

Disparities in Total Hip Arthroplasty Versus Hemiarthroplasty in the Management of Geriatric Femoral Neck Fractures

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Abstract

Introduction: Recent clinical evidence suggests that total hip arthroplasty (THA) provides improved clinical outcomes as compared to hemiarthroplasty (HA) for displaced femoral neck fractures in elderly individuals. However, THA is still utilized relatively infrequently. Few studies have evaluated the factors affecting utilization and the role socioeconomic plays in THA versus HA. **Methods:** In the United States, the National Inpatient Sample (NIS) database was used to identify patients treated surgically for femoral neck fracture, between 2009 and 2010. Patients were identified using *International Classification of Diseases, Ninth Revision*, codes for closed, transcervical femoral neck fractures and closed fractures at unspecified parts of the femoral neck. All candidate predictors of THA versus HA were entered into a multilevel mixed-effect regression model. **Results:** Older patient age, being Asian or Pacific Islander, and having Medicaid payer status were all associated with lower odds of receiving THA. Patients with private insurance including Health Maintenance organization (HMO) had higher odds of THA as did patients with other insurance. Odds of THA were significantly lower among patients in teaching hospitals and higher at hospitals with greater THA volume. **Discussion:** Ethnicity, payer status, hospital size, and institutional THA volume were all associated with the utilization of THA versus HA in the treatment of geriatric femoral neck fractures. **Level of Evidence:** Level III Retrospective Cohort study.

Keywords

geriatric trauma, geriatric medicine, adult reconstructive surgery, trauma surgery, basic research

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Introduction

Geriatric femoral neck fractures represent a major source of patient morbidity and mortality.^{1,2} The optimal management strategy remains uncertain; nondisplaced and valgus impacted fractures are typically treated with fixation, while displaced fractures are treated with arthroplasty. Historically, displaced fractures were treated with hemiarthroplasty (HA), but there has been increasing interest in total hip arthroplasty (THA) with numerous contemporary studies demonstrating better clinical outcomes at a lower overall cost.³⁻¹⁷ However, studies performed in the United States have demonstrated that despite strong clinical evidence, overall rates of THA as compared to HA have not increased significantly over time.^{18,19}

Multiple provider-specific factors may help to explain this observation. It is possible that evidence from recently published clinical trials may not yet have impacted practicing surgeons. Surgeons comfortable with performing HA may not be comfortable performing THA, which is technically more

demanding and associated with a higher rate of dislocation. A growing body of evidence suggests that socioeconomic factors may influence arthroplasty-related decision-making and quality of care for patients with hip fracture.²⁰⁻²³ Factors such as race, sex, and socioeconomic status have been shown to impact both surgeon recommendations for surgery and perceived outcomes after elective joint replacement surgery.^{21,22,24,25} However, the importance of these variables in femoral neck fracture decision-making is unknown.

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A recent study conducted by Bishop et al found that overall rates of THA increased from 1998 to 2010. In light of these findings, few studies have evaluated the factors affecting utilization rates when compared to HA and the role certain factors such as race, ethnicity, insurance status, and other socioeconomic measures may have on the odds of receipt.²⁶ The purpose of this study was to evaluate the associations of patients' race, sex, geography, and other socioeconomic factors on receipt of THA versus HA in the treatment of femoral neck fracture.

Methods

Data from the National Inpatient Sample (NIS) was utilized in this study. National Inpatient Sample is the largest all-payer, inpatient, publicly available health-care database sponsored by the Agency for Healthcare Research and Quality as part of the Healthcare Cost and Utilization Project. Discharge data are deidentified for approximately 8 million hospital stays from more than 1000 hospitals annually. The NIS samples from 46 states account for 97% of the US population and approximate 20% stratified sample of US hospitals.

The cohort for this study included patients with closed, transcervical femoral neck fracture as well as patients with closed fractures at unspecified parts of the femoral neck who underwent THA (*International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] 81.51*) and HA (*ICD-9-CM 81.52*). Fractures at the base of the femoral neck (*ICD-9-CM 820.0*, excluding 820.03) were excluded, as fixation rather than arthroplasty is generally recommended for this fracture location. Patients treated with internal fixation were excluded as our goal was to evaluate decision-making for displaced fractures in the elderly individuals, and the vast majority of elderly patients treated with internal fixation likely had nondisplaced or valgus impacted fractures.

The NIS contains information on hospital variables and patient characteristics that were included in our analysis. Patient characteristics including sex, race, and primary expected payer status (Medicare, Medicaid, private including HMO, self-payers, no charge, and other) were included. Reference groups were as follows: gender (male), race (white), payer status (Medicare), median household income for patient's zip code (USD1-24 999), teaching status (teaching), region (Northeast), hospital location (rural), number of beds (small; see Appendix A for hospital size by number of beds according to NIS). Age was analyzed by patient age in years. To evaluate the effect of patient-level income on THA utilization rates, NIS-provided median household income level of the patient's zip code was used. Hospital characteristics including urban or rural location, teaching status, region, bed size, and case volume by procedure were also examined as predictors of THA.

In order to determine significant predictors of THA versus HA (yes/no), all candidate predictors were entered into a multi-level mixed-effect logistic regression model which included an adjustment for age.

Hospital ID was included as a random effect in order to account for the clustering of patients within health-care facilities. Odds ratios (ORs) and 95% confidence intervals (CIs) for all parameter estimates were derived from this model. Analyses were conducted using the LME4 package in the R Version 3.0.0.

Results

Our cohort included 38 222 femoral neck fracture patients who underwent THA or HA from 2009 to 2010. Of the 38 222 patients included, 29 348 (76.8%) were white, 1365 (3.6%) black, 1294 (3.4%) Hispanic, 499 (1.3%) Asian or Pacific Islander, 185 (0.5%) Native American, 609 (1.6%) other race/ethnicity (Table 1). Among these patients, 3659 underwent THA and 34 563 underwent HA. Hospital region and practice setting (urban vs rural, teaching vs nonteaching) were evaluated. Of the patients included in this study, 31 660 (82.8%) underwent surgery at urban hospitals, while 5994 (15.7%) underwent surgery in rural hospitals (Table 2); 41.8% of patients were from the South region, 19.5% of patients from the West, 22.6% of patients from the Midwest, and 16.2% of patients from the Northeast (Table 2). In all, 23 988 (62.8%) patients underwent surgery in a nonteaching hospital, while 13 666 (35.8%) underwent surgery at a teaching hospital (Table 2).

Older patient age was associated with lower odds of receiving THA (OR: 0.944, P value < .0001, 95% CI: 0.941-0.948; Table 3). Asian or Pacific Islander patients had statistically lower rates of THA compared to Caucasian patients (OR: 0.507, P value = .0019, 95% CI: 0.330-0.778; Table 3). Sex and other race/ethnicities were not significantly associated with odds of receiving THA.

Household income was evaluated using median household income for patient's zip code as individual patient income was unavailable. Income was stratified into 4 income brackets and compared relative to patients in the \$1 to 24 999 income bracket (Table 3). No statistical difference was identified in the rates of THA according to median zip code income.

Discussion

Recent studies indicated that THA is associated with improved clinical outcomes and lower overall cost when compared to HA in the treatment of displaced femoral neck fractures in elderly patients.^{3-5,9-15} In 2010, over 326 100 total hip replacements were performed in the United States.²⁷ In this study, data from 38 222 patients with femoral neck fracture treated with either HA or THA were analyzed to identify factors associated with the selection of surgical THA over HA.

This study has inherent limitations. The use of the NIS cannot assess physician or patient rationale or preferences for a particular procedure or treatment over another. Although we were able to account for all patients treated surgically for a closed transcervical femoral neck fracture based on *ICD-9* diagnosis and treatment codes, the NIS information cannot account for the degree of fracture displacement, functional status of the patient, or comorbidities, all of which likely influence decision-making.

Table 1. Patient Demographics.^a

Characteristics	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Sex				
Male	10 802	28.3	28.3	28.3
Female	27 409	71.7	71.7	100
Race				
White	29 348	76.8	88.1	88.1
Black	1365	3.6	4.1	92.2
Hispanic	1294	3.4	3.9	96.1
Asian or Pacific Islander	499	1.3	1.5	97.6
Native American	185	0.5	0.6	98.2
Other race/ethnicity	609	1.6	1.8	100
Median annual household income				
\$1-\$24 999	9472	24.8	25.3	25.3
\$25 000-\$34 999	10 433	27.3	27.9	53.1
\$35 000-\$44 999	9117	23.9	24.3	77.5
\$45 000-Above	8430	22.1	22.5	100
Procedure				
THA	3659	9.6	9.6	9.6
HA	34 563	90.4	90.4	100
Primary expected payer				
Medicare	32 719	85.6	85.7	85.7
Medicaid	742	1.9	1.9	87.7
Private including HMO	3756	9.8	9.8	97.5
Self-pay	368	1	1	98.5
No charge	33	0.1	0.1	98.5
Other	554	1.4	1.5	100
Total number of patients	38 222			

Abbreviations: IF, internal fixation; HA, hemiarthroplasty; THA, total hip arthroplasty.

^aMedian household income represents income national quartiles for patient's zip code.

Table 2. Hospital Demographics.

Characteristics	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Location				
Rural	5994	15.7	15.9	15.9
Urban	31 660	82.8	84.1	100
Region				
Northeast	6187	16.2	16.2	16.2
Midwest	8633	22.6	22.6	38.8
South	15 967	41.8	41.8	80.5
West	7435	19.5	19.5	100
Teaching status				
Nonteaching	23 988	62.8	63.7	63.7
Teaching	13 666	35.8	36.3	100
Bed size				
Small	4521	11.8	12	12
Medium	9691	25.4	25.7	37.7
Large	23 442	61.3	62.3	100

Moreover, the NIS does not have individual-level income and therefore the median household income of patient's zip code was used, which is an additional limitation of this study. Despite these limitations, this is a large study including data from over 38 000 patients that identifies evidence of disparities in the selection of HA versus THA for femoral neck fracture based on race, payer status, and type of treating hospital.

Older patients in our cohort were less likely to be treated with THA as compared to HA, likely reflecting an emphasis on avoidance of complications rather than maximizing functional outcomes in the oldest and potentially lowest demand patients. This finding is supported with recent literature showing that in patients >70 years of age with an intracapsular fracture had no significant difference in functional outcomes between HA and THA.²⁸ Moreover, mean ages were similar among Medicare and Medicaid patients (80.59 and 80.74, respectively); however, patients undergoing THA were 6.65 years younger than patients undergoing HA (THA 74.54 and HA 81.19). This finding is consistent with a recent study that the rate of THA for the treatment of femoral neck fractures is increasing for patients younger than 70, but decreasing for patients older than 80.²⁹ Total hip arthroplasty has been shown to be a cost-effective treatment for displaced femoral neck fractures in patients 45 to 65 years of age.³⁰ There was significantly less THA in Asian Pacific Islanders. Previous studies indicated significantly lower rates of total hip replacement and total knee replacement surgery among minorities, with researchers hypothesizing that patient preference, perceived and real differences in outcomes, access, insurance status, and other demographics all play a role^{21,22,25,31} (Supplementary Table 1).

Medicaid payer status was associated with lower odds of THA utilization (OR: 0.707, *P* value = .0086, 95% CI: 0.547-0.916) when compared to Medicare patients. Patients

Table 3. Predictors of THA Versus HA.

Characteristics	Estimate	Standard Error ^a	P Value	OR	95% CI
Patient-level factors					
Age	-0.057489907	0.0019372	<.0001	0.94413142	0.9405-0.9477
Gender	-0.015435539	0.0417875	.7118	0.98468298	0.9073-1.0687
Race					
Black	-0.16808374	0.1028635	.1023	0.84528305	0.6910-1.0340
Hispanic	-0.196990626	0.1168365	.0918	0.82119833	0.6532-1.0324
Asian or Pacific Islander	-0.679879977	0.219104	.0019	0.5066778	0.3298-0.7783
Native American	0.284395502	0.2951945	.3353	1.32895843	0.7453-2.3696
Other race/ethnicity	-0.101135296	0.1599221	.5271	0.90381074	0.6607-1.2364
Payer status					
Medicare	-	-	-	-	-
Medicaid	-0.346061432	0.1317606	.0086	0.70746902	0.5465-0.9158
Private including HMO ^d	0.375851844	0.0590286	<.0001	1.45623137	1.2972-1.6348
Self-pay	0.130664353	0.1481705	.3779	1.13958522	0.8525-1.5234
No charge ^c	-0.007180123	0.4930164	.9884	0.99284559	0.3779-2.6083
Other ^b	0.535707412	0.1241833	<.0001	1.70865654	1.3397-2.1793
Median household income for patient's zip code					
\$1-24 999	-	-	-	-	-
\$25 000-34 999	-0.021647591	0.0592561	.7149	0.97858504	0.8713-1.0990
\$35 000-44 999	0.046041323	0.063576	.469	1.04711768	0.9245-1.1860
\$45 000 and above	0.043115869	0.0726473	.5529	1.04405886	0.9056-1.2037
Hospital-level factors					
Teaching vs nonteaching	-0.19658334	0.0975641	.0439	0.82153286	0.6786-0.9946
Region					
Northeast	-	-	-	-	-
Midwest	-0.047444773	0.1341946	.7237	0.95366314	0.7332-1.2404
South	0.021281422	0.1183639	.8573	1.02150949	0.8101-1.2881
West	-0.159310284	0.1361668	.2423	0.85273173	0.6531-1.1134
Hospital location					
Rural	-	-	-	-	-
Urban	0.177958978	0.1287931	.1674	1.19477631	0.9283-1.5377
Number of beds					
Small	-	-	-	-	-
Medium	-0.35381121	0.117831	.0027	0.70200749	0.5573-0.8843
Large	-0.463655423	0.113739	<.0001	0.62898025	0.5033-0.7860
THA hospital volume	0.002530212	0.0003729	<.0001	1.00253342	1.0018-1.0033

Abbreviations: CI, confidence interval; HA, hemiarthroplasty; OR, odds ratio; THA, total hip arthroplasty.

Bold represents statistically significant values, p-value <.05, and or greater or less than 1.

^aStandard error represents standard error of fixed effects.

^bOther includes CHAMPUS/TRICARE, Children's Rehab Services, worker's compensation, Indian Health Services, other, tobacco tax.

^cNo charge includes charity.

^dPrivate insurance includes Health Maintenance Organization (HMO), Preferred Provider Organization (PPO), Blue Cross, and commercial carriers.

^eNote hospital control/ownership was included in the original analysis. No significance was achieved, and a subsequent analysis was run without hospital control variables.

with private insurance including HMO had higher odds of THA (OR: 1.456, *P* value < .0001, 95% CI: 1.297-1.635) as did patients with other insurance (including workers' compensation, CHAMPUS/TRICARE, Children's Rehab Services, Indian Health Services, other, tobacco tax; OR: 1.709, *P* value < .0001, 95% CI: 1.340-2.179). There was no difference between the rates of HA and THA in self-pay patients compared to Medicare patients (Table 3).

The odds of THA were significantly lower among patients in teaching hospitals when compared to nonteaching hospitals (OR: 0.822, *P* value = .044, 95% CI: 0.679-0.995; Table 3). There was no significant difference in the odds of THA by region (ie, Northeast, Midwest, South, and West) or hospital

urbanicity (rural vs urban). When hospital size was evaluated, patients treated at medium-size (OR: 0.702, *P* value = .003, 95% CI: 0.557-0.884) and large-size hospitals (OR: 0.629, *P* value = <.0001, 95% CI: 0.503-0.786) had lower odds of THA than patients treated at small-size hospitals. Recent evidence supports that patients treated at hospital with higher THA volume for femoral neck fractures at higher volume arthroplasty centers fared better in regard to lower mortality and 90-day complication rates.³² In this cohort, patients treated at higher volume THA hospitals also had higher odds of THA for femoral neck fractures (OR: 1.003, *P* value <.0001, 95% CI: 1.002-1.003) than patients treated at hospital with lower THA volume.

Medicaid patients (including both fee-for-service and managed Medicaid patients) had significantly lower rates of THA, while patients with private insurance including HMO and “other” had significantly higher rates of THA, suggesting that payer status impacts treatment strategy and highlighting another important disparity. Payer status has already been shown to have an important impact on access to care of the orthopedic patient³³ as well as outcomes, rates of postoperative in-hospital complications, and consumption of resources following total joint arthroplasty.³⁴ When evaluating hospital-level factors, teaching status was associated with significantly lower rates of THA. This difference may partly be accounted for by differences in patient populations between teaching hospitals and nonteaching hospitals, surgical training, or surgeon preference. Bed size was inversely associated with THA rates, suggesting that the smaller hospitals are more likely to perform THA in these patients relative to HA. Finally, higher hospital THA volume was associated with increased THA rates for femoral neck fracture, which is intuitive.

In conclusion, this study revealed disparities in the utilization of HA versus THA in the elderly patient population with femoral neck fracture. Certain minority groups and patients with less favorable payers/insurance are less likely to be treated with THA despite mounting evidence that this is the optimal treatment in many cases.³⁻¹⁷ Similarly, patients presenting to teaching hospitals, larger hospitals, and hospitals with a low volume of THA are less likely to be treated with THA. Further research is indicated to identify the underlying causes of these disparities, while educational and health policy interventions should be introduced to ensure that all patients have access to high-quality and evidence-based surgical treatment regardless of their demographics.

Appendix A

Table A1. Bed Size Categories.

	Hospital Bed Size		
	Small	Medium	Large
Northeast region			
Rural	1-49	50-99	100+
Urban, nonteaching	1-124	125-199	200+
Urban, teaching	1-249	250-424	425+
Midwest region			
Rural	1-29	30-49	50+
Urban, nonteaching	1-74	75-174	175+
Urban, teaching	1-249	250-374	375+
Southern region			
Rural	1-39	40-74	75+
Urban, nonteaching	1-99	100-199	200+
Urban, teaching	1-249	250-449	450+
Western region			
Rural	1-24	25-44	45+
Urban, nonteaching	1-99	100-174	175+
Urban, teaching	1-199	200-324	325+

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Supplemental Material

Supplementary material for this article is available online.

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