patients in the plate and nail group required revision arthroplasty in the first 2 years. This number was found to be 11 cases for the nailing group and fewer than 11 cases for the plating group at 5 and 10 years. [Table 2].

Nerve Injury

Fewer than 11 patients were noted to have nerve injury within 30 days of primary THA. However, there was no case of nerve injury in the other three groups.

Periprosthetic Fracture

A total of 14 cases of periprosthetic fracture were recorded for the primary THA group. Furthermore, fewer than 11 patients with this complication were observed in the hemiarthroplasty group, with no cases in the plate or

Table 1. Revision and complications

	Primary THA (117 939)	Hemi and THA (71)	Nail and THA (160)	DHS and THA (42)
Revision at 2 years	3487	17	-1*	-1
Revision at 5 years	4155	18	11	-1
Revision at 10 years	4332	18	11	-1
Dislocation	1713	-1	-1	-1
Transfusion	4285	-1	13	-1
SSI	2290	11	-1	-1
PPF	14	-1	0	0
Nerve injury	-1	0	0	0

*= -1 denotes that number is less than 11 but not zero. Pearldiver does not give exact number when the number is less than 11 and report it as -1.

Table 2. Statistical comparison between groups

	Primary THA	Conversion THA	Odd ratio
Revision at 2 years Primary VS Hemi conversion	3487	17	OR-10.532 (6.09 to 18.19) <i>P</i> <0.05
Revision at 5 years Primary VS Hemi conversion	4155	18	OR-9.479 (5.54 to 16.21) <i>P</i> <0.05
Revision at 5 years Hemi conversion vs Nail conversion	18	11	OR- 4.68 (2.07 to 10.58) <i>P</i> <0.05
Revision at 10 years Primary VS Hemi conversion	4332	18	OR- 9.07 (5.3 to 15.52) <i>P</i> <0.05
Revision at 10 years Hemi conversion vs Nail conversion	18	11	OR- 4.68 (2.07 to 10.58) <i>P</i> <0.05
Transfusion Primary VS Nail conversion	4285	13	OR- 2.34 (1.32 to 4.13) <i>P</i> <0.05
SSI Primary VS Hemi conversion	2290	11	OR- 9.25 (4.86 to 17.63) <i>P</i> <0.05

nail groups.

Discussion

Our study revealed that conversion THA for failed proximal femur fracture management is associated with a higher rate of short- and long-term complications. The risk of transfusion and infection was higher in the nailing and hemiarthroplasty groups, respectively. In addition, the hemiarthroplasty group showed a higher risk of 2-year revision. However, the risk of 5- and 10-year revision was higher in both the hemiarthroplasty and nailing groups.

Several researchers have highlighted the higher rate of complication and cost of care associated with

conversion THA and the need for a separate CPT code for this condition. An interesting finding in our study is that all conversion THA for failed proximal femoral fractures does not have the same outcome (Comment: check if it conveys your intended meaning, please.). Our study revealed that conversion of hemiarthroplasty poses the greatest risk, compared to that of nailing or DHS. The risk of short-term complications, like a transfusion, was higher in the nailing group; however, this group showed a lower risk of SSI, dislocation, and periprosthetic fracture. In contrast to the nailing group, the hemiarthroplasty group was found to be associated with a higher risk of complications in the form of infection. Likewise, Hernandez et al. showed

a high risk of complications, especially dislocations and periprosthetic fractures in the hemiarthroplasty conversion group.⁴ A higher complication risk has been also noted in other single-institution studies. The Cochrane database review failed to show any evidence supporting the use of hemiarthroplasty, especially in extracapsular fractures.²⁰

Most of the previous studies have focused on the risk of short- to mid-term outcomes and cost of care.²¹⁻²⁴ However, we identified the risk of short- and long-term revision after conversion THA. Our study revealed a high risk of 2-year revision in the hemiarthroplasty group; however, this rate was not significant in the nailing and plating groups. The 5- and 10-year revision odds were high in both nailing and hemiarthroplasty groups. Nonetheless, the odds of revision in the hemiarthroplasty group was 4.68 higher, compared to the nailing group both at 5-year and 10-year. Few researchers have favored hemiarthroplasty in unstable IT fractures to avoid short-term complications and fixation failure. However, Parker et al. in their Cochrane review presented limited evidence to support that practice. Our findings support surgeons to consider nailing over hemiarthroplasty even in severely comminuted IT fractures, especially in younger patients since hemiarthroplasty is associated with a higher risk of infection and revision after conversion THA.

Conversion of failed DHS and proximal femoral nailing has been investigated by various researchers. Morice et al. studied 59 cases with conversion THA after failed fixation and noted more complications in patients with an extracapsular fracture. However, their cohort study was mostly compromised of DHS, and only six patients underwent nailing.²⁵ Zeng et al. compared 70 patients who underwent conversion THA for failed DHS with 71 patients who underwent conversion THA for failed nailing.¹⁸ They noted an overall higher complication rate in the DHS group (42.9% vs. 20.8%). They also observed a higher risk of periprosthetic fracture in the DHS group (n=11, 15.7%) versus the nailing group (n=3, 4.2%). In another study, Yu et al. reported the outcome of 198 cases with proximal femoral nails converted to uncemented or cemented THA and found a higher complication rate for the uncemented conversion THA.¹⁹ Similarly, in a meta-analysis performed by Dix et al., a higher complication rate was reported for uncemented conversion THA, compared to cemented THA (34% vs. 22%).²⁶ However, in comparison to our research, most of these studies were single center, focused on short-term complications, and did not have a primary THA comparison group. Additionally, none of these studies reported the risk of revision in the short term and long term compared to our study.

Few researchers have utilized a large database to study conversion THA. Quin et al. applied the NASQIP database

and found a higher complication rate associated with conversion THA.⁵ However, the NASQIP database is limited to only 30-day complications.

Furthermore, Quin et al. used a generic CPT code of 27,132 (failed hip fixation) conversion THA without segregating them into DHS, nailing, or hemiarthroplasty. Douglas et al. also used a large database in their study and found a higher complication rate but again utilized the generic CPT code.¹ Additionally, Smith et al. used the Medicare database but only looked at the patients who had previous cephalomedullary nailing and did not include DHS and hemiarthroplasty groups.¹⁵

Our study is not without limitations. While the PearlDiver database does allow for the aggregation of a large amount of data, we are limited to what is coded through this database. The PearlDiver databases reliance on accurate ICD and CPT codes, as well as billing information, creates a potential for reporting bias. Furthermore, the lack of coding laterality in database studies may cause the overestimation of some values by including patients in the conversion THA group who had a primary THA in the hip contralateral to their index procedure. This could potentially have lowered the complication rates of conversion THA, possibly masking significant findings in regard to complications or revisions. Additionally, there is a lack of granularity inherent to large database studies that preclude our ability to stratify results based on the types of implants used, approach, or radiological nature of the failure.

In conclusion, not all conversion THA cases are the same. Conversion THA after nailing and plating is associated with fewer complications, compared to conversion surgery for hemiarthroplasty. Hence, surgeons considering hemiarthroplasty for extraarticular femoral neck fracture should exercise extreme caution in their choice since later conversion of hemiarthroplasty is associated with a much higher risk of infection and re-revision.

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