

General

Comparison of Outcomes Following Bipolar Hemiarthroplasty for Displaced Femoral Neck Fractures versus Unstable Intertrochanteric Fractures: A Retrospective Propensity-Matched Study

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Background

Bipolar hemiarthroplasty (BHA) is commonly used for displaced femoral neck fractures but less frequently for unstable intertrochanteric fractures. This study aimed to compare outcomes of BHA in these two fracture types among elderly patients.

Methods

We retrospectively reviewed 319 femoral neck and 40 intertrochanteric fracture patients treated with BHA. After 1:4 propensity score matching, 38 intertrochanteric patients were compared with 152 femoral neck patients. Primary outcomes included operative time, blood loss, transfusion needs, hospital stay, and complications.

Results

The intertrochanteric group had significantly longer median operation time (195 vs. 170 minutes, $p = 0.008$), greater blood loss (300 vs. 200 mL, $p < 0.001$), and higher transfusion requirements postoperatively (2.4 vs. 0.7 units, $p < 0.001$). Hospital stay was longer (11.5 vs. 9 days, $p < 0.001$). Medical complications, particularly cardiovascular events (13.2% vs. 1.3%), were more common in the intertrochanteric group ($p = 0.007$). Surgical complication rates were similar between groups ($p = 0.78$).

Conclusions

BHA for unstable intertrochanteric fractures is associated with greater surgical burden and a higher risk of medical complications compared with its use for displaced femoral neck fractures. However, the similar rates of surgical complications observed suggest that bipolar hemiarthroplasty may be considered in carefully selected high-risk elderly patients when stable internal fixation is not feasible.

INTRODUCTION

Hip fractures are becoming increasingly prevalent due to the aging population and advancements in medical care.¹ Hip replacement is widely accepted for displaced femoral neck fractures in elderly patients; however, internal fixation remains the standard treatment for most intertrochanteric fractures. In selected elderly patients with unstable intertrochanteric fracture patterns and a high risk of fixation failure, hip arthroplasty may be considered as an

alternative. Bipolar hemiarthroplasty (BHA) is frequently selected for patients with lower ambulation capacity, as it offers advantages such as shorter operative times, reduced blood loss, and lower dislocation rates when compared to total hip arthroplasty.^{2,3}

BHA is well-established in the treatment of displaced femoral neck fractures. Studies demonstrate excellent long-term outcomes, with a 10-year survivorship free from reoperation for any cause at 93.6% and freedom from revision for aseptic femoral loosening or acetabular cartilage wear

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at 95.9%.⁴ Additionally, a separate study reported a 20-year cumulative incidence of revision for any reason at 3.5%, with only 1.4% attributed to aseptic loosening.⁵

In contrast, BHA is less frequently used for unstable intertrochanteric fractures. In selected elderly patients with severely compromised bone quality or fracture patterns in which stable fixation is unlikely, it has been considered as an alternative to facilitate early mobilization.^{6,7} Outcomes for BHA in unstable intertrochanteric fractures have shown promise, with benefits such as earlier weight-bearing and improved postoperative function compared to internal fixation.⁸ Despite these advantages, BHA for unstable intertrochanteric fractures should be reserved for carefully selected patients due to its associated higher complication rates, including increased intra- or postoperative morbidity, longer operative times, and significant blood loss.⁹

Although bipolar hemiarthroplasty has been studied in both displaced femoral neck and unstable intertrochanteric fractures, direct comparisons using a standardized surgical approach are limited. Consequently, the impact of fracture pattern on perioperative risk and surgical burden remains poorly defined. This study aimed to compare perioperative outcomes of bipolar hemiarthroplasty between these two fracture types using propensity score matching. Clarifying differences in operative time, blood loss, hospital stay, transfusion requirements, and complications may help inform patient selection and perioperative planning in elderly patients.

METHODS

This retrospective study was conducted using data from the electronic medical records of a university hospital, covering cases from 2013 to 2023. The study included patients aged 60 years or older who sustained low-energy femoral neck or unstable intertrochanteric fractures and underwent BHA. Exclusion criteria included pathological fractures, multiple fractures, and previous hip surgeries. This study received approval from an institutional review board, with a waiver of informed consent due to the retrospective nature of the data.

Surgery was performed in patients with displaced femoral neck fractures and unstable intertrochanteric fractures who were considered to be at high risk of internal fixation failure, including those with severe comminution, femoral neck extension, or poor bone quality. At our institution, arthroplasty for unstable intertrochanteric fractures was considered only when stable internal fixation was judged to be unlikely based on fracture characteristics and bone quality.

All operations were performed by an experienced arthroplasty surgeon using the posterior approach with the patient in the lateral decubitus position. Spinal anesthesia was the preferred method in all cases; however, general anesthesia was utilized when necessary, such as for patients on potent anticoagulants or in cases where spinal anesthesia was unsuccessful. The choice of anesthesia was based

on the patient's medical condition in consultation with the anesthesiologist.

The selection of prosthesis type was based on the fracture pattern. For fractures with sufficient proximal bone support, a smooth taper cemented stem was used. In cases involving calcar extension, a cementless diaphyseal fit stem was preferred. Additionally, cerclage wiring was performed when greater trochanteric extension or calcar fractures were present.

Postoperatively, patients were encouraged to begin ambulation the day after surgery. Foot and ankle pumping exercises were initiated immediately following the operation to promote circulation and prevent complications. Anticoagulant therapy was initiated on the first day after surgery. Patients were discharged once they met specific criteria: verbal numerical pain score < 4, ability to ambulate with support, and absence of wound drainage.

All patients were scheduled for follow-up visits at 2 weeks, 6 weeks, 3 months, 6 months, and 1 year postoperatively.

STATISTICAL ANALYSIS

Statistical analyses were performed using t-tests for continuous variables, chi-square tests and Fisher's exact test for categorical variables, and rank-sum tests for non-normally distributed continuous data. All analyses were conducted using R software, version 4.0.5 (R Foundation for Statistical Computing, Vienna, Austria). A P-value of <0.05 was considered statistically significant across all tests.

To adjust for potential confounding factors between the two groups, propensity score matching was employed. Matching variables included gender, age, BMI, involved side, American Society of Anesthesiologists (ASA) score, pre-injury walking ability, and underlying comorbidities. This approach ensured balanced baseline characteristics between the groups for accurate comparison of outcomes.

RESULT

The study initially included 40 patients with unstable intertrochanteric fractures and 319 patients with displaced femoral neck fractures who underwent bipolar hemiarthroplasty. Baseline characteristics, including age, body mass index (BMI), and pre-injury walking status, showed significant differences between the groups. Therefore, propensity score matching was applied in a 1:4 ratio to ensure balanced distribution of these variables for a more accurate comparison of outcomes. After matching, 38 patients remained in the Intertrochanteric Group and 152 in the Femoral Neck Group. Post-matching, there were no significant differences in age, BMI, or pre-injury walking status between the groups ([Table 1](#)).

Intraoperative variations between the two groups revealed no significant difference in the type of anesthesia used, with the majority of patients in both the Intertrochanteric and Femoral Neck groups receiving spinal block anesthesia (71.1% and 73.7%, respectively; $P = 0.902$). However, significant differences were observed in the type

Table 1. Patient Demographic Data

Characteristics	Pre-matched cohort		p-value	Post-matched cohort		p-value
	Intertrochanteric Group (N=40)	Femoral Neck Group (N=319)		Intertrochanteric Group (N=38)	Femoral Neck Group (N=152)	
Age (year)	84 (80.8-89)	80 (60-98)	0.002	84 (81.2-89)	84 (79-88)	0.59
Gender			0.794			1
Female	28 (70.0)	234 (73.4)		27 (71.1)	107 (70.4)	
Male	12 (30.0)	85 (26.6)		11 (28.9)	45 (29.6)	
Side			1			1
Left	21 (52.8)	167 (52.5)		19 (50)	77 (50.7)	
Right	19 (47.2)	152 (47.5)		19 (50)	75 (49.3)	
Body Mass Index	20.9 (4.2)	22.4 (3.9)	0.029	20.9 (4.2)	21.4 (4.2)	0.437
ASA score			0.43			0.97
II	14 (35.0)	137 (42.9)		14 (36.8)	53 (34.9)	
III	26 (65.0)	182 (57.1)		24 (63.2)	99 (65.1)	
Pre injury walking ability			< 0.001			1
No support	24 (61.5)	208 (66.0)		23 (62.2)	92 (61.7)	
Support	15 (38.5)	107 (34)		14 (37.8)	57 (38.3)	
Underlying disease						
DM	6 (15.4)	95 (29.9)	0.088	5 (13.5)	39 (25.8)	0.171
HT	28 (71.8)	217 (68.2)	0.788	27 (73)	106 (70.2)	0.896
DLP	20 (51.3)	131 (41.2)	0.302	19 (51.4)	59 (39.1)	0.241
CKD	4 (10.3)	45 (14.2)	0.674	4 (10.8)	19 (12.6)	1
None	4 (10.3)	45 (14.2)	0.674	4 (10.8)	19 (12.6)	1

of femoral stem and the use of wiring. The Intertrochanteric group had a lower percentage of cemented femoral stems (73.7%) compared to the Femoral Neck group (91.4%; $P = 0.01$), and all patients in the Intertrochanteric group (100%) underwent wiring, in contrast to only 7.9% of the Femoral Neck group ($P < 0.001$).

Intraoperative and postoperative outcomes demonstrated significant differences between the Intertrochanteric and Femoral Neck groups (Table 2). The Intertrochanteric group exhibited a significantly longer median operation time compared to the Femoral Neck group. Additionally, total blood loss was substantially higher in the Intertrochanteric group, along with significantly greater preoperative and postoperative blood transfusion requirements. Although the incidence of intraoperative fractures did not differ significantly between the groups, the Intertrochanteric group experienced a longer median hospital stay and extended postoperative recovery duration.

For medical complications (Table 3), the Intertrochanteric Group exhibited significantly higher overall complication rates ($p=0.007$), with cardiovascular issues being particularly prominent (13.2% vs. 1.3%). Other complications, such as pulmonary, neurological, renal, and gas-

trointestinal events, were infrequent and did not reach statistical significance. Surgical complications, including dislocation and infection, were comparable between the two groups, with no significant differences observed ($p=0.777$).

DISCUSSION

Hip fractures represent a significant public health concern due to their increasing prevalence among the aging population, often resulting in considerable morbidity and health-care costs.¹⁰ BHA is a well-established treatment for displaced femoral neck fractures and, less frequently, for unstable intertrochanteric fractures.¹¹⁻¹³ Despite the known benefits of BHA for femoral neck fractures, there is limited research comparing its outcomes for these two types of fractures within a single treatment framework. This study aimed to address this gap by directly comparing BHA outcomes for displaced femoral neck versus unstable intertrochanteric fractures. Our findings reveal that while BHA for unstable intertrochanteric fractures is associated with longer operation times, higher blood loss, and increased complication rates compared to femoral neck fractures.

Table 2. Intraoperative and postoperative outcome

	Intertrochanteric Group (N=38)	Femoral Neck Group (N=152)	P-value
Operation time (min.)	195 (161.2-223.8)	170 (150-195)	0.008
Total blood loss (ml)	300 (200-500)	200 (100-300)	< 0.001
Pre-operative blood transfusion (unit)	0.4 (0.9)	0.1 (0.5)	0.029
Post-operative blood transfusion (unit)	2.4 (2.5)	0.7 (1)	< 0.001
Iatrogenic intraoperative fracture			0.387
Calcar Fracture	0 (0)	6 (3.9)	
Greater trochanter Fracture	1 (2.6)	2 (1.3)	
None	37 (97.4)	144 (94.7)	
Total hospital stays (Day)	11.5 (9-22.2)	9 (7-12)	< 0.001
Post-operative hospital stays (Day)	8.3 (5.5)	5.7 (3.8)	0.002

Table 3. Postoperative complication

	Intertrochanteric Group (N=38)	Femoral Neck Group (N=152)	P-value
Medical complication			0.007
None	27 (71.1)	116 (76.3)	
Cardiovascular	5 (13.2)	2 (1.3)	
Pulmonary	2 (5.3)	14 (9.2)	
Neurological	0 (0)	1 (0.3)	
Renal	3 (7.9)	19 (12.5)	
Gastrointestinal system	1 (2.5)	0 (0)	
Surgical complication			0.777
None	36 (95)	301 (94.7)	
Dislocation	1 (2.5)	8 (2.5)	
Infection	0 (0)	4 (1.3)	
Fracture	1 (2.5)	5 (1.6)	

The longer median operation time observed in the Intertrochanteric group compared to the Femoral neck group aligns with findings from other studies, such as those by Kumar et al.¹⁴ and Abdelkhalek et al.,¹⁵ who reported prolonged surgical durations for unstable intertrochanteric fractures treated with BHA (mean operative times of 116 and 140 minutes, respectively). This increased complexity is often attributed to additional procedures like wiring or the use of long-stem implants, which contribute to the extended operative time.¹⁶ In contrast, femoral neck fractures generally allow for quicker implantation due to their more straightforward anatomy.

The significantly higher total blood loss in the intertrochanteric group, along with greater pre- and postoperative transfusion requirements compared to the femoral Neck group. This finding is consistent with previous research, such as the study by Andriollo et al., which reported a decrease in preoperative hemoglobin levels and a high rate of blood transfusions among patients undergoing arthroplasty for intertrochanteric fractures.¹⁷ Similarly, Bonneville et al. found a high transfusion rate, with pa-

tients receiving an average of 2.29 units of blood per patient.¹⁸ The increased bleeding risks with intertrochanteric fractures are attributed to the highly vascularized area and significant disruption of bone and soft tissue. This risk is further heightened by the extensive surgical approach, which involves longer incisions and additional procedures like wiring.¹⁹

Our analysis of medical complications revealed significantly higher rates in the intertrochanteric group, particularly for cardiovascular issues (13.2% vs. 1.3%). This highlights the increased cardiovascular risk associated with the more complex and stressful surgical management of intertrochanteric fractures. Other complications, such as pulmonary, neurological, renal, and gastrointestinal, were infrequent and not statistically significant. Importantly, surgical complications, including dislocation and infection, were similar between the groups, consistent with findings from Kumar et al.¹⁴ and Abdelkhalek et al.,¹⁵ who reported no significant differences in infection or dislocation rates. Similarly, Andriollo et al. reported low rates of surgical

complications, supporting the consistency of surgical outcomes across studies despite varying medical risks.¹⁷

This study has some limitations. First, the retrospective nature introduces potential biases related to patient selection and data collection. Although propensity score matching was used to balance baseline characteristics between groups, unmeasured variables could still affect outcomes. Second, the study was conducted at a single institution, which may limit the generalizability of the findings to other settings with different patient populations or surgical practices. Future research should consider multi-center designs with standardized surgical techniques and postoperative care to further validate these findings and enhance generalizability.

CONCLUSION

This study demonstrates that bipolar hemiarthroplasty in unstable intertrochanteric fractures is associated with increased operative time, blood loss, and medical complications, particularly cardiovascular events, compared to its use in femoral neck fractures. However, comparable rates of surgical complications suggest that bipolar hemiarthroplasty may still be a reasonable option in carefully selected elderly patients with poor bone quality or high surgical risk. Close perioperative management is essential in such cases. Further prospective studies are needed to refine indications and optimize outcomes in this challenging patient population.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ethics Committee and Institutional Review Board of the Faculty of Medicine, Prince

of Songkla University. Consent to participate: Not applicable

CONSENT FOR PUBLICATION

Not Applicable

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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AUTHORS' CONTRIBUTIONS

VY, ST: Study design, data collection, statistical analysis, and writing the paper; CA: Study design, statistical analysis, and writing the paper, PT,TH : Data collection and writing the paper; KI: Corresponding author, study design, statistical analysis, and writing the paper. All authors have read and approved the final manuscript.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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