Unipolar Hemiarthroplasty, Bipolar Hemiarthroplasty, or Total Hip Arthroplasty for Hip Fracture in Older Individuals

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Background: Practice patterns regarding the use of unipolar hemiarthroplasty, bipolar hemiarthroplasty, and total hip arthroplasty (THA) for femoral neck fractures in older patients vary widely. This is due in part to limited data stipulating the specific circumstances under which each form of arthroplasty provides the most predictable outcome. The purpose of this study was to investigate the patient characteristics for which unipolar hemiarthroplasty, bipolar hemiarthroplasty, or THA might be preferable due to a lower risk of all-cause revision.

Methods: A U.S. health-care system's hip fracture registry was used to identify patients ≥60 years old who underwent unipolar hemiarthroplasty, bipolar hemiarthroplasty, or THA for hip fracture from 2009 through 2021. Unipolar and bipolar hemiarthroplasty were compared with THA within patient subgroups defined by age (60 to 79 versus ≥80 years) and American Society of Anesthesiologists (ASA) classification (I or II versus III); patients with an ASA classification of IV or higher were excluded. Multivariable Cox proportional hazard regression analysis was used to evaluate all-cause revision risk while adjusting for confounders, with mortality considered as a competing risk.

Results: There were 14,277 patients in the final sample (median age, 82 years; 70% female; 80% White; 69% with an ASA classification of III; median follow-up, 2.7 years), and the procedures included 7,587 unipolar hemiarthroplasties, 5,479 bipolar hemiarthroplasties, and 1,211 THAs. In the multivariable analysis of all patients, both unipolar (hazard ratio [HR] = 2.15, 95% confidence interval [CI] = 1.48 to 3.12; $p < 0.001$) and bipolar (HR = 1.92, 95% CI = 1.31 to 2.80; $p < 0.001$) hemiarthroplasty had higher revision risks than THA. In the age-stratified multivariable analysis of patients aged 60 to 79 years, both unipolar (HR = 2.17, 95% CI = 1.42 to 3.34; $p = 0.004$) and bipolar (HR = 1.69, 95% CI = 1.08 to 2.65; $p = 0.022$) hemiarthroplasty also had higher revision risks than THA. In the ASA-stratified multivariable analysis, patients with an ASA classification of I or II had a higher revision risk after either unipolar (HR = 3.52, 95% CI = 1.87 to 6.64; $p < 0.001$) or bipolar (HR = 2.31, 95% CI = 1.19 to 4.49; $p = 0.013$) hemiarthroplasty than after THA. No difference in revision risk between either of the hemiarthroplasties and THA was observed among patients with an age of ≥80 years or those with an ASA classification of III.

Conclusions: In this study of hip fractures in older patients, THA was associated with a lower risk of all-cause revision compared with unipolar and bipolar hemiarthroplasty among patients who were 60 to 79 years old and those who had an ASA classification of I or II.

Level of Evidence: Therapeutic Level III. See Instructions for Authors for a complete description of levels of evidence.

Arthroplasty is the standard of care for the treatment of displaced femoral neck fractures in the older patients[1]. However, controversy remains with regard to the specific type of arthroplasty procedure that should be performed. Specifically, unipolar hemiarthroplasty, bipolar hemiarthroplasty, and total hip arthroplasty (THA) are all reasonable treatment options in this patient population[2,3].

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While unipolar hemiarthroplasty is a reliable treatment option for displaced femoral neck fractures in the older population, there are concerns that acetabular erosion could limit the durability of the operation, especially in individuals who live longer or are more active. To reduce the risk of acetabular erosion, bipolar hemiarthroplasty devices—which feature an internal articulation between the femoral stem and prosthetic head—were developed[4-6], although studies have been equivocal with regard to clinical outcomes and reoperation rates[3,7-10]. THA is theoretically the most durable option following hip fracture in older individuals and has been gaining in popularity, especially for more active patients, but it has been associated with an increased risk of complications including dislocation[12-17].

There is likely no single best arthroplasty procedure for the treatment of displaced femoral neck fractures in older patients[2,12,18,19]. Instead, the optimal procedure likely varies based on patient characteristics. However, formal guidelines stipulating the specific circumstances under which one operation might be preferred over another are lacking[20,21]. In the absence of clear recommendations, practice patterns currently vary widely with regard to the use of unipolar hemiarthroplasty, bipolar hemiarthroplasty, and THA in the management of displaced femoral neck fractures in the older population[22,23].

The purpose of this study was to investigate the patient characteristics for which unipolar hemiarthroplasty, bipolar hemiarthroplasty, or THA might be preferable based on a lower risk of all-cause revision.

Materials and Methods

Study Design and Sample

A retrospective cohort study was conducted using data from the Kaiser Permanente Hip Fracture Registry. This integrated health-care system includes over 12 million members in 8 geographical regions throughout the U.S.[24]. Members of the health-care system have previously been found to be representative of the geographical areas included[25-27]. This study was approved by the Kaiser Permanente institutional review board prior to commencement.

Patients ≥60 years of age who underwent hemiarthroplasty or THA for treatment of a hip fracture from 2009 through 2021 were identified. Cases were excluded if they involved bilateral hip fracture, pathologic fracture, open fracture, polytrauma, additional procedures during the hospitalization, or prior surgery on the affected hip. Patients with a history of metastatic cancer, paralysis, or an American Society of Anesthesiologists (ASA) classification of IV or higher were also excluded given that THA is rarely indicated in patients with these conditions. In addition, patients were excluded if they had received a femoral stem usually used in the infection or revision setting or a non-conventional THA (e.g., ceramic on ceramic, metal on metal, constrained, or dual mobility) (Fig. 1).

Data Source

Details regarding the variables, data collection procedures, and coverage of the registry have been published previously[28-30]. Briefly, the patient-, procedure-, implant-, surgeon-, and hospital-related

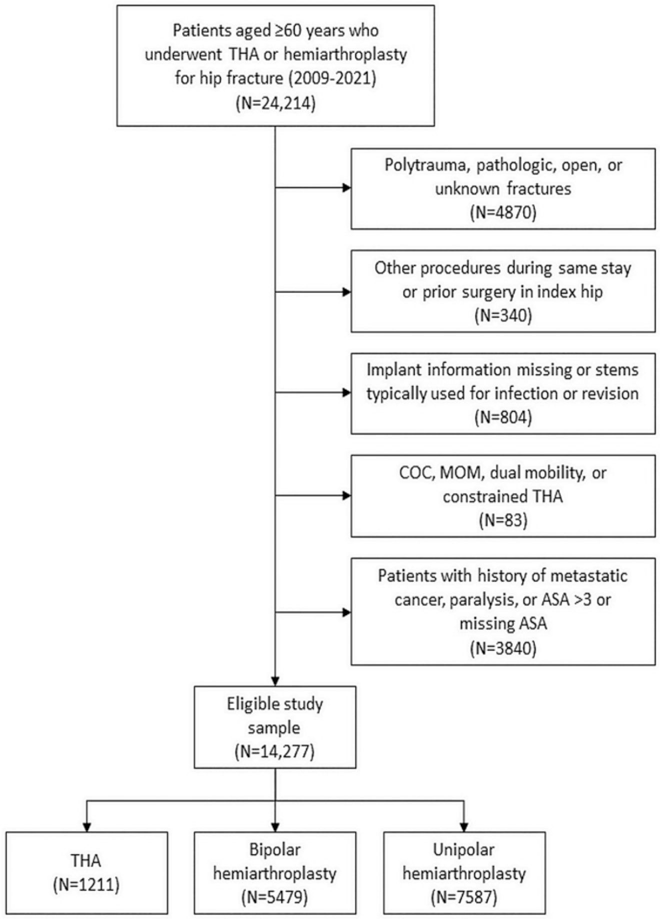

Fig. 1
Study sample flowchart. THA = total hip arthroplasty, COC = ceramic on ceramic, and MOM = metal on metal.

information for all hip fracture procedures performed within the integrated health-care system is collected, along with data from the electronic health record (EHR) as well as administrative claims data, membership data, and mortality records. There were no formal guidelines or policies in place across the Kaiser Permanente system regarding surgical management of hip fractures in patients during the data collection period. Outcomes are prospectively monitored using validated electronic screening algorithms within the EHR. The registry collects information on procedures performed in the Hawaii, Northern California, Northwest, and Southern California regions, where care is performed in institution-owned hospitals.

Exposure of Interest

The primary exposure was arthroplasty type (unipolar hemiarthroplasty, bipolar hemiarthroplasty, or THA).

Outcome of Interest

The primary outcome measure was revision for any reason. Revisions were defined as any reoperation following the index procedure where the original implant was removed or replaced. Dislocations requiring closed reduction only were not included. All cases in the registry are longitudinally monitored for revision until either membership termination or death. Mortality was considered as a competing event and validated using Social Security Administration data.

Covariates

Covariates included gender, body mass index (BMI), race/ethnicity (Asian, Black, Hispanic, Other, or White as self-reported by patients in the integrated health-care system), smoking status, diabetes, Elixhauser medical comorbidities[31,32], time from admission to surgery (categorized as <24 or ≥24 hours), anesthesia type (general, regional, or mixed), cement use, and operative time.

Effect Modification

Age (60 to 79 versus ≥80 years) and ASA classification (I or II versus III) were considered potential effect modifiers in the association between procedure and revision risk. Analyses were therefore stratified by age and ASA classification.

TABLE I Characteristics of 14,277 Patients Who Underwent Treatment for Hip Fracture within a U.S.-Based Health-Care System from 2009 Through 2021*

	Hemiarthroplasty			
Characteristic	Unipolar	Bipolar	THA	SMD†
Total no.	7,587	5,479	1211	
Patient factors				
Age				
Mean (SD) *(yr)*	82.4 (8.3)	82.0 (8.3)	71.3 (7.5)	**0.940**
No. (%) of patients in age groups				
60-79 yr	2,530 (33.3)	1,961 (35.8)	1,034 (85.4)	
≥80 yr	5,057 (66.7)	3,518 (64.2)	177 (14.6)	
Male‡	2,284 (30.1)	1,657 (30.2)	399 (32.9)	0.041
ASA classification of III‡	5,538 (73.0)	3,861 (70.5)	499 (41.2)	**0.450**
BMI§ *(kg/m²)*	23.8 (4.6)	24.1 (4.6)	25.5 (4.5)	**0.252**
Race/ethnicity‡				0.156
Asian	497 (6.6)	421 (7.7)	89 (7.3)	
Black	327 (4.3)	199 (3.6)	30 (2.5)	
Hispanic	482 (6.4)	620 (11.3)	104 (8.6)	
Other	30 (0.4)	35 (0.6)	12 (1.0)	
White	6,251 (82.4)	4,204 (76.7)	976 (80.6)	
Smoking status‡				0.098
Never	4,087 (53.9)	3,018 (55.1)	660 (54.5)	
Quit/former	2,918 (38.5)	2,058 (37.6)	418 (34.5)	
Smoker	461 (6.1)	304 (5.5)	104 (8.6)	
Missing	121 (1.6)	99 (1.8)	29 (2.4)	
Surgical factors				
Time to surgery‡				0.065
<24 hours	4,682 (61.7)	3,506 (64.0)	801 (66.1)	
≥24 hours	2,864 (37.7)	1,950 (35.6)	403 (33.3)	
Missing	41 (0.5)	23 (0.4)	7 (0.6)	
Anesthesia‡				**0.224**
General	3,929 (51.8)	2,458 (44.9)	430 (35.5)	
Mixed (regional and general)	234 (3.1)	184 (3.4)	59 (4.9)	
Regional	3,401 (44.8)	2,820 (51.5)	719 (59.4)	
Missing	23 (0.3)	17 (0.3)	3 (0.2)	
Femoral head size <36 mm‡	—	—	512 (42.3)	
Cement used‡	4,305 (56.7)	3,167 (57.8)	196 (16.2)	**0.635**
Operative time§ *(min)*	73.9 (24.4)	77.5 (24.3)	95.5 (33.6)	**0.498**

*ASA = American Society of Anesthesiologists, BMI = body mass index, SD = standard deviation, SMD = standardized mean difference. Missing: BMI = 96 (0.7%), operative time = 294 (2.1%). †Values in bold indicate an SMD of >0.2, which indicates imbalance in the covariate between study groups. ‡The values are given as the number (percent). §The values are given as the mean (SD).

TABLE II All-Cause Revision Following Treatment of Hip Fracture*

	Crude 5-Year Incidence of All-Cause Revision† *(no. [%])*	Adjusted HR‡ (95% CI)	P Value§
Unipolar hemiarthroplasty	275 (4.0)	2.15 (1.48-3.12)	**<0.001**
Bipolar hemiarthroplasty	173 (3.5)	1.92 (1.31-2.80)	**<0.001**
THA	34 (3.3)	Ref.	—

*HR = hazard ratio, CI = confidence interval. †Calculated as the crude incidence at 5-year follow-up using the Aalen-Johansen estimate. ‡Cox proportional hazard regression model adjusted for age, gender, BMI, race/ethnicity, ASA classification, deficiency anemias, fluid and electrolyte disorders, peptic ulcer disease/bleeding, valvular disease, anesthesia, and cement fixation, and including a random intercept for operating surgeon. §P < 0.05 indicates significance (in bold).

Statistical Analysis

Means and standard deviations (SDs) or frequencies and percentages were used to describe the study sample. The standardized mean difference (SMD) for each covariate across study groups was determined; SMD > 0.2 implied imbalance. Revisions were modeled as the time to the event using survival analysis techniques. Follow-up time was defined as the time from the index procedure to revision for those who experienced that event, and as the time from the index procedure to the date of death, health-care membership termination, or study end date (December 31, 2021), whichever came first, for those who did not undergo a revision. Death was treated as a competing event, whereas membership termination and study end date were censoring events. Crude cumulative cause-specific revision incidence was calculated using the Aalen-Johansen estimate. Cause-specific multiple Cox proportional hazard regression was used to evaluate risk of revision during follow-up. Regression models were adjusted for gender as well as all covariates that had an SMD of >0.1 and were also associated with the outcome ($p < 0.1$). A random intercept at the surgeon level was included, which allowed for adjustment by surgeon performance and experience. THA was the reference in all models; pairwise comparisons between unipolar and bipolar hemiarthroplasty were also performed. Hazard ratios (HRs) and 95% confidence intervals (CIs) were reported. The proportional hazard assumption for the exposure variable was checked by the proportionality test and met. Missing values for categorical covariates were modeled as a separate group, while missing values for continuous covariates were imputed with the mean and included a missing indicator. $P < 0.05$ represented significance, and all tests were 2-sided. Analyses were performed using R version 3.6.2 (R Foundation for Statistical Computing).

Results

The study sample (median age, 82 years; 70% female; 80% White; 69% with an ASA classification of III) included 14,277 procedures performed by 533 surgeons at 35 hospitals, including 7,587 unipolar hemiarthroplasties, 5,479 bipolar hemiarthroplasties, and 1,211 THAs. Patient characteristics are presented in Table I; comorbidity information is presented in the Appendix. In comparison to patients who underwent hemiarthroplasty, those who underwent THA tended to be younger and have fewer medical comorbidities. The THA procedures were more commonly performed under regional anesthesia, took longer, and used cement less frequently compared with the other 2 procedures (Table I).

The median follow-up was 2.7 years (interquartile range [IQR] = 0.9 to 5.1 years), with 6.3% of the patients lost to follow-up through membership termination at a median of 1.9 years (IQR = 0.7 to 4.0 years). The overall mortality rate was 4.2% at 30 days and 17.6% at 1 year.

All-Cause Revision

In the adjusted analysis of all patients, we observed a higher risk of all-cause revision following unipolar (HR = 2.15, 95% CI =

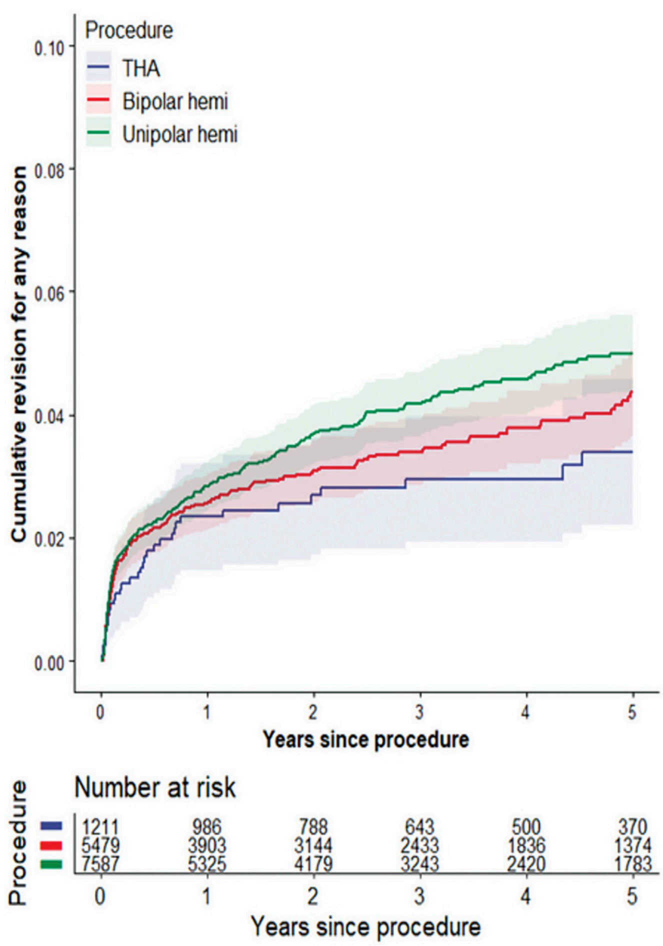

Fig. 2

Crude cumulative all-cause revision incidence following treatment for hip fracture by procedure. The shaded areas represent the 95% confidence intervals. The table along the x axis presents the number of patients still at risk at each year of follow-up. THA = total hip arthroplasty.

TABLE III All-Cause Revision Following Treatment of Hip Fracture, Stratified by Age and ASA Classification*

	Crude 5-Year Incidence of All-Cause Revision† *(no. [%])*	Adjusted HR‡ (95% CI)	P Value§
Age 60-79 yr (n = 5,525)			
Unipolar hemiarthroplasty	130 (5.8)	2.17 (1.42-3.34)	**0.004**
Bipolar hemiarthroplasty	75 (4.2)	1.69 (1.08-2.65)	**0.022**
THA	29 (3.4)	Ref.	—
Age ≥80 yr (n = 8,752)			
Unipolar hemiarthroplasty	145 (3.2)	1.26 (0.55-2.90)	0.58
Bipolar hemiarthroplasty	98 (3.1)	1.27 (0.55-2.94)	0.57
THA	5 (3.0)	Ref.	—
ASA classification I or II (n = 4,379)			
Unipolar hemiarthroplasty	93 (5.3)	3.52 (1.87-6.64)	**<0.001**
Bipolar hemiarthroplasty	45 (3.4)	2.31 (1.19-4.49)	**0.013**
THA	12 (2.2)	Ref.	—
ASA classification III (n = 9,898)			
Unipolar hemiarthroplasty	182 (3.6)	1.46 (0.93-2.31)	0.10
Bipolar hemiarthroplasty	128 (3.6)	1.51 (0.95-2.39)	0.084
THA	22 (4.9)	Ref.	—

*ASA = American Society of Anesthesiologists, HR = hazard ratio, CI = confidence interval, THA = total hip arthroplasty. †Calculated as the crude incidence at 5-year follow-up using the Aalen-Johansen estimate. ‡Cox proportional hazard regression model adjusted for age, gender, BMI, race/ethnicity, deficiency anemias, fluid and electrolyte disorders, peptic ulcer disease/bleeding, valvular disease, anesthesia, and cement fixation, and including a random intercept for operating surgeon. §P < 0.05 indicates significance (in bold).

1.48 to 3.12) and bipolar (HR = 1.92, 95% CI = 1.31 to 2.80) hemiarthroplasty compared with THA (Table II). There was no difference in all-cause revision risk between unipolar and bipolar hemiarthroplasty in the overall sample (crude 5-year incidence, 4.0% versus 3.5%; HR = 1.12, 95% CI = 0.93 to 1.36; p = 0.24). The crude cumulative incidence of revision for the entire cohort is presented in Figure 2. The mean (and SD) times to revision in years were 1.0 ± 1.8 for THA, 1.2 ± 1.9 for bipolar hemiarthroplasty, and 1.2 ± 1.8 for unipolar hemiarthroplasty.

Effect Modification by Age

In the age-stratified multivariable analysis, patients aged 60 to 79 years had higher all-cause revision risks after unipolar (HR = 2.17, 95% CI = 1.42 to 3.34) and bipolar (HR = 1.69, 95% CI = 1.08 to 2.65) hemiarthroplasty than after THA (Table III). In this age group, there was a trend toward higher all-cause revision risk for unipolar compared with bipolar hemiarthroplasty (crude 5-year incidence, 5.8% versus 4.2%; HR = 1.29, 95% CI = 0.97 to 1.71; p = 0.08). The mean times to revision in years in this age group were 0.8 ± 1.2 for THA, 1.4 ± 2.1 for bipolar hemiarthroplasty, and 1.4 ± 2.0 for unipolar hemiarthroplasty.

For patients aged ≥80 years, the all-cause revision risk did not differ between hemiarthroplasty (either form) and THA (Table III) or between unipolar and bipolar hemiarthroplasty (crude 5-year incidence, 3.2% versus 3.1%; HR = 0.99, 95% CI = 0.76 to 1.28; p = 0.96). The mean times to revision in years in this age group were 1.8 ± 3.5 for THA, 1.0 ± 1.6 for bipolar hemiarthroplasty, and 0.9 ± 1.5 for unipolar hemiarthroplasty.

Figure 3 presents the cumulative revision incidence stratified by age (60 to 79 versus ≥80 years).

Effect Modification by ASA Classification

In the multivariable analysis of patients with ASA I or II, unipolar (HR = 3.52, 95% CI = 1.87 to 6.64) and bipolar (HR = 2.31, 95% CI = 1.19 to 4.49) hemiarthroplasty had higher revision risks than THA (Table III). In this group, unipolar also had a higher revision rate than bipolar hemiarthroplasty (crude 5-year incidence, 5.3% versus 3.4%; HR = 1.52, 95% CI = 1.07 to 2.16; p = 0.018). The mean times to revision in years in this group were 1.1 ± 1.7 for THA, 1.9 ± 2.2 for bipolar hemiarthroplasty, and 1.6 ± 1.9 for unipolar hemiarthroplasty.

For patients with ASA III, we observed no difference in revision risk between hemiarthroplasty and THA (Table III) or between unipolar and bipolar hemiarthroplasty (crude 5-year incidence, 3.6% versus 3.6%; HR = 0.97; 95% CI = 0.77 to 1.22; p = 0.81). The mean times to revision in years in this group were 1.0 ± 1.9 for THA, 0.9 ± 1.7 for bipolar hemiarthroplasty, and 0.9 ± 1.7 for unipolar hemiarthroplasty.

Figure 4 presents the cumulative revision incidence during follow-up stratified by ASA category (I or II versus III).

Discussion

In this study of 14,277 older patients treated with unipolar hemiarthroplasty, bipolar hemiarthroplasty, or THA in a large U.S. integrated health-care system, the relative performance of these 3 treatment options varied based on patient

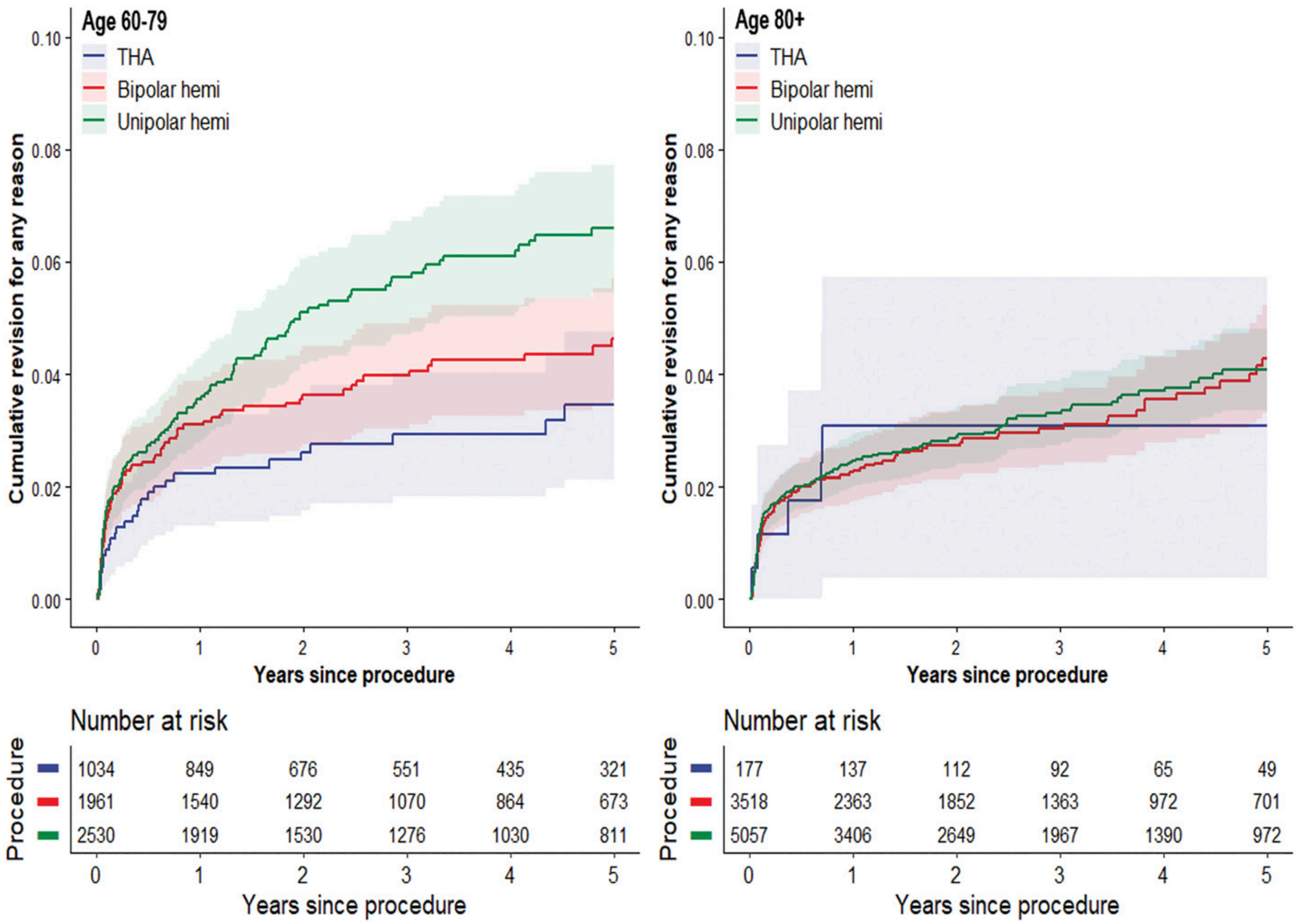

Fig. 3

Crude cumulative all-cause revision incidence following treatment for hip fracture by procedure and stratified by age. The table along the x axis presents the number of patients still at risk at each year of follow-up. THA = total hip arthroplasty.

characteristics. For patients who had an age of 60 to 79 years or an ASA classification of I or II, THA had a lower rate of all-cause revision compared with both forms of hemiarthroplasty. Bipolar hemiarthroplasty had a lower risk of all-cause revision than unipolar hemiarthroplasty in patients with an ASA classification of I or II and trended toward a lower rate of all-cause revision among patients aged 60 to 79 years ($p = 0.08$). However, there were no differences among the 3 forms of arthroplasty for patients who were aged 80 years and above or had an ASA classification of III at the time of their hip fracture.

The overall revision rates observed in our study were similar to those reported in the literature. Specifically, the 5-year risk of revision following hemiarthroplasty (3.5% to 4%) was similar to that reported by the Australian Orthopaedic Association National Joint Replacement Registry (4% to 5%)[3]. Similarly, the 5-year revision risk following THA (3.3%) falls within the range of 2%[33] to 5%[34] reported for THA following femoral neck fracture.

Prior studies have sought to determine the optimal form of arthroplasty for the treatment of displaced femoral neck fractures in older patients. Some retrospective studies found THA to be superior to hemiarthroplasty[11] whereas others did not detect any differences[19] and still others have suggested that THA could be associated with a higher complication rate[13-17]. In a meta-analysis of 13 randomized clinical trials published between 1986 and 2018, THA was associated with improved outcomes, including a lower reoperation rate at an average of 5.3 years postoperatively[12]. However, the HEALTH (Hip Fracture Evaluation with Alternatives of Total Hip Arthroplasty versus Hemi-Arthroplasty) investigators conducted a multicenter randomized clinical trial involving 1,495 patients at 80 sites in 10 countries and found no difference in the rate of secondary procedures between hemiarthroplasty and THA at 2 years[2]. Possible reasons for the differing results observed in the HEALTH study include the shorter duration of follow-up (none beyond 2 years), the inclusion of closed reductions for dislocation in the composite "secondary procedures" outcome measure (which accounted for 29 of 57 secondary procedures in the THA group), and the lack of effect modification by patient characteristics[35].

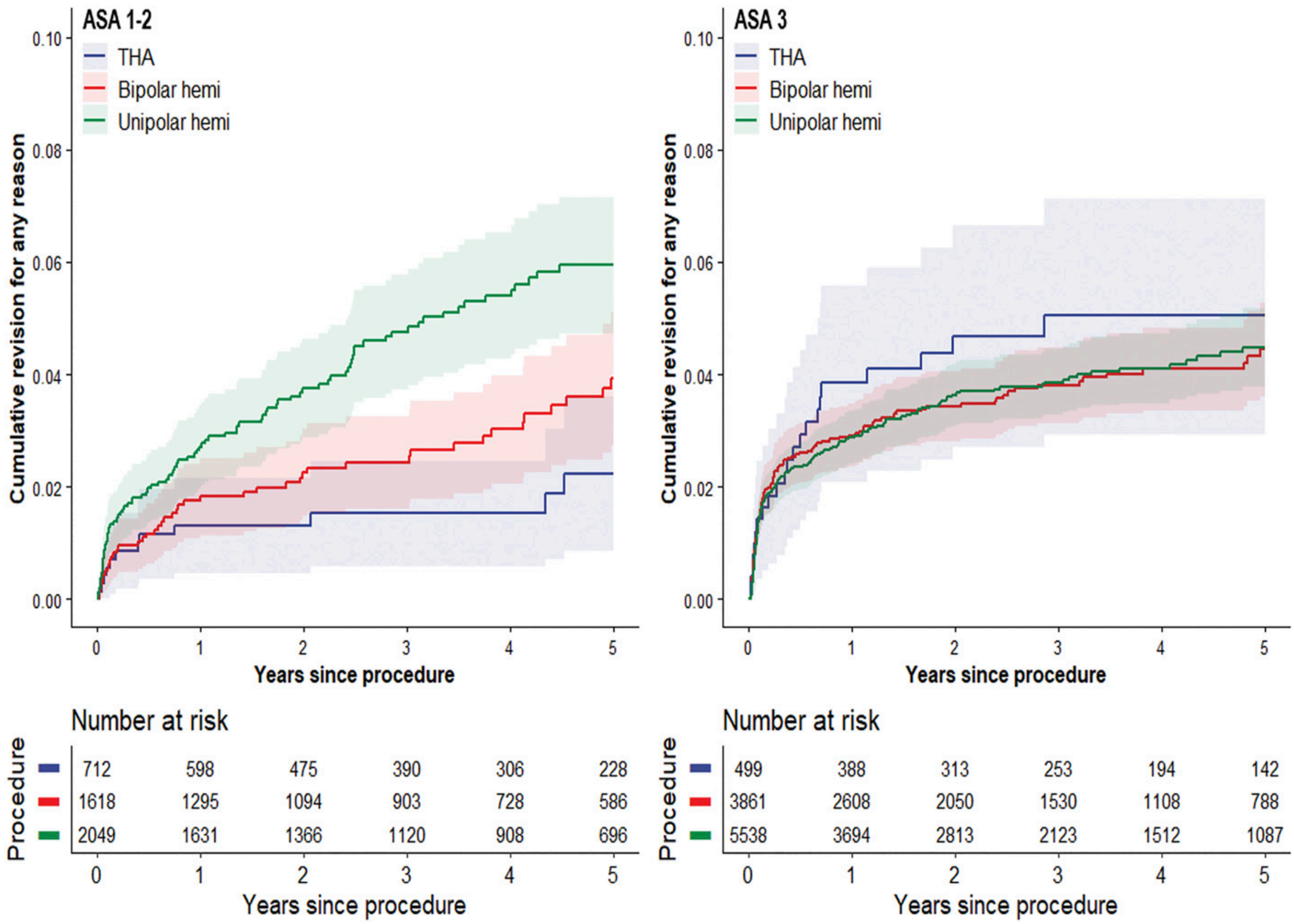

Fig. 4

Crude cumulative all-cause revision incidence following treatment for hip fracture by procedure and stratified by ASA classification. The table along the x axis presents the number of patients still at risk at each year of follow-up. THA = total hip arthroplasty.

There is likely no single best arthroplasty procedure for the treatment of displaced femoral neck fractures in the older population. Instead, the optimal form of arthroplasty likely varies depending on patient characteristics. While THA is generally preferred for patients who are "younger," "healthier," and "more active," guidelines stipulating the conditions under which each form of arthroplasty might be preferable are lacking. As a result, practice patterns currently vary widely among surgeons[22,23]. For example, one study found that over half of the variation in THA usage was due to the treating surgeon, with an additional 18% due to the institution where the patient received the surgery[23].

In our study, THA was associated with a lower risk of all-cause revision among patients aged 60 to 79 years but there was no significant difference among those aged ≥80 years. These findings are consistent with prior studies[36]. In a recent meta-analysis of randomized controlled trials, for example, THA was associated with a higher Harris hip score among patients aged <80 years but not among those aged >80 years (although there were no differences in reoperation rates between the 2 age groups)[12].

In our study, THA was also associated with a lower risk of all-cause revision among patients with ASA classification I or II but not among those with ASA III. (Patients with ASA IV or higher were excluded from this study as nearly all of those patients received hemiarthroplasty, with few receiving THA.) We are not aware of prior research assessing for effect modification by ASA classification. However, the idea that patients with ASA I or II could derive greater benefit from THA is certainly plausible given that a lower ASA classification is a marker of longer life expectancy and higher functional status.

Among patients with ASA I or II, we found a survivorship advantage for bipolar compared with unipolar hemiarthroplasty. There was also a trend toward a lower revision rate for bipolar hemiarthroplasty in the 60 to 79-year age group, although the difference did not reach significance (p = 0.08). These results parallel those from other settings, including registries[3,9] and prospective trials[5,6]. Given that bipolar devices tend not to differ greatly in cost relative to their unipolar counterparts[37], they may be preferable in cases where hemiarthroplasty is indicated.

Our study benefits from the data source: a large registry that captures all hip fracture procedures performed within an integrated health-care system and longitudinally monitors outcomes using validated surveillance screening algorithms. The cohort included 14,277 procedures performed by 533 surgeons at 35 hospitals, which increases generalizability. The study also focused on patients for whom all 3 surgical procedures were plausible while excluding, for example, patients with an ASA classification of IV, who would clearly benefit from the expediency of hemiarthroplasty.

Our study also has limitations. While our primary outcome measure was revision surgery, other outcomes of clinical relevance (such as patient-reported outcome measures, radiographic findings, and complications not requiring surgical intervention) were not evaluated due to the limitations of the data set. Specifically, our study did not consider dislocation treated with closed reduction alone, which occurs more frequently following THA than after hemiarthroplasty and has been associated with worse outcomes compared with those in patients without dislocation after THA[38]. In addition, revision surgery could be influenced by surgeon decision-making, with the options for addressing a symptomatic hemiarthroplasty device (i.e., conversion to THA) potentially being more straightforward than the options for addressing a symptomatic THA. Also, although our statistical analysis attempted to address confounding, there is still the potential for residual confounding due to unmeasured factors. While our study considered chronologic age, it is likely that physiologic age may be more relevant and this was only indirectly assessed via the ASA classification system, which has been found to have moderate interrater reliability[39]. Although the study cohort included over 14,000 procedures, only 1,211 were THAs, which limited our ability to stratify by other patient characteristics. In addition, our study did not consider dual mobility THA (which could be associated with a lower revision rate due to the reduced risk of dislocation) or surgical approach (which has also been shown to affect revision rates[40]). Finally, the findings of this observational study represent association, and not necessarily causality.

Conclusions

In this study of older patients treated for hip fracture, THA was associated with fewer revisions compared with unipolar and bipolar hemiarthroplasty among patients with an age of 60 to 79 years or an ASA classification of I or II. In contrast, we did not observe any significant differences between THA and hemiarthroplasty (or between bipolar and unipolar hemiarthroplasty) among patients who were aged 80 years or above or in those who had an ASA classification of III. However, the final choice of procedure in this patient population should be individualized based on the specific characteristics of each patient.

Appendix

eA Supporting material provided by the authors is posted with the online version of this article as a data supplement at jbjs.org (http://links.lww.com/JBJS/H770). ■

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