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Original Research Article

A study on functional outcome of cemented bipolar hemiarthroplasty and proximal femoral nailing for intertrochanteric fractures of femur in elderly patients 60-90 years

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ABSTRACT

Background: Intertrochanteric fractures are common in elderly patients, often resulting from low-energy falls and exacerbated by osteoporosis. Procedures like bipolar hemiarthroplasty (BHA) and proximal femoral nailing (PFN) present unique benefits and challenges. The aim of the study was to compare the functional outcome of intertrochanteric fracture treated with proximal femoral nail and cemented bipolar hemiarthroplasty.
Methods: A longitudinal observational study was conducted among patients with complaint of an intertrochanteric fracture between March 2021 and August 2022. A total of 24 patients were selected based on particular inclusion and exclusion criteria and divided into two groups of 12. After the respective procedure, patients were monitored for a duration of 5 months, both preoperatively and postoperatively at 1, 3, and 5 months. The collected data included demographic data, clinical data as well as Harris hip score which was then entered into excel sheets and then analyzed using EZR version 1.54 software.
Results: The present study included 24 patients of which 37.5% were males and 62.5% were females with a mean age of 78.17±9.13 years. The mean blood loss observed was 203.75±65.99 ml, mean surgery time was 96.42±26.02 minutes, and mean number of days needed to bear full weight was 28.21±20.42 days. Of the fracture patterns, 31-A2 was the most common encountered (54.2%). The mean amount of blood loss among participants in the PFN group was 152.50±24.17 ml and in the bipolar group the mean blood loss was 255±52.83 with this difference being statistically significant ($p<0.05$).
Conclusions: This study found significant intraoperative blood loss differences between PFN and CBH in older intertrochanteric fracture patients. The statistically significant reduction in blood loss makes PFN a safer surgery for this sensitive group.

Keywords: Blood loss, Functional outcomes, Hemiarthroplasty, Intertrochanteric fractures

INTRODUCTION

The rising percentage of the elderly population, extended life expectancy, and sedentary lifestyle have led to an increase in osteoporosis and osteoporotic fractures, resulting in significant economic burdens and challenges in nursing management for patients, healthcare professionals, and society at large. Hip fractures are a primary consequence of osteoporosis, resulting in severe outcomes for affected individuals, including a significantly elevated risk of recurrent fractures.[1] In 1990, around 1.3 million hip fractures were documented worldwide, with projections suggesting a range of 7.3 to 21.3 million by 2050.[2,3]

Intertrochanteric femur fractures occur between the greater and lesser trochanters. These constitute some of the most prevalent hip fractures in elderly individuals and are seldom in younger patients. Intertrochanteric femur fractures frequently occur in elderly persons and typically

result in considerable impairment. The treatment seeks to facilitate a swift restoration to the previous functional status while minimizing problems and mortality rates. Internal fixation is the primary surgical intervention for the majority of these fractures.[3]

The surgical therapy options for intertrochanteric fractures have advanced considerably over time. Proximal femoral nailing (PFN) has been prominent among treatment techniques due to its minimally invasive characteristics and positive clinical results. PFN offers secure fixation via intramedullary nailing, facilitating early mobilization, which is essential for older patients susceptible to problems from extended immobilization. The objective of PFN system design is to reduce soft tissue injury while ensuring sufficient support for fracture repair.[4,5] Bipolar hemiarthroplasty (BHA) facilitates early complete weight-bearing and functional rehabilitation, so it has recently been recognized as an effective therapy for intertrochanteric fractures. Furthermore, the utilization of bipolar hemiarthroplasty facilitates earlier mobilization than osteosynthesis, potentially resulting in a substantial decrease in the occurrence of postoperative cerebrovascular incidents.[6]

The selection between BHA and PFN is determined by various aspects, such as the patient's bone quality, fracture stability, and general health condition. The cemented BHA is frequently used due to its capacity for facilitating early pain-free mobility and has been linked to reduced complication rates in specific studies. This method entails substituting the femoral head with a prosthetic element that enhances joint functionality while reducing the likelihood of fixation failure. Conversely, PFN is a less invasive technique that use intramedullary nailing to fix the fracture. This strategy aims to promote early weight-bearing and rehabilitation, essential for reducing consequences related to prolonged immobility, including deep vein thrombosis and pulmonary embolism.[7,8] The present study was conducted to address the lack of research on the preferred option for surgeons between these two procedures.

The present study was conducted with the aim to compare the functional outcome of two different surgical treatments used to treat intertrochanteric femur fractures among elderly patients. The objectives of the study were to assess the functional outcome of cemented BHA in 60 to 90 years old patients with intertrochanteric fracture of femur, to assess the functional outcome of PFN in 60 to 90 years old patients with intertrochanteric fracture of femur. The final objective was to compare the functional outcome of both operative methods for intertrochanteric fracture of femur among patients aged 60-90 years.

METHODS

A longitudinal observational study was conducted among patients who presented to the department of orthopedics of Azeezia Institute of Medical Sciences and Research between March 2021 and August 2022 with complaint of an intertrochanteric fracture. The study was undertaken after obtaining ethics approval from the institutional human ethics committee (IHEC) with reference number AEC/REV/2021/25 and informed consent from all selected patients.

The patients were included in the present study if they were aged between 60-90 years and presented with intertrochanteric fracture of femur. Patients with pathological fractures, patients who were non-ambulating before surgery, patients requiring total hip replacement and patients with fractured neck of femur were excluded from the present study. The following formula was used to calculate the sample size for the present study using results from a previously conducted study.[9]

$$N = 2(Z_{1-\alpha/2}+Z_{1-\beta})^2 [1+ (m-1) \rho[= m[(\mu1-\mu2)/ \sigma]^2$$

$$m =3, Z_{(1-\alpha/2)} = 1.96, Z_{1-\beta} =1.282, \alpha =5\%, 1-\beta = 90\%, \rho = 0.5$$

n = 12 in one group. Therefore, a total of 24 samples were required for two groups. Purposive sampling was used for selection of the participants.

This study included patients receiving cemented BHA with PFN for intertrochanteric femoral fractures. The patients were monitored for a duration of 5 months, both preoperatively and postoperatively at 1 month, 3 months, and 5 months. One surgeon participating in the study favored proximal femoral nailing, whereas the other surgeon favored cemented bipolar hemiarthroplasty. All patients received antibiotics both preoperatively and postoperatively. The selection of antibiotics adhered to the established antibiotic protocol. The investigator personally gathered the patient's details. Patients receiving cemented bipolar hemiarthroplasty and proximal femoral nailing were studied independently and scored using the Harris hip score.

Operative techniques

PFN group

The treatment was performed on an orthopedic fracture table with the patient in a supine position. Following the draping and preparation of the area, a 5 cm incision was executed proximally from the apex of the greater trochanter, and the gluteal muscles are dissected along its axis. A bone awl was employed to establish the entry location, followed by the placement of a guide wire and nail over the wire. Proximal and distal locking has been completed. The wound was sutured in stages without the use of a drain.

BHA group

The patient was consistently positioned in the lateral decubitus group after the induction of anesthesia. 10 cm-long, curved incision centered over the greater trochanter.

External rotators were ligated and severed. The capsule was released uniformly following the insertion of the head extractor. The femoral head was excised. The greater trochanter, abductor muscles, and all vascularized bone fragments were meticulously maintained. The femoral medullary canal was subsequently reamed to the appropriate stem size and diameter. During the procedure, meticulous restoration of neck length, offset, and version was performed to optimize hip joint stability. The femoral stem was affixed in a malleable condition. Minor calcar bone pieces were diminished on the medial side of the femoral stem behind the stem collar after insertion. A closed suction drain.

Statistical analysis

Data collected were entered in MS excel and analysed using EZR version 1.54 software functional outcome was assessed between two groups at three time points using ANOVA.

RESULTS

The present study included 24 patients with a mean age of 78.17±9.13 years and included 9 (37.5%) male and 15 (62.5%) female participants. The mean blood loss observed was 203.75±65.99 ml, mean surgery time was 96.42±26.02 minutes, mean duration of hospital stay was 5.75±1.07 days, mean number of days needed to bear full weight was 28.21±20.42 days. The mean Harris hip score at 5 months was 81.50±6.01 (Table 1 and Figure 1).

Of the fractures involved, right sided fractures were operated in 54.2% patients and 45.8% patients presented with left sided fractures and all patients required pre injury ambulation (100%). Of the fracture patterns observed among the study participants, 31-A2 was the most common encountered (54.2%) followed by 31-A3 (25%). An equal proportion of PFN and bipolar implants were used during the course of the study (50% each).

Table 1: Demographic and clinical details.

Variables	Mean
Age (years)	78.17±9.13
Blood loss (ml)	203.75±65.99
Surgery time (minutes)	96.42±26.02
Duration of hospital stay (days)	5.75±1.07
Duration to full weight bearing (days)	28.21±20.42
Harris hip score at 5 months	81.50±6.01

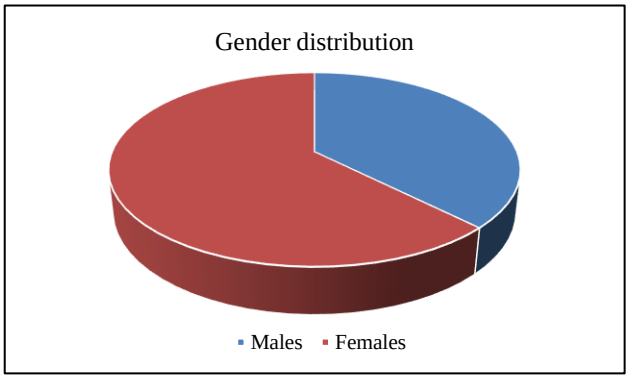

Figure 1: Distribution of gender among study participants.

Table 2: Distribution of clinical variables.

Variables	Subcategory	Percentage
Side of fracture	Right	54.2
	Left	45.8
Per-injury ambulation	Yes	100
	No	0
Fracture pattern	31-A1	20.8
	31-A2	54.2
	31-A3	25
Prosthesis implant used	PFN	50
	Bipolar	50

PFN: Proximal femoral nailing

Table 3: Comparison of type of prosthesis implant with regard to clinical and demographic variables.

Variables	Prosthesis used	Mean	Std. error mean	P value
Age (years)	PFN	80.08±7.61	2.197	0.157
	Bipolar	76.25±10.41	3.005	
Blood loss (ml)	PFN	152.50±24.17	6.977	0.004*
	Bipolar	255±52.83	15.250	
Surgery time (minutes)	PFN	80.08±17.61	5.085	0.335
	Bipolar	112.75±22.88	6.605	
Duration of hospital stay (days)	PFN	6±1.04	0.302	0.713
	Bipolar	5.50±1.09	0.314	
Duration to full weight bearing (days)	PFN	46.08±5.55	1.602	0.094
	Bipolar	10.33±12	3.463	
Harris hip score at 5 months	PFN	80.58±5.87	1.694	0.795
	Bipolar	82.42±6.27	1.811	

*:Statistically significant ($p<0.05$), PFN: proximal femoral nailing

Table 4: Comparison between fracture pattern, side of fracture and gender toward prosthesis used.

Variables	Subcategories	Prosthesis used (%)		Total (%)	P value
		PFN	Bipolar		
Fracture pattern	31-A1	4 (80)	1 (20)	5 (100)	0.280
	31-A2	6 (46.2)	7 (53.8)	13 (100)	
	31-A3	2 (33.3)	4 (66.7)	6 (100)	
Side of fracture	Right	8 (61.5)	5 (38.5)	13 (100)	0.207
	Left	4 (36.4)	7 (63.6)	11 (100)	
Sex	Male	4 (44.4)	5 (55.6)	9 (100)	0.500
	Female	8 (53.3)	7 (46.7)	15 (100)	
Total		12 (50)	12 (50)	24 (100)	

The different types of prosthesis used in surgery were compared among the different demographic and clinical variables and the results showed that the mean amount of blood loss among participants in the PFN group was 152.50±24.17 ml and in the bipolar group the mean blood loss was 255±52.83 with this difference being statistically significant ($p<0.05$). The difference in the two groups with regard to variables such as age, surgery time, duration of hospital stay, duration of full weight bearing and Harris hip score at 5 months was not found to be statistically significant ($p>0.05$) (Table 3).

Table 4 showed the comparison between side and pattern of fracture as well as gender of participant to the prosthesis used among the participants and the results showed that there was no association between the prosthesis used and the two subcategories of variables considered ($p>0.05$).

DISCUSSION

Intertrochanteric fractures are managed by two approaches: conservative and surgical. The conservative approach now has a restricted application, utilized exclusively for people at elevated risk for anesthesia and surgery, as well as non-ambulatory individuals experiencing minimal pain post-fracture. A successful surgical intervention for an unstable intertrochanteric fracture should yield a stable, pain-free hip with an adequate range of motion. BHA proves to be an effective implant for unstable intertrochanteric fractures, addressing these deficiencies by circumventing the phases of bone healing.[10] It facilitates early mobilization, reduces hospital stays, and promotes a favorable range of motion.[11] This study aimed to examine the efficacy of BHA and PFN in individuals with intertrochanteric fractures.

The present study included 24 patients with a mean age of 78.17±9.13 years and included 9 (37.5%) male and 15 (62.5%) female participants. The findings were analogous to those reported by Singh et al, where the mean age of the studied patients was 73.7±5.25 years, and the female-to-male ratio was 3:2.[12] This aligns with a research by Elhadi et al, which reported a mean age of 76.15±7.2 years, with female participants being predominant.[13] The female predominance is attributable to postmenopausal osteoporosis and reduced peak bone mass, as evidenced by prior Indian investigations.[14,15] The average blood loss recorded was 203.75±65.99 ml, which is comparatively low in relation to prior studies on analogous operations. Research on cemented bipolar hemiarthroplasty indicated blood losses between roughly 320 mL and beyond 350 mL.[12,13,16] This reduced blood loss may suggest a less invasive method or proficient surgical skill in this group. The average surgical duration was 96.42±26.02 minutes, comparable to the operating periods documented in other research, which vary from approximately 78 to 110 minutes for analogous procedures.[12,16] Efficient surgical procedures may decrease operative duration, which is advantageous for geriatric patients. The average duration of hospital stay was 5.75±1.07 days, much lower than those from other research, which reported hospital stays of between 10 to 15 days for comparable procedures.[12,13,16] The abbreviated hospital stay in this study may indicate efficient postoperative treatment and prompt mobilization protocols.

The average length required to bear full weight was 28.21±20.42 days, which exceeds the typical timeframe described in studies on cemented bipolar hemiarthroplasty, when patients often attain full weight-bearing status within roughly 5 to 6 days postoperatively.[12,16] The prolonged duration of this study may be ascribed to patient-specific variables, like age, comorbidities, or the characteristics of the fractures. The average Harris hip score at 5 months was 81.50±6.01, indicating a favorable functional outcome for the patients studied.[12,13] This number signifies adequate healing and functionality; nonetheless, it is crucial to compare it with results from alternative interventions for a thorough assessment.

The results indicated a little predominance of right-sided fractures in this group, potentially correlating with overall trends that show right-sided injuries are more prevalent due to characteristics such as handedness or activity levels. The most prevalent fracture pattern among the study participants was 31-A2, reported in 54.2% of cases, followed by 31-A3 at 25%. Per AO/OTA

classification, 31-A2 is categorized as a fracture exhibiting comminution at the fracture site, indicating it is an unstable fracture. This research encompassed patients categorized as 31-A2.[4] The predominant types of trochanteric fractures identified in the Swedish fracture register by Leif Mattisson and colleagues were 31-A1 and 31-A2, aligning with our cohort findings.[17,18]

The findings indicated that the average blood loss in the PFN group was 152.50±24.17 ml, whereas in the bipolar group, it was 255±52.83 ml. This difference was statistically significant ($p<0.05$), suggesting a correlation between the two variables. These findings align with the current literature that emphasizes the benefits of PFN over cemented bipolar hemiarthroplasty (CBH) regarding reduced intraoperative hemorrhage. Previous studies indicate that PFN typically leads to less blood loss in comparison to hemiarthroplasty treatments. Roy et al conducted a comparison analysis revealing that the mean blood loss related with PFN was much less than that of bipolar hemiarthroplasty (about 174 ml compared to 288 ml).[19] The experiment conducted by Pradeep et al resulted in a minimal blood loss, averaging 67.4 ml, with a high of 250 ml.[20] Individuals who had bipolar hemiarthroplasty experienced greater blood loss compared to those who received a proximal femoral nail (PFN). The decreased blood loss is especially advantageous for elderly people with potentially impaired physiological reserves.

The analysis of the relationship between fracture side and pattern, as well as participant gender, in relation to the prosthesis utilized revealed no significant link with the examined subcategories of variables ($p>0.05$). The absence of a substantial correlation between the type of prosthesis and the side or pattern of fractures is remarkable. Surgical decisions concerning prosthesis selection were likely influenced by overarching clinical factors rather than particular fracture attributes. This corresponds with prior research indicating that surgeons frequently employ standardized protocols for prosthesis selection to facilitate decision-making in emergency situations, especially when swift action is required.[21,22] Research indicates that both cemented bipolar hemiarthroplasty and proximal femoral nailing are effective treatments for intertrochanteric fractures; however, the choice between them may depend on patient comorbidities and overall health rather than only on fracture characteristics.[23] The AO/OTA classification reveals that unstable fractures (e.g., 31-A2) frequently occur in older people; yet, treatment options may not vary considerably between right- and left-sided fractures.[24] The lack of correlation between gender and the type of prosthesis utilized underscores a significant facet of orthopedic surgery. This study indicates that, although gender may impact fracture patterns and outcomes, it did not influence the selection of surgical intervention. This discovery advocates for a fairer treatment approach, wherein both categories of prosthesis are regarded as viable alternatives irrespective of gender.[12]

The comparative analysis of cemented bipolar hemiarthroplasty (BHA) versus proximal femoral nailing (PFN) for unstable intertrochanteric fractures in geriatric patients uncovers several benefits and drawbacks. BHA promotes early movement and exhibits enhanced initial functional outcomes, evidenced by elevated Harris hip scores, hence benefiting elderly individuals susceptible to problems arising from immobility. In contrast, PFN is linked to markedly reduced intraoperative blood loss, hence improving its safety profile in specific instances. Nonetheless, the limited sample size and brief follow-up period of the study restrict the applicability of the results, necessitating bigger investigations to validate findings across varied populations. Furthermore, although BHA may offer enhanced stability and pain alleviation, it is associated with hazards, including bone cement implantation syndrome. The absence of notable correlations between prosthesis type and demographic characteristics indicates a necessity for more customized surgical strategies. These findings emphasize the significance of personalized treatment strategies that take into account patient-specific characteristics and the need for efficient rehabilitation regimens to enhance recovery. Subsequent study must concentrate on more extensive cohorts and prolonged follow-up durations to enhance comprehension of the long-term effects of each surgical approach on patient outcomes and quality of life.

CONCLUSION

In conclusion, this study shows significant variations in intraoperative blood loss between PFN and CBH while treating older patients with intertrochanteric fractures. For this susceptible group, PFN is a safer surgical choice due to its statistically significant reduced blood loss. Even though there was no discernible difference in functional outcomes at five months, more study is required to assess long-term results and rehabilitation tactics for both surgical approaches. In order to maximize healing and reduce complications, the results highlight the significance of customized surgical techniques depending on patient demographics and fracture characteristics.

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