

## Original Research Article

# Primary bipolar replacement arthroplasty versus internal fixation in the management of unstable intertrochanteric fractures in the elderly

Abhishek Bansal<sup>1</sup>, Rajendra Kumar Beniwal<sup>2\*</sup>, Saumya Agarwal<sup>2</sup>

<sup>1</sup>Department of Orthopaedic Surgery, Max Superspeciality Hospital, Vaishali, Ghaziabad, Uttar Pradesh, India

<sup>2</sup>Department of Orthopaedics, Central Institute of Orthopaedics, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India

**Received:** 07 September 2019

**Revised:** 16 November 2019

**Accepted:** 23 November 2019

**\*Correspondence:**

Dr. Rajendra Kumar Beniwal,  
E-mail: [drkbeniwal@gmail.com](mailto:drkbeniwal@gmail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

**Background:** Management of unstable intertrochanteric femur fracture in the elderly has been always a matter of debate. There has been always a dilemma between osteosynthesis and prosthesis.

**Methods:** We retrospectively evaluated, 108 osteoporotic elderly patients with unstable intertrochanteric for internal fixation versus primary bipolar replacement arthroplasty in a span of 4 years.

**Results:** Bipolar replacement arthroplasty gives better outcome as compared to internal fixation with sliding hip screw.

**Conclusions:** It was found that cemented bipolar arthroplasty is the choice in freely mobile elderly osteoporotic comminuted displaced intertrochanteric fracture, though is a surgically demanding technique, it spares the postoperative complication of non-weight bearing after internal fixation of these fracture. The internal fixation is also compounded by osteoporosis, medical illness, difficulty to achieve and maintain reduction of comminuted and widely displaced unstable fractures, which restricts the mobilization and weight bearing and further increase the risk of morbidity and mortality in elderly in comparison to cemented bipolar replacement arthroplasty which allows early mobilization and weight bearing.

**Keywords:** Osteoporosis, Unstable intertrochanteric fractures, Bipolar replacement arthroplasty, Internal fixation

### INTRODUCTION

Fractures of the proximal femur are relatively common in elderly individuals and occur as a result of only moderate or minimal trauma and are more common in women than in men with a ratio of 3:1.<sup>1,2</sup> The treatment of unstable, comminuted intertrochanteric fractures of the hip in the elderly is a difficult surgical problem and over the years there have been many protocols developed to deal with difficult comminuted fractures.<sup>3,4</sup> Non operative treatment methods have largely been abandoned after Horowitz et al reported a mortality rate of 34.6% for

trochanteric fractures treated by traction and 17.5% for those treated by internal fixation.<sup>2</sup> In elderly patients with osteoporosis and complex intertrochanteric fractures, the technique of internal fixation using sliding compression hip screws with side plate assembly does not allow for unrestricted weight bearing with a reported rate of failure between 5% and 12%. Excessive collapse, loss of fixation and cut-out of the lag screw resulting in poor function remains an issue. To allow earlier postoperative weight bearing and to avoid excessive collapse at the fracture site, some surgeons have recommended prosthetic replacement for the treatment of unstable intertrochanteric fractures.<sup>5,6</sup> The purpose of this

retrospective study was to evaluate the functional and clinical outcomes of cemented bipolar arthroplasty as a primary treatment for unstable intertrochanteric fracture in the elderly patient compared to internal fixation using a sliding or dynamic hip screw.

## METHODS

Between April 2014 and March 2018, 108 patients admitted to Safdarjung Hospital, New Delhi, India with the diagnosis of unstable intertrochanteric fractures were evaluated retrospectively. The patients included in the study were above 65 years and all were independently mobile before sustaining the fracture. Seventy patients were walking independently without support while rest of them required an aid like a cane or a walking stick. Detailed clinical and radiological examination was carried out. Routine antero-posterior and lateral X-rays of pelvis with both the hip joints and thighs were taken. Fractures were classified on the basis of Tronzo's classification and those with type IIIb, IV, and V were chosen as a study group. All the chosen patients were explained regarding the nature of study and an informed consent was obtained. All the patients were allocated into one of the two groups based on random number tables - group A [Artificial Bipolar Femoral Head (ABFH) group] and group B [Internal fixation (IF) group]. This allocation was done in the operation theatre to avoid any discrepancy. Exclusion criteria included patients unable to walk before the fracture, patients less than sixty five years old, patients with pathological fractures, patients with preexisting hip pathologies, patients with associated fractures that might significantly affect the final functional outcome, patients with psychiatric disorders, and patients with stable fractures and intact lesser trochanters. Detailed attention was paid to all medical aspects, specifically to the systemic review, which included detailed lab studies and pre-anaesthetic check-up for anaesthesia management and proper rehabilitation program. Pre-operative data included: age, sex, fracture type, and pre-operative co-morbid medical problems. Peri-operative data included type of anaesthesia, operative time, amount of blood loss, number of units of blood transfused, and duration of hospital stay. Postoperative data included Harris Hip Scores, time to full weight bearing, postoperative complications such as pulmonary problems, urinary tract infection, deep vein thrombosis, cardiac problems, infection (superficial and deep), pressure sores, fixation failure, prosthetic dislocation, and mortality. Surgery was performed by the principal investigator in all the cases along with the same surgical team under spinal or general anaesthesia.

In the ABFH group, Charnley components were used with 28 mm head and a self-centering femoral cup. Surgery was performed using a standard posterior approach in lateral decubitus position. The femoral head and neck were osteotomised at a level determined by preoperative templating of the uninjured side. In 21 cases,

the lesser trochanter was in continuity with the neck of the femur and was reconstructed with the shaft and greater trochanter using non-absorbable sutures. A neck cut was then taken roughly about 1–2 cm above the lesser trochanter depending upon the amount of comminution. At times, the lesser trochanter was found as a separate fragment where it was difficult to reconstruct the calcar. In these cases, the lesser trochanter and the greater trochanter were fixed to the shaft using non-absorbable sutures; however, most of the portion of the neck had to be sacrificed. In five cases where the lesser trochanter was comminuted, the trochanter pieces were left attached to the soft tissue and the medial defect was reconstructed using a cement mantle. In 19 cases, the greater trochanter was the fracture en masse and was reattached to the main shaft using non-absorbable sutures. In 9 cases where the greater trochanter was coronally split a tension band was applied beneath the gluteus medius tendon and a bony tunnel was drilled in the distal greater trochanter. In 7 cases, the greater trochanter was found to be severely comminuted; here ethibond sutures were used to suture together the trochanter pieces and the soft tissue to make a stable construct. The gluteus medius, greater trochanter, and the vastus lateralis apparatus were maintained in continuity as a stable lateral sleeve. This was then fixed loosely to the shaft fragment with ethibond sutures. In cases where both greater and lesser trochanters were comminuted (n=2), they were both segregated together with the ethibond sutures to form separate masses and were reattached to the shaft after the insertion of a cemented femoral stem. Thus at the end of reconstruction, the greater trochanter, the lesser trochanter, and the shaft were wired together using non-absorbable sutures in 32 cases while only ethibond sutures were used in five cases which were severely comminuted. The femoral medullary canal was broached with appropriate anteversion to appropriate stem size and diameter. Trial reductions were performed and with the trial prosthesis in-situ, traction was applied to the leg and compared with the opposite leg for limb length equality. After confirming the leg length the final implant was inserted into the femur and joint was reduced. Traction was then applied with final implant in-situ to achieve the desired limb length by comparing with the opposite limb on table. Applied traction causes the femur to be pulled distally and, a note of distraction between the prosthesis and the femoral cut was made and the level on the prosthesis was marked. This gives an idea of how much the femur implant should sink into the proximal femur so as to achieve limb length at the time of final cementing of the implant. This ensured careful restoration of neck length, offset and version to maximize stability of the hip joint. During the final fixation of the stem, the cemented stem was allowed to sink in the femoral canal up to the mark made on the prosthesis in previous step and for the remaining portion a cement mantle was made so that the final limb length was equalized. Once the prosthesis was fixed, the broken trochanter and calcar were again retightened by tensioning the sutures. The sleeve of

gluteus medius, greater trochanter and vastus medialis if reconstructed was now reattached to the shaft by additional sutures. Any protrusion of cement between the reduced bone fragments was cleaned out. The short external rotators were then sutured back using bone tunnels in the greater trochanter with the closure of the superficial layers, as routine after achieving meticulous hemostasis. No drains were used.

In the internal fixation group, the operations were performed on an orthopaedic fracture table, with the patient lying supine. Biplane fluoroscopy was routinely used. The aim of closed reduction was to obtain an optimum position, with a correct angle between the femoral neck and shaft or a slight valgus position. Distraction of the fragments, varus position, or lateral displacement of the shaft was carefully avoided. The proximal part of the femur was exposed through a lateral approach with splitting of the vastus lateralis muscle, and dynamic hip screw was inserted. Injectable bone graft was used in all the cases. The wound was closed in layers after achieving meticulous hemostasis. The use of prophylactic antibiotics was the same in both the groups at the time of induction of anaesthesia as well as in post-operative period. Painkillers were given as needed. Quadriceps femoris muscle strengthening exercises were started from day one of both the groups. Patients in the ABFH group were ambulated full weight bearing on the first postoperative day with the aid of physiotherapist. Patients in the internal fixation group were ambulated non-weight bearing on the first postoperative day and gradually progressed to partial then full weight bearing depending on the quality of bone fixation assessed intraoperatively and bone healing on follow up radiographs. After discharge from hospital, patients in both groups were followed at one and six weeks, at three, six and twelve months; and yearly thereafter for radiological and functional evaluation using the Harris Hip score at each visit. The Harris hip scores<sup>7</sup> at each follow-up visit were classified into four categories: excellent (90 to 100), good (80-89), fair (70-79) and poor (60-69). The level of pain in the groin and thigh after surgery was divided into 3 grades: mild, moderate, and severe. The changes in walking ability from before to after surgery were investigated.

Antero-posterior and lateral radiographs of the affected hip were made post-operatively and at each follow-up visit. The initial fixation of the femoral stem was assessed in the proximal and isthmus areas on the radiograph taken immediately after the surgery. The reduction of the fracture was considered anatomical (<50 of varus or valgus and/or anteversion or retroversion), acceptable (50 to 100), or poor (>100).<sup>8</sup> The changes in the alignment and subsidence of the femoral components were measured from after surgery to the last follow up; >30 of varus or valgus change, >3 mm progressive longitudinal subsidence, and a continuous radiolucent line progressive or wider than 2 mm at the bone-cement interface in all

zones were considered signs of unstable stem. The radiolucent line, bone resorption and osteolysis were examined in the 7 zones described by Gruen et al.<sup>9</sup> A radiolucent line denoted the radiolucent area around the stem surrounded by radio dense lines, and was considered present if it occupied >50% of any zone. Any erosion of the acetabular cartilage with horizontal or vertical migration of the bipolar cup of >2 mm was documented.

Statistically t-test was used to assess significant difference among all numerical parameters of the study within the two surgical groups. Whereas, Fisher's exact test was used for statistical analysis among all studied categorical variables such as gender, pre-morbid conditions and postoperative complications. P value <0.05 were considered statistically significant.

## RESULTS

108 patients were enrolled in this study (Table 1). All have unilateral intertrochanteric fracture of the hip after falling from standing position to ground level. The mean operating time and intraoperative blood loss was higher in the internal fixation group. The mean blood transfusions required and average length of stay in hospital was greater in the internal fixation group (Table 2). Patients who underwent internal fixation had more post-operative complications than those having bipolar arthroplasty such as pressure sore, pulmonary complications, cardiac complications, superficial wound infection. No significant difference was noted between the two groups as regards the occurrence of urinary tract infection and deep vein thrombosis (Table 3). In 2 years of follow up, there was single mortality in bipolar arthroplasty group and 2 mortalities in internal fixation group.

The radio-clinical analysis in surviving patients showed that in the internal fixation group 11 patients had unsatisfactory results: 4 patients had shortening of the limb with marked limitation in range of motion (bony collapse along fracture line in 2 cases, migration of the femoral head into varus and retroversion in 2 cases), 2 patients had the lag screw cutting out from the femur head and underwent salvage hip arthroplasty, 2 patients were unable to walk due to generalized weakness, 2 patients had marked limping, and 1 patient had marked pain. In the hemiarthroplasty group, the radio-clinical results of 4 patients were considered unsatisfactory: 1 patient had restriction in the range of movement of the affected limb, 1 patient had leg length discrepancy (15 mm), 1 patient was unable to ambulate due to generalized weakness, 1 patient had moderate pain and limping associated with non-union of the greater trochanter. There was no dislocation, no signs of femoral instability, or acetabular erosion with cup migration.

The Harris Hip score after 3 months follow up was significantly higher in patients who underwent bipolar

arthroplasty compared to those in the internal fixation group. The time (days) to independent full weight bearing and return to the pre-fracture level of daily activity was

significantly earlier in patients who underwent bipolar arthroplasty compared to those in the internal fixation group (Table 4).

**Table 1: Demographic and pre-operative data.**

Parameters	Hemiarthroplasty group	Internal fixation group	P value
<b>Number</b>	56	52	
<b>Age (years) (%)</b>	76.26 (6.91)	75.73 (6.79)	0.68
<b>Sex (F:M)</b>	36:20	32:20	0.843
<b>Tronzo fracture type (no. of patients)</b>			
IIIb	19	18	0.976
IV	19	18	
V	18	16	
<b>Medical illness (no. of patients)</b>			
Cardiovascular disease	25	28	0.441
Diabetes	38	40	0.390
Neurological disease	20	18	1.000
Hypertension	13	12	1.000
Pulmonary disease	5	5	1.000
Chronic renal failure	2	3	0.670

\*Values are expressed as mean and (standard deviation) unless otherwise stated. P value <0.05 was considered significant.

**Table 2: Intra operative data.**

Parameters	Hemiarthroplasty group	Internal fixation group	P value
<b>Number</b>	56	52	
<b>Type of anaesthesia</b>			
Block	47	43	1.000
General	9	9	
<b>Operative time (min) (%)</b>	111.91 (12.87)	146 (16.21)	<0.0001
<b>Amount of blood loss (ml) (%)</b>	192.60 (28.88)	266.88 (61.89)	<0.0001
<b>Blood transfusions (units) (%)</b>	0.91 (0.64)	1.58 (0.97)	<0.0001
<b>Duration of hospital stay (days) (%)</b>	6.05 (1.05)	7.52 (1.36)	<0.0001

\*Values are expressed as mean and (standard deviation) unless otherwise stated. P value <0.05 was considered significant.

**Table 3: Post-operative complications.**

Parameters	Hemiarthroplasty group	Internal fixation group	P value
<b>Mortality rate</b>	0	1	
<b>During hospital stay</b>			
<6 weeks	0	0	1.000
6-24 months	1	1	
<b>Pulmonary complications (%)</b>	7 (12.5)	14 (26.92)	0.874
<b>Urinary tract infections (%)</b>	6 (10.71)	6 (11.54)	1.000
<b>Deep vein thrombosis (%)</b>	3 (5.36)	3 (5.77)	1.000
<b>Cardiovascular complications (%)</b>	2 (3.57)	5 (9.62)	0.258
<b>Prosthetic/fixation failure (%)</b>	0 (0)	2 (3.85)	0.229
<b>Wound infection (%)</b>			
Superficial	0 (0)	5 (9.62)	0.001
Deep	0 (0)	0 (0)	
Pressure sores	3 (5.36)	15 (28.85)	

\* Values are expressed as mean and (standard deviation) unless otherwise stated. P value <0.05 was considered significant.

**Table 4: Functional outcome.**

Parameters	Hemiarthroplasty group	Internal fixation group	P value
<b>Follow up period (months) (%)</b>	24.62 (13.19)	19.88 (14.51)	0.08
<b>Time to full weight bearing (days) (%)</b>	8.98 (2.76)	67.96 (10.59)	<0.0001
<b>Harris Hip score (100) (%)</b>			<0.0001
3 months post-operative HHS	76.15 (6.11)	64.89 (5.66)	
12 months post-operative HHS	80.35 (4.98)	68.17 (5.22)	<0.0001
24 months post-operative HHS	82.76 (4.78)	70.91 (5.25)	
<b>Harris pain score at 24 months (44) (%)</b>	43.71 (1.04)	40.95 (5.34)	0.002
<b>Return to normal daily activities (days) (%)</b>	33.62 (2.78)	54.3 (6.29)	<0.0001
<b>Complete bony union (weeks) (%)</b>	19 (1.87)	19.23 (1.73)	0.51

\* Values are expressed as mean and (standard deviation) unless otherwise stated. P value <0.05 was considered significant.

## DISCUSSION

Unstable intertrochanteric fractures in elderly patients with osteoporosis are characterized by severe comminution and unsatisfactory surgical outcome is common in such patients, medical illness, osteoporosis, and fracture instability being the contributing factors.

Maintenance of reduction is a major problem during the healing period and to reduce the healing time dynamic devices such as sliding hip screw have replaced the static ones.<sup>10</sup> Furthermore, partial weight bearing creates a micro movement in the dynamic systems which increases union rate. Implant cutout is the main complication in dynamic devices and hence central positioning of the screw in the femoral neck has been recommended, which yields cutout rate of about 13%.<sup>11</sup> The cutout rate in our study was 19.6% (n=10). This is comparable to the incidence of internal fixation failures in other studies ranging from 10% to 30%. Therefore, treatment with primary bipolar arthroplasty rather than internal fixation could return these patients to their pre-injury level of activity more quickly, thus obviating the post-operative complications caused by immobilization or failure of the implant.<sup>12</sup>

A lot of surgeons have published their work on arthroplasty for treatment of unstable trochanteric fractures in the elderly in order to decrease complications: Stern and Angerman reported 94% good and excellent result after a mean follow up period of 8 months.<sup>12</sup> Haentjen et al compared the clinical results of internal fixation and bipolar arthroplasty for unstable trochanteric fractures and reported 75% satisfactory result and less post-operative complications in the latter group.<sup>13</sup> They insisted that early weight bearing was the major factor responsible for decreasing post-operative complications.

In this study, the results of the hemiarthroplasty group were significantly better than those of the internal fixation group regarding operative time, blood loss, peri-operative blood transfusion and hospital stay.

The rate of deep infection and dislocation rate in both groups in our study was zero. The large diameter of the head and self-centering cup that was used in the bipolar arthroplasty might explain the decreased tendency to dislocate.<sup>14</sup> To establish a proper limb length, the center of the prosthetic head was adjusted to be in line with the tip of the anatomically repositioned greater trochanter.<sup>15</sup>

In current study one case of non-union along the greater trochanter attachment was encountered in the hemiarthroplasty group. However, the patient could walk inspite of mild to moderate hip pain and lurching gait. This was possibly because of the low functional demand. Similar results were reported by Green et al who had two painful hips in their series due to trochanteric non-union and also by Chan and Gill who had one case of greater trochanteric non-union.<sup>15,16</sup> None of these patients required reoperation. Stern and Angerman reported that all the hips were stable after hemiarthroplasty regardless of whether the greater trochanter was anatomically reduced or just sutured near the prosthesis.<sup>12</sup>

The present study also showed that the cemented mantle used to fix the prosthesis in the femoral shaft was possibly able to transmit the stresses of weight bearing directly to the femoral diaphysis bypassing the posteromedial area of the proximal femur. In addition, calcar reconstruction had the potential advantage of improved trochanteric healing, restoration of bone stock, re-establishment of proper limb length and reduced implant cost. This mechanism was properly efficient for elderly patients with low functional demands.<sup>16</sup>

The Harris Hip score was significantly better in the hemiarthroplasty group than in the internal fixation group at all follow-up visits. At 2 years follow-up the hemiarthroplasty group results were regarded as "good" and in the internal fixation group as "fair" using the Harris Hip Score. One retrospective study by Andreas HJ et al demonstrated a higher rate of morbidity and mortality among the hemiarthroplasty group.<sup>17</sup> This may be explained by the longer operative time and hospital stay along with a delay in the mobilization of the patient.

## CONCLUSION

According to the results, we believe that cemented bipolar arthroplasty is of choice in freely mobile elderly patients above sixty-five years of age with an intertrochanteric femoral fracture. Postoperative full weight bearing after hemiarthroplasty spares the postoperative complications of non-weight bearing after internal fixation. This also reflects on the functional outcome if the patient survives after the first year postoperatively. Yet hemiarthroplasty in these cases is a surgically demanding technique. Bad surgical technique may lead to prolonged operative time, high incidence of deep infection, dislocation, and a poor radiological and functional outcome.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the institutional ethics committee*

## REFERENCES

1. Jensen JS. Trochanteric fractures. An Epidemiological, Clinical and Biomechanical Study. *Acta Orthop Scand.* 1981;188:11-9.
2. Horowitz BG. Retrospective analysis of hip fractures. *Surg Gynecol Obstet.* 1966;123:565.
3. Claes H, Broos P, Stappaerts K. Pertrochanteric Fractures in Elderly Patients: Treatment with Ender's Nails, Blade-Plate, or Endoprosthesis? *Injury.* 1985;16:261-4.
4. Cobelli NJ, Sadler AH. Ender Rod versus Compression Screw Fixation of Hip Fractures. *Clin Orthop.* 1985;201:123-9.
5. Broos PL, Rommens PM, Geens VR, Stappaerts KH. Pertrochanteric fractures in the elderly. Is the Belgian VDP prosthesis the best treatment for unstable fractures with severe comminution? *Acta Chir Belg.* 1991;91:242:9.
6. Harwin SF, Stern RE, Kulick RG. Primary Bateman-Leinbach bipolar prosthetic replacement of the hip in the treatment of unstable intertrochanteric fractures in the elderly. *Orthopaedics.* 1990;13:1131-6.
7. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end result study using a new method of result evaluation. *J Bone Joint Surg Am.* 1969;51(4):737-55.
8. Schipper IB, Steyerberg EW, Castelein RM, van der Heijden FH, den Hoed PT, Kerver AJ, et al. Treatment of unstable trochanteric fractures. Randomized comparison of the gamma nail and the proximal femoral nail. *J Bone Joint Surg Br.* 2004;86:86-94.
9. Gruen TA, McNeice GM, Amstutz HC. "Modes of failure" of cemented stem-type femoral components: a radiographic analysis of loosening. *Clin Orthop Relat Res.* 1979;141:17-27.
10. Sinno K, Sakar M, Jirard J et al. The effectiveness of primary bipolar arthroplasty in treatment of unstable intertrochanteric fractures in elderly patients. *North Am J Med Sci.* 2010;2(12):561-8.
11. Charnley J. Low Friction Principle, and Clean Air-Operating Theory. In *Low Friction Arthroplasty of the Hip. Theory and Practice.* New York, Springer; 1979: 3-15, 152-168.
12. Stern MB, Angerman ALEX. Comminuted intertrochanteric fractures treated with Leinbach prosthesis. *Clin Orthop.* 1987;218:75-80.
13. Haentjen P, Lamraski G. Endoprosthetic replacement of unstable, comminuted intertrochanteric fracture of the femur in the elderly, osteoporotic patient: a review. *Disabil Rehabil.* 2005;27(18-19):1167-80.
14. Kim S, Kim Y, Hwang J. Cementless calcar-replacement hemiarthroplasty compared with intramedullary fixation of unstable intertrochanteric fractures. *J Bone Joint Surg Am.* 2005;87:2186-92.
15. Chan KC, Gill GS. Cemented hemiarthroplasties for elderly patients with intertrochanteric fractures. *Clin Orthop.* 2000;371:206-15.
16. Green S, Moore T, Proano F. Bipolar prosthetic replacement for the management of unstable intertrochanteric hip fractures in the elderly. *Clin Orthop Relat Res.* 1987;224:169-77.
17. Andess HJ, Kahl S, Kranz C, Gierer P, Schürmann M, Lob G. Clinical and finite element analysis of a modular femoral prosthesis consisting of a head and stem component in the treatment of pertrochanteric fractures. *J Orthop Trauma.* 2000;14:546-53.

**Cite this article as:** Bansal A, Beniwal RK, Agarwal S. Primary bipolar replacement arthroplasty versus internal fixation in the management of unstable intertrochanteric fractures in the elderly. *Int J Res Orthop* 2020;6:111-6.