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HIP ARTHROPLASTY

Total hip arthroplasty for hip fractures in patients older than 80 years of age: a retrospective matched cohort study

Jerry Arraut[1] · Mark Kurapatti[1] · Thomas H. Christensen[1] · Joshua C. Rozell[1] · Vinay K. Aggarwal[1] · Kenneth A. Egol[1] · Ran Schwarzkopf[1]

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Abstract

Introduction Increasing age and hip fractures are considered risk factors for post-operative complications in total hip arthroplasty (THA). Consequently, older adults undergoing THA due to hip fracture may have different outcomes and require additional healthcare resources than younger patients. This study aimed to identify the influence of age on discharge disposition and 90-day outcomes of THA performed for hip fractures in patients ≥ 80 years to those aged < 80.

Materials and methods A retrospective review of 344 patients who underwent primary THA for hip fracture from 2011 to 2021 was conducted. Patients ≥ 80 years old were propensity-matched to a control group < 80 years old. Patient demographics, length of stay (LOS), discharge disposition, and 90-day post-operative outcomes were collected and assessed using Chi-square and independent sample *t* tests.

Results A total of 110 patients remained for matched comparison after propensity matching, and the average age in the younger cohort (YC, $n=55$) was 67.69 ± 10.48, while the average age in the older cohort (OC, $n=55$) was 85.12 ± 4.77 ($p \leq 0.001$). Discharge disposition differed between the cohorts ($p=0.005$), with the YC being more likely to be discharged home (52.7% vs. 27.3%) or to an acute rehabilitation center (23.6% vs. 16.4%) and less likely to be discharged to a skilled nursing facility (21.8% vs. 54.5%). 90-day revision (3.6% vs. 1.8%; $p=0.558$), 90-day readmission (10.9% vs. 14.5%; $p=0.567$), 90-day complications ($p=0.626$), and 90-day mortality rates (1.8% vs 1.8%; $p=1.000$) did not differ significantly between cohorts.

Conclusion While older patients were more likely to require a higher level of post-hospital care, outcomes and perioperative complication rates were not significantly different compared to a younger patient cohort. Payors need to consider patients' age in future payment models, as discharge disposition comprises a large percentage of post-discharge expenses.

Level of evidence Level III, Retrospective Cohort Study.

Keywords Elderly · Outcomes · Hip fracture · Total hip arthroplasty

Introduction

Total hip arthroplasty (THA) is a common treatment modality for elderly patients with fractures of the acetabulum and femoral head and neck, and has been associated with favorable outcomes when compared to internal fixation [1–4]. Rates of THA for all indications are expected to increase drastically in the next decade, particularly in the population over 80 years of age [5, 6]. Given that hip fractures are more common in the elderly, rates of THA for fracture can be expected to rise as well [7].

While improvements in anesthesia and surgical techniques including blood management and opioid-sparing pain protocols have made THA increasingly safe and effective

Senior Author: Ran Schwarzkopf.

✉ Jerry Arraut
Jerry.Arraut@nyulangone.org

Ran Schwarzkopf
Ran.Schwarzkopf@nyulangone.org

[1] Department of Orthopedic Surgery, NYU Langone Orthopedic Hospital, 301 East 17th Street, New York, NY, USA

for these patients [8–11], age over 80 years is associated with increased in-hospital mortality rate for patients with acetabular and femoral neck fractures [12]. It is essential to understand whether outcomes are different between these groups, as elderly patients have a greater preoperative surgical risk than their younger counterparts due to frailty and medical comorbidities [13–15]. Only then surgeons can properly risk-stratify patients prior to surgery and provide the appropriate post-operative care. Additionally, as the current value-based healthcare system links hospital payment to outcomes after surgery, this information may have notable financial implications [16–19].

Since an increasing number of patients over 80 years of age will undergo THA for fracture in the upcoming decades, and these patients have a greater risk of post-operative complications [5–7, 20, 21], it is important to investigate potential age-related differences in outcomes of primary THA for hip fractures. As there is sparse literature currently published on this topic, this study aimed to identify the influence of age on discharge disposition as well as post-operative mortality and complications rates in patients undergoing THA for hip fractures. Compared to the younger cohort (YC), we hypothesized that the older cohort (OC) would have similar 90-day post-operative outcomes.

Methods

This retrospective analysis utilized a prospectively collected THA database at a large tertiary care university-affiliated orthopedic specialty hospital. A total of 17,049 consecutive primary THA were performed between June 2011 and July 2021. These cases were identified using the Current Procedure Terminology (CPT) code 27130. Only those with primary diagnosis denoting acetabular, femoral neck, intertrochanteric, and subchondral femoral head fracture were included in this study. Patients were stratified based on their age at the time of surgery. An older cohort ($n=67$) composed of patients 80 years old and above at the time of surgery was compared to a younger cohort ($n=277$) of patients less than 80 years old at the time of surgery. All patients included in this study participated in our institution-wide comprehensive total joint pathway, which encompasses uniform standardized protocols for all aspects of perioperative care, including physical therapy, anesthesia, and pain management. Patient records and data were de-identified as part of our institutional quality improvement program. Human-subjects review approval by our Institutional Review Board (IRB) was obtained prior to this study.

Data collection

Patient demographic data, including age, sex, body mass index (BMI; kg/m^2), American Society of Anesthesiology (ASA) classification, and Charlson Comorbidity Index (CCI), were collected. Additionally, clinical data including surgical time, LOS, discharge disposition, and 90-day post-operative outcomes, including readmission rates, complication rates, all-cause revision rates, and mortality rates, were collected. All data were collected from our electronic patient medical record system (Epic Caboodle. Version 15; Verona, WI) using Microsoft SQL Server Management Studio 2017 (Redmond, WA) and organized using Microsoft Excel software (Microsoft Corporation, Redmond, WA).

Statistical analysis

A binary variable was created to identify patients ≥ 80 years old and those younger than 80 years of age. Study participants' demographic and clinical baseline characteristics were described as means with standard deviations (SD) for continuous variables and frequencies with percentages for categorical variables. All statistical analyses were performed using SPSS v25 (IBM Corporation, Armonk, New York). A cut-off p value less than 0.05 was considered statistically significant.

Patient demographics were compared between the OC and YC for both the entire cohorts and the 1:1 matched cohort using propensity score. The OC was propensity-matched to the YC to account for any potential confounding [22]. For this study, the propensity score was defined as the conditional probability of any of the measured outcomes given the patient's baseline characteristics, including age, sex, BMI, smoking status, ASA, and CCI scores. A 1:1 match was performed using a balanced, nearest-neighbor propensity score [23]. This method of cohort matching has been established by the previous literature as an optimal method for estimating differences between treatment groups [24]. After propensity score matching, independent sample, two-sided t tests were used to test for significant differences between continuous variables, including age, BMI, ASA and CCI scores, surgical time, and LOS. Chi-squared (χ^2) tests were used to detect any differences among categorical variables, including sex, smoking status, discharge disposition, 90-day readmission, 90-day complication rates, 90-day all-cause revision rates, and 90-day mortality rates. A post hoc power analysis determined that the total sample size of 110 patients included in the analysis provided adequate power to elucidate significant differences in discharge disposition between the cohorts.

Results

Patient demographics

A total of 344 primary THAs for hip fractures were performed during the study period. Of these, 67 (19%) were at least 80 years old and included in the OC, and 277 (81%) were younger than 80 years old and included in the YC. After applying the 1:1 propensity score matching, there were 55 patients in each cohort for a total of 110 patients for the matched comparison. Twelve patients were not matched based on their calculated propensity score and were excluded from the statistical analysis. Before matching, patients in both cohorts were statistically similar with respect to sex ($p = 0.268$), smoking status ($p = 0.491$), and race ($p = 0.530$). However, age ($p \leq 0.001$), BMI ($p = 0.017$), and ASA classification ($p = 0.006$) differed significantly between the cohorts, and the OC had significantly higher CCI scores (5.26 ± 1.43 vs. 3.63 ± 2.45, $p \leq 0.001$) than the YC. These differences were no longer significant upon propensity score matching, indicating a successful match for all desired covariates. The only significant difference between the OC and YC was the age at the time of surgery (85.12 ± 4.77 vs. 67.69 ± 10.48, $p \leq 0.001$). Table 1 summarizes all demographic data.

Outcome comparison

Discharge disposition differed between the two groups ($p = 0.005$), with the YC cohort being more likely to be discharged home (52.7% vs. 27.3%) or to an acute rehabilitation center (23.6% vs. 16.4%) and less likely to be discharged to a skilled nursing facility (21.8% vs. 54.5%). The proportion of patients discharged to other facilities (1.8% vs. 1.8%) did not differ between the cohorts. While the YC had a longer LOS than the OC (6.26 ± 5.50 vs. 5.72 ± 2.41 days; $p = 0.505$), this difference was not statistically significant.

Mean surgical time (119.23 ± 43.77 vs. 112.67 ± 39.77 min; $p = 0.412$), 90-day all-cause revision (3.6% vs. 1.8%; $p = 0.558$), 90-day readmission (10.9% vs. 14.5%; $p = 0.567$), and 90-day complication rates ($p = 0.626$) did not differ significantly between cohorts. Eight patients in the OC were readmitted within 90 days after their surgery. Causes for readmission included periprosthetic joint infection (PJI) ($n = 1$), periprosthetic fracture (PPF) ($n = 1$), aseptic failure ($n = 1$), dislocation ($n = 2$), cardiovascular complications ($n = 1$), and other non-orthopedic causes ($n = 2$).

Table 1 Demographic data

Characteristic	Unadjusted cohort comparison			Matched cohort comparison		
	< 80 (*N* = 277)	≥ 80 (*N* = 67)	*P* value	< 80 (*N* = 55)[a]	≥ 80 (*N* = 55)	*P* value
Age—mean (SD)	67.40 (8.67)	85.25 (4.52)	< 0.001*	67.69 (10.48)	85.12 (4.77)	< 0.001*
Sex			0.268			0.482
Female—no. (%)	183 (66.1%)	49 (73.1%)		45 (81.8%)	42 (76.4%)	
Male—no. (%)	94 (33.9%)	18 (26.9%)		10 (18.2%)	13 (23.6%)	
BMI—mean (SD)	25.30 (4.94)	23.67 (4.31)	0.017*	24.37 (5.19)	23.19 (3.88)	0.181
ASA—no. (%)			0.006*			0.105
1	17 (6.2%)	0 (0.0%)		1 (1.8%)	0 (0.0%)	
2	158 (57.9%)	29 (43.9%)		34 (61.8%)	24 (43.6%)	
3	88 (32.2%)	31 (47.0%)		16 (29.1%)	28 (50.9%)	
4	10 (3.7%)	6 (9.1%)		4 (7.3%)	3 (5.5%)	
Smoking status—no. (%)			0.491			0.207
Never smoker	189 (68.2%)	48 (71.6%)		30 (54.5%)	39 (70.9%)	
Former smoker	69 (24.9%)	17 (25.4%)		22 (40%)	14 (25.5%)	
Current smoker	19 (6.9%)	2 (3.0%)		3 (5.5%)	2 (3.6%)	
Race—no. (%)			0.530			0.636
White	215 (77.6%)	54 (80.6%)		45 (81.8%)	46 (83.6%)	
Black	14 (5.1%)	1 (1.5%)		1 (1.8%)	1 (1.8%)	
Asian	11 (4.0%)	4 (6.0%)		1 (1.8%)	4 (3.6%)	
Other	37 (13.4%)	8 (11.9%)		8 (14.5%)	13 (11.8%)	
CCI score (SD)	3.63 (2.45)	5.26 (1.43)	< 0.001*	4.54 (3.31)	5.43 (1.47)	0.073

ASA American Society of Anesthesiologists, *BMI* body mass index, *no*. number, *SD* standard deviation

[a]Propensity-matched group based on sex, race, BMI, smoking status, CCI score, and ASA score

*$p < 0.05$

Six patients in the YC readmitted within 90-days after their surgery. Causes for readmission in the YC included PJI ($n=3$), PPF ($n=1$), dislocation ($n=1$), and cardiovascular complications ($n=1$).

Additionally, 90-day mortality rates did not differ between the cohorts (1.8% vs 1.8%; $p=1.000$). One patient in the OC died on post-operative day 1 due to an episode of aspiration followed by hypoxemia and progressive bradycardia leading to cardiac arrest. One patient in the younger cohort died on post-operative day 7 due to cardiovascular complications. Table 2 summarizes all outcomes comparison between the groups.

Discussion

The number of THA for all indications and hip fractures is expected to rise over the next decade among the elderly population [5–7], and hip fractures have been associated with higher post-operative complications and mortality rates [12, 25, 26]. In addition, disparities in THA outcomes may have significant financial implications due to varying expenses in discharge disposition [16–19, 27]. However, potential disparities in THA outcomes for patients older than 80 years of age versus younger patients is poorly documented in the literature, especially for THA for hip fractures. The present study demonstrated that other than discharge disposition, there were no differences in outcomes between patients 80 years or older and those younger than 80 years of age following THA for hip fractures.

Previous studies have evaluated the effect of age on the post-operative recovery of patients undergoing THA. A 2013 study on 3914 THA patients found lower LOS, higher complication rate, and a lower revision rate in octogenarians relative to patients under 80 years old [25]. Similarly, a more recent 2018 study on 66,839 THA patients found that age older than 80 years was an independent risk factor for complications and mortality following THA [26]. Other studies, however, suggest patients over 80 years old can safely undergo THA with no notable differences in outcomes relative to younger patients [28–30]. Despite the conflicted literature, our results showed no differences in surgical time, LOS, 90-day revision rate, 90-day readmission rate, or 90-day complication rate between the cohorts. While increased age has also been associated with higher mortality [31, 32], there was no statistical difference in 90-day mortality rate between the cohorts.

Notably, discharge disposition differed among the two cohorts in the present study, with the OC less likely to be discharged to home and more likely to be discharged to a skilled nursing facility (SNF) than the YC. Several factors were taken into consideration for the post-discharge decision-making process, and our institution has certain milestones that must be met prior to safe home discharge [33]. To be discharged home, patients must demonstrate the ability to independently move between supine and standing position

Table 2 Clinical outcomes comparison—propensity-matched cohorts

Outcome	< 80 (*N* = 55)[a]	≥ 80 (*N* = 55)	*P* value[a]
Surgical time—min. (SD)	119.23 (43.77)	112.67 (39.77)	0.412
LOS—days (SD)	6.26 (5.50)	5.72 (2.41)	0.505
Discharge disposition—no. (%)			0.005*
Home	29 (52.7%)	15 (27.3%)	
SNF	12 (21.8%)	30 (54.5%)	
Acute Rehab	13 (23.6%)	9 (16.4%)	
Other	1 (1.8%)	1 (1.8%)	
90-Day revision—no. (%)	2 (3.6%)	1 (1.8%)	0.558
90-Day readmission no. (%)	6 (10.9%)	8 (14.5%)	0.567
90-Day complication rates no. (%)			0.626
PJI	3 (5.5%)	1 (1.8%)	
PPF	1 (1.8%)	1 (1.8%)	
Aseptic failure	0 (0.0%)	1 (1.8%)	
Dislocation	1 (1.8%)	2 (3.6%)	
CV complications	1 (1.8%)	1 (1.8%)	
Other	0 (0.0%)	2 (3.6%)	
90-Day mortality	1 (1.8%)	1 (1.8%)	1.000

LOS length of stay, *PJI* periprosthetic joint infection, *PPF* periprosthetic fracture, *CV* cardiovascular, *SNF* skilled nursing facility, *SD* standard deviation, *no.* number, *Min.* Minutes

*$p<0.05$

[a]Propensity-matched group based on sex, race, BMI, smoking status, CCI score, and ASA score

and transfer to and from a chair. After these initial criteria are met, patients must then be able to ambulate at least 100 feet. If there are stairs leading to their residence, patients must also be able to ascend and descend a full flight of stairs prior to discharge. If the patient was unable to meet these criteria and/or did not have social support at home and/or did not feel safe going home, an external care facility was chosen based on the patient's needs.

A study by Sabeh et al. [34] found significant differences in the overall expense of THA according to discharge disposition, with higher episode-of-care costs associated with discharge to SNF and rehabilitation facility compared to discharge to home. Moreover, up to 55% of total joint arthroplasty (TJA) costs come from post-acute care, with non-home discharge playing an enormous role in such costs [35, 36]. Consequently, while we found that the OC is not at higher risk of 90-day revisions and complications, the relatively higher number of discharges to SNF may have resulted in a larger overall episode-of-care financial burden for the OC compared to the YC. With healthcare financing moving toward alternative payment models [37], reimbursement levels must account for the increased burden associated with caring for patients older than 80 years of age undergoing THA for hip fractures.

The present study is not without limitations. First, the evidence presented has limited strength due to this study's retrospective nature, which inherently has potential selection bias. Second, only data available in our electronic medical records were analyzed. As such, possible patient revisions, readmissions, and follow-ups outside this institution may not have been captured by our analysis. However, most of our institution's patients tend to follow up within our institution, and as such, we do not consider this a major caveat. Third, we did not control for the variability in surgeons who performed THA on patients in this study. Thus, the potentially minor differences in surgical technique may serve as an additional confounding variable, although all surgeons follow rigorous institutional protocol. Finally, our institution is a high-volume orthopedic specialty center. Consequently, the results in this study may not be generalizable to lower volume institutions.

Conclusion

While primary THA for hip fractures in older patients may increase the risk for post-operative complications, this study demonstrates that patients 80 years of age or older had similar outcomes and perioperative complication rates compared to the younger group. However, elderly patients may be more likely to be discharged to a non-home facility and, consequently, may face a higher overall episode-of-care financial burden than younger patients undergoing primary THA for hip fractures. Payors need to consider patients' age in future payment models, as discharge disposition comprises a large portion of post-discharge expenses.

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Declarations

Conflict of interest J.A., M.K., T.H.C and V.K.A. have nothing to disclose. J.R. reports being a board or committee member for NYSSO. K.A.E. reports receiving IP royalties and being paid consultant for Exactech, recieving research support from Acummed and Synthesis, being a paid presenter or speaker for Smith and Nephew, receiving publishing royalties, financial or material support from SLACK, having stock or stock options and being an unpaid consultant in Polypid, being a board or committee member for the Orthopaedic Trauma Association, and receiving publishing royalties, financial or material support from Wolters Kluwer Health - Lippincott Williams & Wilkins. R.S. reports being a board or committee member for AAOS and AAHKS, being part of the editorial or governing board for Arthroplasty Today and JOA, having stock and stock options in Gauss surgical and PSI, being a paid consultant and having stock or stock options in Intelijoint, and being a paid consultant and receiving IP royalties and research support from Smith and Nephew.

Ethical approval Our Institutional Review Board (IRB) approved the present study.

Informed consent Informed consent was obtained from all individual participants included in the study.

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