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ORIGINAL ARTICLE

Cemented bipolar hemiarthroplasty for unstable intertrochanteric fracture in elderly patients over 70 years: Boon or bane?

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Abstract

Introduction The surgical management of intertrochanter femur fracture in elderly patient is still under debate. Various implants can be utilised but prosthetic replacement is gaining popularity. This study was performed to evaluate the functional and clinical outcomes of cemented bipolar arthroplasty as a primary treatment for unstable intertrochanteric fracture in elderly patients (> 70 years).

Materials and methods Thirty-seven patients with unstable intertrochanteric fracture in elderly patient (> 70 years) who underwent cemented bipolar hemiarthroplasty. Intra-operative and post-operative complications were noted; functional outcomes were assessed using Harris hip score (HHS). All patients were followed up for a minimum of 12 months.

Results Overall 90% of patients has some minor or major intra or post-operative complication. One year mortality rate was 16% (6/37). Cardiopulmonary events were the most common life threatening incident. Mean fall in Haemoglobin was 1.6 gm/dL. The average time for full weight bearing mobilisation with the help of walker was 2.8 ± 1.2 days (1–8 days). The average duration of surgery was 58 ± 6 min (44–96 min) with an average blood loss of 126 ± 24 mL (90–380 mL). HHS at the end of 12 months was 77.

Conclusions The use of bipolar hemiarthroplasty in senile patient with unstable hemiarthroplasty gives an advantage of early weight bearing. However, it is associated with risk of significant intra or post-operative morbidity due to intra-operative trauma, surgical time and blood loss during the surgery. Although hemiarthroplasty can be a single-time solution to the complexities of intertrochanter fracture in elderly patients but should be performed in selected patients only.

Keywords Cardiopulmonary event · ASA grade · Unstable intertrochanter fracture · Blood loss · Mortality · Cemented bipolar hemiarthroplasty

Introduction

An intertrochanter femur fracture is a complex entity in the elderly population. With increasing lifespans and the incidence of comorbidities, surgical management has become challenging. An unstable intertrochanter femur in the elderly is associated with morbidity and a 20% rate of mortality in 1st post-operative year [1]. The surgical treatment included angle blade plates, dynamic hip screws with plates and cephalomedullary nails, etc. There is no single implant handling all the complex problems associated with intertrochanter fracture management. Malreduction, delayed or non-union of fracture, excessive collapse at the fracture site, loss of reduction, cut-out of lag screws, iatrogenic fractures, revision surgeries, and protruding implants are a few of the challenges related to the surgery [2]. Apart from those other issues associated with geriatric age like osteoporosis,

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delayed rehabilitation, bed sores, chest or urinary infections, etc. also needs to be managed.

The prosthetic replacement has been recommended by surgeons in the past decade as a one-time solution to a few of the major problems of osteosynthesis [3, 4]. Early rehabilitation, decreased complications pertaining to mal-reduction, non-union at the fracture site, and implant-related issues have led to the increasing popularity of bipolar hemiarthroplasty in the management of intertrochanter femur fracture [5]. There is still a lack of consensus regarding the safety profile and reliability of prosthetic replacement in elderly patients.

The purpose of this retrospective study is to evaluate the functional and clinical outcomes of cemented bipolar arthroplasty as a primary treatment for unstable intertrochanteric fracture in elderly patients.

Materials and methods

This retrospective single centre study consisted of 37 patients with an intertrochanter femur fracture, managed with cemented bipolar hemiarthroplasty over the period of 6 years (2017–2021). The study was approved by the Ethics board committee.

The inclusion criteria were: age of more than 70 years of either gender and presence of isolated unstable intertrochanter femur fracture, whereas the exclusion criteria included patient not fit for surgery, compound fracture, polytrauma patient, sub-trochanteric extension of fracture or fracture in the same limb, pathological fracture, pelvic fracture, immobility or difficulty in walking before suffering an injury, implant in the ipsilateral hip or history of the septic hip joint at any point of time, and not able to follow-up for at least 12 months. All the patients were assessed clinically, radiologically, and with laboratory investigations. All the patients included in the study were referred to our arthroplasty unit from all the other orthopaedics units for the surgery. The arthroplasty unit (two senior arthroplasty surgeons) specialised only for Hip and Knee arthroplasty surgeries.

Preoperative demographic data including age, gender, side of injury, and duration since injury were recorded. The clinical assessment included the recording of the comorbidities and, the American society of anesthesiologists physical status classification (ASA grading). Radiologically, all patients were assessed with pelvis and hip with femur radiographs. The fracture was classified based on Boyd and Griffin classification, AO/OTA classification, and CT scan assessment. All patients had either type 2, 3, or 4 fractures according to Boyd and Griffin classification (Fig. 1); 31-A2.2 and 31-A2.3 fracture type according to AO/OTA classification. CT scan depicted at least 3 comminuted fragments of the intertrochanter region with osteoporosis.

Fig. 1 Preoperative radiographs showing unstable intertrochanter femur fracture

All patients were managed by cemented bipolar hemiarthroplasty with/without stainless steel wire encirclage for the comminuted fragments. The posterior approach was performed in all the patients. Duration of surgery, intra-operative blood loss or any intra-operative complications were recorded.

Postoperatively, all the patients were mobilised full weight bearing with the help of a walker. The time for full weight-bearing mobilisation, average hospital stay, need for blood transfusions, Harris hip score at 2-year, and post-operative complications were also recorded.

All patients were managed by Cemented bipolar hemiarthroplasty with stainless steel wire encirclage for the comminuted fragments after initial haemodynamic stabilisation and preoperative anaesthetic fitness. The surgery was performed using Moore's approach with the patient in a lateral decubitus position. The femoral neck was either approached via a trans-trochanteric approach or a standard approach. Utmost care was taken to preserve the integrity of abductors muscles, greater trochanter fragments, and their vascularity. The presence of an intact neck of the femur along with the femoral head posed a surgical difficulty in the extraction of the femoral head from the acetabulum. The short external rotators of the hip were preserved sacrificing few fibres of quadratus femoris. The capsule was dissected from the external rotators and incised in T shaped fashion. Slowly

and cautiously the capsule was removed from all sides and the corkscrew inserted deep in the femoral head through the femoral neck. The femoral head at last freed from all sides and freely rotating in the acetabulum. The extraction of the femoral head and neck required more space and tissue dissection as compared to femoral neck fracture surgery. The femoral head was assessed using the jigs and bipolar head size was decided. The integrity of the acetabulum was checked and care was taken not to damage the cartilage or acetabular labral tissue. The fractured intertrochanteric femur fragments were assessed. The femoral canal was then reamed accordingly. The greater trochanter fragments were reduced and fixed with the help of stainless steel (SS) wire over the trial implant. The SS wire was passed in the proximal femur at the level of the lesser trochanter, crossed laterally and then passed through the gluteus medius and gluteus minimus muscle belly. Tissue tensioning was assessed and then femoral preparation was done. Trial reduction with best fit stem and head was performed taking care of limb length, offset restoration, and hip balancing. The femoral canal was prepared for bone cementing. The femoral canal was thoroughly washed with pulsatile lavage and hydrogen peroxide. The canal was thoroughly dried with epinephrine soaked guaze. Retrograde cementing and pressurisation was performed with the help of long nose cement gun. Highly polished cemented stems with centralizer were placed with the help of Palacos® cement. The cement protruding out of the canal or from the fracture site was removed and waited for appropriate time for cement curing. The hip was thoroughly washed with normal saline with the help of pulse lavage. The hip reduction was performed with or without the help of skid instrument. The tension band wiring stabilising the greater trochanter was then further tightened in figure of 8 fashion. The hip joint was thoroughly washed and the posterior capsule as well as the short external rotators were sutured to the proximal femur. The gluteus medius, vastus lateralis, and fascia lata were approximated and sutured to provide a soft tissue cover over the fracture site.

Post-operatively, the radiographs were performed and mobilisation was performed as per the comfort of the patient. Haemoglobin (Hb) was assessed in the post-operative period, and if values were below 8 g/dL, 1-unit blood was transfused and reassessed after 24 h. The number of transfusions (intra-operative and post-operative) was also recorded. Any post-operative complications were also noted and due management was performed. Patient discharge criteria included good general health condition, well-controlled comorbidities, full weight-bearing walking with the help of a walker, and deep vein thrombosis prophylaxis. All the patients were followed-up for at least 24 months. Radiographs were performed at last follow-up (Fig. 2) and HHS were calculated. Six patients died (16%) within 12 months of the surgery.

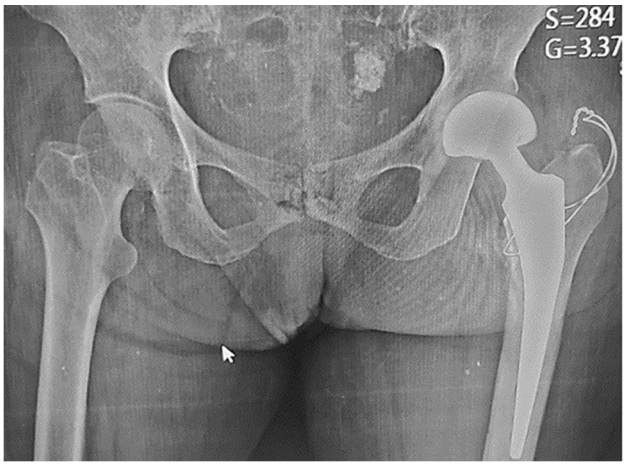

Fig. 2 Post-op radiographs done at 28 months follow-up depicting no stem sinkage or aseptic loosening

Statistical analysis was done using MS excel and SPSS 22.0 software. The mean, standard deviation, and range were calculated.

Results

The study initially included 37 patients but 6 patients died within the follow-up of 1-year (11 males and 20 females) with a mean age of 76.8 ± 7.5 (SD) years (70–93 years). There was a range and combination of comorbidities in the patients including hypertension, asthma, chronic obstructive pulmonary disease, chronic kidney disease, hypothyroidism, and diabetes mellitus, the latter being the most common disease with combination of others (Table 1). Left side was involved in 17 patients whereas 14 patients had right-side fractures. The duration since injury was 3.2 ± 1.2 days (1–11 days). The average ASA grade was 3.5 (Table 2).

Radiological outcomes

The pelvis with both hip radiographs depicted unstable intertrochanter fracture in all the patients. Boyd and Griffin classification depicted type 2 in 7 patients, type 3 in 10 patients, and type 4 in 14 patients. According to AO/OTA classification 24 patients suffered 31A2.3 fracture and 7 patients had 31A2.2 fracture. CT scan was performed in all the patients showing a 3-part comminuted fracture in 12 patients and a 4-part comminuted fracture in 19 patients.

The radiological outcome at post-operative period depicted the well placed implant with no dislocations or iatrogenic fractures. The cementing was assessed in various gruen zones and was satisfactory in all the patients. Few

Table 1 Distribution and details of comorbidities among study population

S. no.	DM	HTN	CAD	COPD/Asthma	CKD	Anaemia	Others
1	X	X				X	
2	X				X	X	
3		X					
4			X			X	
5	X			X			
6		X					Hypothyroidism
7				X			
8	X	X					
9	X					X	
10	X				X	X	
11	X		X				
12		X	X	X			
13		X				X	Pheochromocytoma
14	X	X	X				
15	X			X	X	X	
16		X		X			Breast carcinoma
17	X		X	X			
18		X					
19	X						
20	X	X					Hypothyroidism
21							
22	X						
23	X				X		
24		X	X				
25							
26	X				X	X	
27	X		X				
28				X			
29	X	X	X			X	
30		X	X	X			
31	X		X		X	X	

DM diabetes mellitus, *HTN* hypertension, *CAD* coronary artery disease, *COPD* chronic obstructive pulmonary disease, *CKD* chronic kidney disease

bone fragments or excess cement were found around the stem not hindering the hip motions.

The radiographs at the follow-up showed no stem shrinkage or aseptic loosening in any grunz zones. There was no fracture suffered in the same limb or dislocation of the implant.

Implant details

All the patients were operated with similar operative technique and bipolar hemiarthroplasty of same make were used. The implant Meril Latitud® cemented femoral stem were utilised in all the patients with 40 g Palacos® bone cement. This was a highly polished, double tapered and collarless stem with femoral neck standard 12/14 taper male trunnion. The Bipolar cup system comprised of factory assembled ultra-high molecular weight polyethylene inner liner and highly polished stainless steel outer metal dome (37–47 mm). Modular femoral head of 22 mm and 28 mm were available.

The stem sizes of 3 were most commonly utilised in 18 patients. Size 1 stem was used in 4 patients, size 2 stem was used in 12 patients and stem 4 was used in 3 patients. The details of the implant utilised are listed in Table 3.

Surgical outcomes and complications

The average duration of surgery was 58 ± 6 min (44–96 min) with an average blood loss of 126 ± 24 mL (90–380 mL). A total of 18 patients required 1-unit blood transfusion intra-operative.

Table 2 Descriptive data of the study population

Number of patients	31
Mean age	76.8 ± 7.5 (70–93 years)
Side involved	Right: 14; Left: 17
Mean duration since injury	3.2 ± 1.2 days (1–11 days)
Mean ASA grading	3.5 ± 1.2 (2–4)
Fracture type: body and griffin classification	Type 2: 7
	Type 3: 10
	Type 4: 14
AO classification	31A3.2: 7
	31A3.3: 24
CT scan	3-part fracture: 12
	4-part fracture: 19
Mean duration of surgery	58 ± 6 min (44–96 min)
Average blood loss	126 ± 24 ml (90–380 mL)
Average fall in Hb	1.6 ± 0.8 g/dL (1–3.2 g/dL)
Average time for full weight bearing	2.8 ± 1.2 days (1–8 days)
Average hospital stay	5.4 ± 2.3 (3–18 days)
Need for blood transfusion	25 patients
Average follow-up	26.2 months (24–40 months)
Average HHS score	77.2 ± 2.3 (70–83)

Intra-operative complications included sudden fall in blood pressure in 16 patients requiring medications for management, whereas 8 patients were managed with fluids only. A sudden fall in oxygen saturation was also recorded in 16 patients managed with supplemental oxygen. Two patients had intra-operative cardiac events requiring medication and consultation from the cardiologist. Later investigations revealed the occurrence of myocardial infarction, managed with medications. None of the patients had an iatrogenic fracture or neurovascular injury.

Post-operatively, all patients were kept in the intensive care unit for 48 h. The average fall in Hb was 1.6 ± 0.8 g/dL (1–3.2 g/dL). Sixteen patients required 1-unit blood transfusion intraoperatively. Twenty-three patients required 1-unit blood transfusion, whereas 2 patients required 2 units of blood transfusions post-operatively. The cut-off for blood transfusion was Hb of less than 8 g/dL or the hemodynamic status of the patient as assessed by the anaesthesia/physician.

The average time for full weight bearing mobilisation with the help of walker was 2.8 ± 1.2 days (1–8 days). The average length of hospital stay was 5.4 ± 2.3 days (3–18 days).

The true limb length discrepancy was assessed in all the patients postoperatively. There was average shortening of 1.2 cm (range 0–2 cm) on the operate limb compared to other side. The limb length discrepancy remained same (no increase) during the follow-up in all the patients. None of the patients required shoe raise for walking. None of the patients complained of any gait disturbance during the follow-ups.

The post-operatively complications included deep vein thrombosis in 3 patients, periprosthetic joint infection (PJI) in 1 patient, superficial infection in 2 patients, urinary tract infection in 5 patients, pulmonary complications in 4 patients, and cardiac complications in 6 patients. DVT, cardiac complications, urinary complications, pulmonary and superficial infections were managed with medications, whereas PJI required two-stage revision in 1 patient only. Limb length discrepancy was observed in 8 patients. No patient developed pressure sores in the rehabilitation phase (Table 4).

Six patients died before the minimum follow-up of the study. Out of 6, 1 patient expired in a road traffic accident (unrelated to the surgery), whereas 2 patients with multiple comorbidities including diabetes mellitus, hypertension, coronary artery disease and hypothyroidism expired during high risk cardiac surgery. Three patients expired in due course of time over 12 months period post-surgery. At least for 3 months postoperatively, the patients were walking with walking aid and no major post-operative complications. There were medical antecedent events (no surgery/no trauma) which cannot be ascertained and ultimately suffered cardiopulmonary arrest. These patients had multiple comorbidities including diabetes mellitus, renal disorders,

Table 4 Details of complications reported in the study

Complications	
Intra-operative complications	
1. Sudden fall in blood pressure (SBP > 20 mm Hg)	24
2. Sudden fall in oxygen saturation (< 92%)	16
Post-operative complications	
1. DVT	3
2. PJI	1
3. Superficial wound infection	2
4. Urinary tract infection	5
5. Pulmonary complications	4
6. Cardiac complications	4
7. Limb length discrepancy	8

Table 3 Details of the implant utilised in the study

	Stem sizes				Outer shell/femoral head (size) (No. of patients: femoral head offset)					
	Size 1	Size 2	Size 3	Size 4	Size 39/22 mm	Size 41/22 mm	Size 43/22 mm	Size 45/28 mm	Size 47/28 mm	Size 49/28 mm
Patient no.	4	12	18	3	5: + 0.0	5: + 0.03: + 4	7: + 0.02: + 4	5: + 0.01: + 4	5: + 0.01: + 4	3: + 4

hypertension, cardiac disorders and hypothyroidism in different combinations.

The mean follow–up was 26.2 months (24–40 months) with the average HHS at 2 year being 77.2 (70–83).

Discussions

Intertrochanter femur fracture in the elderly population is referred to as end-of-life fracture due to the morbidity and mortality associated with it [6]. Elderly patients have severe osteoporosis and poor muscle bulk leading to comminuted fractures. The goals of intertrochanteric fractures surgery in elderly patients are to provide stable bony fixation with fewer complications leading to early mobilisation, pain relief, and prevention of prolonged bedridden complications like pneumonia, DVT, pulmonary embolism, etc. [7]. Treatment options for intertrochanteric fracture presently include osteosynthesis using proximal femur nail with or without trochanteric plates, Enders nail, dynamic hip screw with plates, and prosthesis replacement using hemiarthroplasty or total hip replacement [8]. In spite of extensive research on this topic, the ideal treatment for intertrochanteric fracture is still a topic of debate [9]. Nowadays many surgeons are keeping arthroplasty as the first treatment option in unstable intertrochanteric fractures due to higher failure rate and prolonged rehabilitation period of osteosynthesis [9, 10]. Due to fear of fixation failure early full weight-bearing mobilisation is not permitted, especially in osteoporotic bones in elderly patients.

In unstable fractures, proximal femur nailing is the preferred choice of implant for osteosynthesis [11, 12]. It is a minimally invasive procedure, however, reduction before the nailing remains the utmost important step of the surgery. Osteosynthesis came a long way in the last two decades, even now the newer generations of nails, and augmentation plates are getting used. However, despite advancements in implants, the results of osteosynthesis are still far from perfect [13, 14]. Reported implant failure rates are as high as 56% [15]. Therefore, the management of these unstable trochanteric fractures is still an unsolved mystery. Various complications associated with osteosynthesis includes malreduction, excessive varus collapse, cut-out of lag screws, iatrogenic fractures and delayed rehabilitation [16]. Previous literature reported a failure rate between 7.1 and 12.5% for PFNA in treating intertrochanter femur fracture [17, 18]. Still, it is the favoured surgical approach as it is less invasive, minimal blood loss, reduced surgical time, and less chances of cardiac event or pulmonary embolism. All these lead to less chances of dreaded post-operative complications.

Hip arthroplasty is a proposed alternative option, it gives stability and allows immediate/early weight bearing [19–21]. Many complications of fracture fixations like coxa vara, non-union, mal-union, and fixation failure can be avoided with hemiarthroplasty. However, there are some concerns regarding hip arthroplasty in elderly osteoporotic patients like longer surgical time, more blood loss, larger incisions, and risk of bone cement syndrome. All these factors increase the intra-operative risk of cardiac and pulmonary events in these elderly patients, already had compromised cardiac or pulmonary functions. Other post-operative risks of arthroplasty included non-union of greater trochanter, dislocation, periprosthetic fracture, aseptic loosing and infection. In the present study, it was observed that 90.3% of patients had either intra-operative or post-operative complications. These events can be life-threatening and led to increased morbidity.

Blood loss and surgical time of the surgery are important factors affecting the mortality and morbidity in such elderly patients. In present study, mean blood loss was approximately 126 mL and mean surgical time was 58 min. There is vast variation in the literature regarding these factors. Venkataraman et al. [22] depicted significant less blood loss and surgical time in PFNA group as compared to bipolar hemiarthroplasty group. The data reported in a meta-analysis by Kumar et al. emphasised enough the beneficial effect of lesser surgical time and blood loss in PFNA group than hemiarthroplasty group. Similar finding was reported by various authors depicting bipolar hemiarthroplasty is more time-consuming and associated with more blood loss as compared to intramedullary nailing or dynamic hip screw [23]. Though there are few reports depicting the less blood loss and surgical time [24]. Overall these results suggested that hemiarthroplasty should be used with cautions in patients who cannot tolerate major blood loss or long surgery time.

The mean hospital stay in present study was 5.4 days and mean time to full weight bearing was 2.8 days. These results corroborated with the previous study depicting shorter hospital stay in PFNA group as compared to hemiarthroplasty group [25]. Early ambulation in one of the goals of surgery in such elderly patients. Early mobilisation is well known to reduce the chances of DVT, pressure sores, and pulmonary infection. Compare to osteosynthesis, hemiarthroplasty has distinct advantage of early full weight-bearing gait [26]. This is further supported by higher HHS scores in the initial 3 months of the surgery but at later follow-up there was no significant difference [27] or PFNA group had higher HHS score [28] as compared to hemiarthroplasty group. Few literature depicts higher post-operative medical complications rate in hemiarthroplasty group even with patients mobilising early [27]. The root-cause has being pointed out as massive intra-operative blood loss, higher perioperative blood transfusion rate and invasiveness of the surgery on the fragile body of the elderly population. Even after hemiarthroplasty only 75–88% of the patients could be successfully ambulated [29].

In present study, Haris hip score at one year was 77.2. The meta-analysis by Wang et al. reported that although arthroplasty is associated with early recovery but long terms results are more favourable with osteosynthesis [30]. Park et al. observed that although scores are comparable at 12 months, but at 24 months scores are better with intramedullary nailing as compared to hemiarthroplasty [31]. Overall, it seems that PFNA group may achieve better functional results in middle-to-long term follow-up as compared to hemiarthroplasty group [32]. Further long-term randomised control studies are required to ascertain this.

Six patients out of 37 patients (16%) died within 1-year of the surgery in this study. Some of the previous studies reported that the mortality rate was higher with hemi arthroplasty [33, 34], whereas some studies observed a similar mortality rate as compared to osteosynthesis [35]. Golge et al. observed that 3 years mortality is 5 times higher with hemiarthroplasty as compared to PFN [36]. Tang et al. concluded PFNA had a significant superiority over hemiarthroplasty regarding post-operative mortality [37]. Yalkin et al. observed that presence of 3 or more comorbidities associated with higher 1-year mortality [38], whereas few published literature depicted no increase in mortality rate [35, 39]. There is no literature evidence depicting less mortality in hemiarthroplasty group compared to PFNA group. The blame is given to the higher perioperative surgical trauma incurred during the bipolar hemiarthroplasty surgery in such elderly population.

Bipolar hemiarthroplasty patients rarely presented with implant related problems in our study. Only one patient got infected and revised later. Even at 2-years follow-up there was no complications of aseptic loosing, periprosthetic fractures, dislocations or persistent pain. This seems to a very beneficial factor in favour of bipolar hemiarthroplasty group decreasing reoperation or implant failures in such elderly patients.

The present study has several limitations. The sample size of the study population is small with no comparison group as it was retrospective study with only referred patients were included in the study. Rest of the patients in our hospital were managed by trauma unit with osteosynthesis. It was impossible to analyse the preoperative mobility status of these elderly patients. Follow-up time was limited to report the long-term complications related to the implant or mortality rates.

Conclusions

The use of bipolar hemiarthroplasty in senile patient with unstable intertrochanter femur fracture gives an advantage of early weight bearing. However, in patients with underlying comorbities affecting the ASA grade or cardiopulmonary functional status, this should be used with caution. The surgeon should manage these comorbidities well before embarking on the hemiarthroplasty surgery. Although hemiarthroplasty can be a single-time solution to the complexities of intertrochanter fracture in elderly patients but should be performed in well medically managed patients. Although osteosynthesis is still the treatment of choice in senile intertrochanter femur patients but hemiarthroplasty provides a good alternative option. Hemiarthroplasty in intertorchanter femur fracture is a boon for senile patients and bane for few patients with multiple comorbidities.

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Declarations

Conflict of interest Authors have no conflict of interest.

Ethical approval Institutional ethical committee approval was received for this study. The procedure performed in the study was in accordance with ethical standard of institute.

Informed consent Written and informed consent was received from all the authors.

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