Bipolar Hemiarthroplasty by Using Cemented Calcar Replacement Stem for Unstable Inter-trochanteric Fractures in Old Age

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Abstract

Background: Internal fixation of unstable inter-trochanteric is challenging and most of the morbidity is associated with prolonged immobilization and implant cut outs. Aim of this study is to evaluate clinical outcomes of bipolar hemiarthroplasty in old age patients with unstable inter-trochanteric fractures by using cemented calcar replacement stem.

Methods: 80 hips of inter-trochanteric fractures (AO/OTA type 31-A2.2 and 31-A2.3) in 80 patients, 49 females and 31 male patients from Aug 2016 to Sept 2019. All the patients were operated by posterolateral approach, and hemi-replacement done using cemented modular calcar replacement stem, greater trochanter also reconstructed in all the patients. Patients were followed at 6 wks, 3 months, 6 months and 1 year. Primary outcome included Harris hip score and secondary outcome includes functional walking ability (kovals), thigh pain, dislocation, trendelenberg test and infection, mortality.

Results: No dislocation, No e/o infection, only two patients complained of anterior thigh pain. One patient developed pulmonary embolism treated and recovered, limb length discrepancy seen in 4 patients (lengthening 4, no shortening) range 0-20 mm, Perioperative mortality during hospitalization is seen in two patients due to cardiac complications. 5 patients died from discharge to within one year. 3 patients lost to follow up. Fifty five patients (78.57%) regained preinjury ambulation status at final follow up. At final follow up, Average Harris hip score (HSS) was 80 (Range 70 to 95) , poor (<70)-3, fair(70-79)-12, Good (80-89)-50, Excellent (90-100)-5.

Conclusion: Hemiarthroplasty using calcar replacement stem in unstable inter-trochanteric fracture in old age patients helps in early mobilization of patients and early regaining of preinjury ambulation status.

keyword: Unstable inter-tochanteric fracture; Cemented bipolar; Calcar stem bipolar.

Level of evidence: Therapeutic level II

Introduction

Inter-trochanteric fracture is one of the most common fracture encountered in orthopedic practice, most of these are low velocity trauma with underlying osteoporosis. Though osteosynthesis is the treatment of choice for inter-trochanteric fractures, stable fracture though has reliable prognosis, unstable I.T. fracture has increased risk of fixation failure [2], has delayed weight bearing and morbidity and mortality associated with it. Endoprosthetic replacements has been used to facilitate early ambulation of patients. Many cementless as well as cemented options have been used for hemi-arthroplasty in such patients. Purpose of this study is to evaluate clinical outcomes of unstable inter-trochanteric fractures treated with cemented calcar replacement stem.

Material and methods

The study was cleared by ethical committee of the institution. Informed written consent was taken from all cases. The study 80 hips of inter-trochanteric fractures (AO/OTA type 31-A2.2 and 31-A2.3) in 80 patients, 49 females and 31 male patients from Aug 2011 to Sept 2019. All patients were above 70 years of age. Mean age at time of surgery was 76 years (Range 70 to 106 years). All patients had radiological osteoporosis. Two patients died in perioperative period and both were having co morbid conditions. Five patients died from discharge to within a year. Three patients lost to follow up. Average follow up period was 2.5 years. Final study included of 70 patients.

All the procedures are carried out by using RCH calcar replacement stem. (Figure 1)

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Inclusion criteria

- Unstable inter-tochanteric fracture (AO/OTA type 31-A2.2 and 31-A2.3)
- Old age (more than 70 years)
- Comminuted fracture
- Severe osteoporosis/wide medullary cavity
- Obese pt
- Neglected/old I.T. #
- History of failure of internal fixation in opposite hip

Exclusion criteria are

- Age less than 70 years
- Stable fractures
- Patients unable to walk before fractures

Preoperative preparation: All necessary laboratory investigations done, cardiological evaluation done, DVT prophylaxis started on admission and risk assessment done.

Figure 1: Calcar replacement stem

Procedure

All the procedures done by same surgeon under spinal anesthesia, all necessary precautions taken to prevent hypotension after anesthesia. In a lateral position hip is exposed with posterolateral incision, gluteus maximus retracted with self retaining retractors. At this stage it is very important to assess fracture geometry of greater trochanter which helps in deciding approach to femoral head. Greater trochanter can be a single large fragment, comminuted, # at tip or it may be coronally split.

By putting a retractor at proximal femur vastus lateralis is retracted and fracture site is exposed, fracture haematoma may come out at this stage which is drained out. For stability of hip after implantation, it is very important to keep maximum soft tissue attachments to greater trochanter. So for approaching femoral head we may have to retract greater trochanter either superiorly or anteriorly or posteriorly depending upon fracture geometry of GT, so accessing femoral head through I.T. fracture site is most crucial for success of procedure. Once femoral neck is exposed a judet head extractor is passed into head assessing orientation of femoral head and once it holds the head, by rotating it, circumferential capsular attachment is released very flush to neck of femur, and head is delivered out of acetabulum from inferior part of acetabulum, size of femoral head is confirmed and acetabular cartilage is asssed with finger.

Now femoral shaft is exposed by rotating leg 90 degrees, medullary cavity prepared. A trial stem insertion of calcar replacement stem is done and its implant size selected. Sometimes we may need to remove anteromedial spike of proximal part of shaft of femur if it hampers stem insertion to desired level.

Restoration of limb length

Most important thing in bipolar in I.T. fractures is restoration of limb length. As this is a modular system length is determined by (1) stem insertion and (2) selection of neck length, as implant is modular. Also as amount of bone loss proximally is variable in I.T. fractures, some higher (long/extra long) neck lengths should be ready on table.

As intact lesser trochanter is not available in I.T. fractures various landmarks are used to decide level of stem insertion. Our Target stem insertion is to such a level that, shoulder of stem should approximately come to midpoint of distance between GT tip & vastus lateralis ridge (In anatomical position). Landmarks along lateral column of femur can now be used as a reference for length adjustment as tip of GT in reduced position, vastus lateralis ridge, flare of GT, or superior border of gluteus maximus insertion. In highly comminuted fractures, when there are no bony landmarks, superior border of gluteus maximus insertion which is usually preserved can approximately give us idea about Where level of vastus lateralis ridge should supposed to be (Figure 2). Normal distance between vastus lateralis ridge and upper border of insertion gluteus maximus is between 35 to 40 mm.

Trial reductions is also helpful in deciding length, after trial reductions, On table allis-galleazi test is done by comparing level of both tibial tuberosities in 90 degree knee flexion and both ankles are at same level.

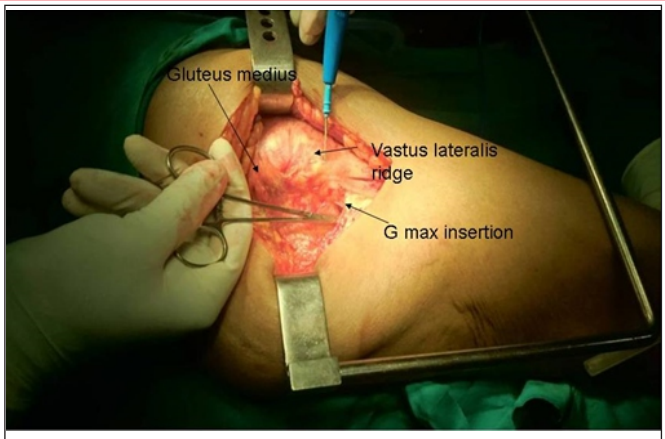

Figure 2: Normal relation between upper border of gluteus maximus insertion and vastus lateralis ridge, and greater trocahanteric tip

Soft tissue tension (schuk test) is not a reliable indicator of length in such cases due to avulsion of GT.

Preparation of femur

Two drill holes are made in lateral part of proximal femur, both ends of a stainless steel wire 18/20G are passed through that and brought out through medullary cavity (outside in) forming a small loop on laterally, these both ends of wires and loop are used later on for reconstruction of greater trochanter after reduction. (Figure 3A). Thorough wash given, intramedullary contents are sucked out, a cement restrictor is passed at the desired level; a drain tube is kept in medullary cavity as an air vent to be removed after cementing and before implantation. Acetabulum is packed with wet roller gauze so that extruded cement do no go to acetabular cavity, this roller gauze is removed after implantation.

In all the patients simplex cement is used with manual mixing and insertion with a cement gun (second generation technique). As most of these patients are of high risk and associated comorbid conditions, Patient should not be in hypotension to avoid systemic complications during cementing. Cement should be inserted into medullary cavity as late as allowed. Stem is inserted at desired level determined by trial implantation, anteversion is decided by orienting stem at angle to tibial axis. At the time of Cementing, care is taken so that both ends of stainless steel wires are kept pulled lateral to stem and there is no cement mantle at lateral aspect of proximal shaft where GT is supposed to be attached. As presence of cement may not allow greater trochanter union to shaft. Once cemented, again trial reduction done, neck length selected to maitain length and then final reduction is done.

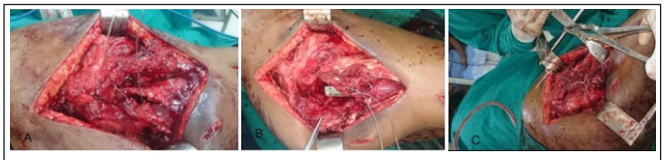

Figure 3: A) Both ends of wire passed through two holes in lateral cortex forming loop outside
B) During implantation care is taken that both ends of wire should come out of lateral aspect of proximal end of shaft
C) Both ends of wires are passed inside out in gluteus medius insertion so that it will come outside at two different sites in G medius, One wire then is passed through loop created on lateral aspect of a shaft, and both wires are then tightened to each other

Reconstruction of greater trochanter

Capsular sutures are taken first before reconstruction of GT. Reconstruction of GT is the most crucial step of this surgery. Greater Trochanter reconstruction is done after reduction of prosthesis, once we achieve proper length and offset, in 30 to 40 degrees of hip flexion, greater trochanter usually falls in it's place. GT is fixed to proximal femur with both vertical and horizontal stainless steel encirclage wires. Both ends of vertical wires which have came out through lateral aspect of medullary cavity forming a loop on lateral aspect of proximal shaft (figure 3A) inserted before cementing. These both ends are now brought inside out through abductors, of which now one end again goes through the loop and both ends are tied to each other (figure 3C).

Horizontal encirclage wires

A wire is passed through hole in proximal part of stem (this wire is passed before tightening vertical encirclage) both end of which are brought inside out from anterior & posterior aspect of greater trochanter and both ends are tied to each other over the GT.

If GT is a large fragment and vastus lateralis is attached to GT, vastus lateralis itself will prevent proximal migration of greater trochanter. If required cancellous graft from head can be put at junction of GT & shaft to enhance its chances of union to shaft. Short external rotators if cut should be sutured back to greater Trochanter with ethibond sutures. Incision sutured in layers over a suction drain.

Post oprative protocol

Bed side sitting started next day, full weight bearing walking with walker started after 48 hours, DVT prophylaxis continued till 6-8 weeks post operation.

For clinical outcomes surgical time, blood loss, quantity of blood transfusions, duration of stay in hospital, timing of starting full weight bearing were documented.

Patient were then examined post operatively at 6 wks, 3 months, 6 months, 1 year and there after annually. On follow up complaints were asked specially for any thigh pains, walking ability assessed, trendelenberg test tested, and harris hip score (HSS) was documented.

Results

Average age of patients was 76 years (Range 70 to 106 years) [Table 1]. Oldest patient of study was 106 years, (figure 4). All patients were osteoporotic on plain x ray (Figue 6, figure 7, figure 8). 32 patients were having associated co-morbidities, 58 patients were walking independently without support before fracture, 8 were independent household ambulators, and 4 were community ambulatory with cane before fracture.(Table 2). 69/70 patients were operated within 8 days from trauma, one pt presented 3 months post trauma. (Figure 5)

Average surgical time was 75 minutes (Range 55 to 90 minutes), average intra-operative blood loss is 250 ml (Range200-400ml), 62/70 patients needed blood transfusion in post operative period. Simplex low viscosity cement was used in all patients, 9/70 patients developed hypotension during cementing but rebounded back on table. Patient started full weight bearing (with walker) on an average 2.5 days post operation. Average duration of hospital stay is 8.2 days. Two patients expired in perioperative period due to cardiac complications. One patient developed pulmonary embolism despite being on DVT prophylaxis, he recovered with treatment. 6 patients developed superficial decubitus ulcers which healed later on. There was no incidence of infection and no incidences of dislocation in any of 70

Table 1 :

Mean age	76 years
Patients with co morbid conditions	27
Average surgery time	75 minutes
Average amount of blood loss	250 ml
Mean day of full weight bearing	2.5 days
Superficial infection	nil
Pulmonary embolism	1
Deep infection	nil
Bed sores	6 all superficial
Dislocation	nil
Limb length discrepancy	4
HHS at 3-month	56.2
HHS at 6-month	74.2
HHS at 24-month	80

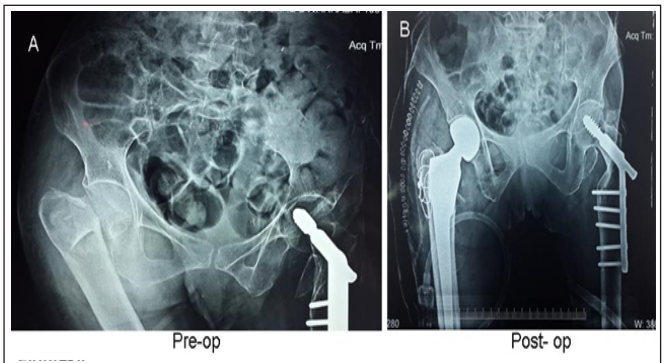

Figure 4: (A)106 yr old female with comminuted Right intertrochanteric fracture.
(B) Post oprative X ray shows cemented calcar stem bipolar on Right side with GT fixation with TBW

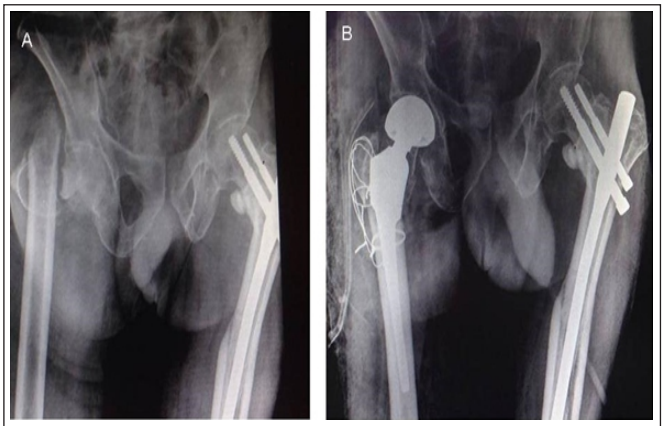

Figure 5: (A)75 yr old male with 3 month old comminuted Right intertrochanteric fracture.
(B) Post operative X ray shows cemented calcar stem bipolar on Right side with GT fixation with TBW

Table 2: Ambulatory status of patient before injury and at final follow up (koval's classification)[1]:

Ambulatory status	Pre-op ambulatory status	Ambulatory status at final follow up
Independent community ambulator	58	50
Community ambulator with cane	4	10
Community ambulator with walker/ crutches	0	0
Independent household ambulator	8	5
Household ambulator with cane	0	5
Household ambulator with walker/ crutches	0	0
Non functional ambulator	0	0

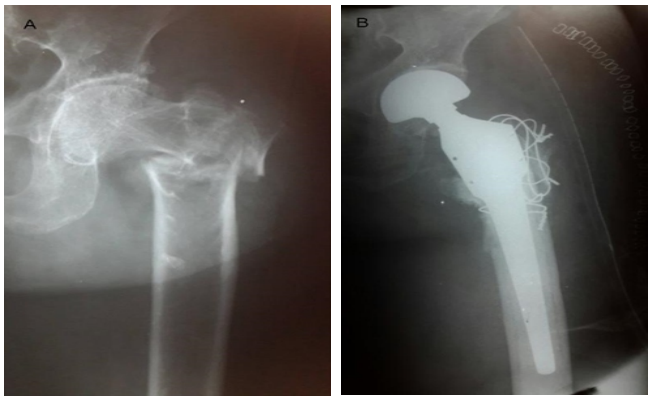

Figure 6: (A) 80 yr old female with comminuted Left intertrochanteric fracture .
(B) Post operative X ray shows cemented calcar stem bipolar on Left side with GT fixation with TBW

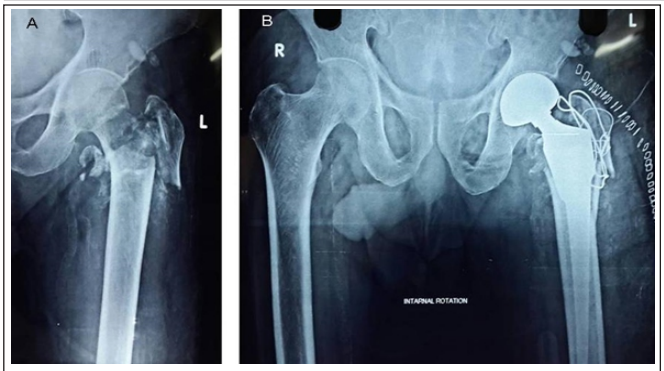

Figure 7: (A) 80 yr old male with comminuted Left intertrochanteric fracture .
(B) Post operative X- ray shows cemented calcar stem bipolar on Left side with GT fixation with TBW

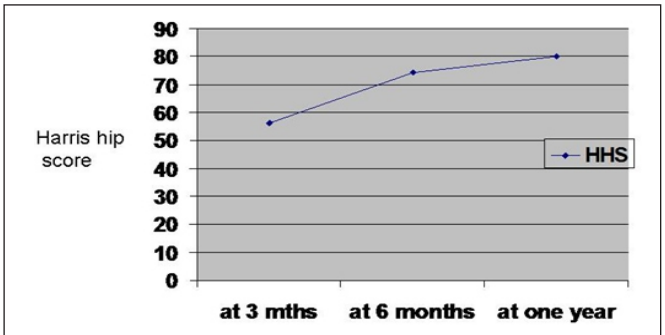

Figure8: Average HSS at 3 moths 56.2, at 6 months 74.2 and at 1 year-80

patients followed. On follow up two patients complained of thigh pain, trendelenberg test was positive in all the patients at 3 months follow up, 27/70 patients at 6 month follow up and 10 patients at 1yr follow up.
Limb length discrepancy seen in 4 patients, all four were lengthening range (0-20 mm), but patient were asymptomatic. Average Harris hip score (HSS) was 56.2 at 3 month follow up, 74.2 at 6 month follow up and 80 at final follow up. (Range 70 to 95), poor (<70)-3, fair (70-79)-12, Good (80-89)-50, Excellent (90-100)-5. (figure-8) Fifty five patients (78.57%) regained preinjury ambulation status at final follow up [1] as (Table 2).

Discussion

Inter-trochanteric fracture is one of the commonest fractures encountered in orthopaedic practice. Though stable I.T. fracture have predictable prognosis, unstable fractures have increased chances of fixation failure [2], increasing chances of future revisions, it not only increases non weight bearing period but also increases morbitity [3] cost of treatment and mortality.
So in such patient's of unstable I.T. fractures in which fixation failure is opting for primary hemi-replacement is more practical option.
Hemiarthroplasty has been used for unstable inter-trochanteric fractures since 1971, Rosenfeld, Schwartz, and Alter reported good results with the use of the Leinbach prosthesis [4].
When we operate for bipolar in I.T. fractures there are many ways by which proximal bone loss is taken care of. This proximal bone loss can be replaced by cement collar [5] or bone [6,7] (either by putting U shaped bone graft proximally/restructuring LT) or by metal or by putting uncemented distal fitting stem [7].
Advantages of bipolar over internal fixation in inter-trochanteric fracture have been suggested In various studies previously, Gashi YN [8] compared results of DHS with cemented bipolar in unstable inter-trochanteric fractures and concluded that systemic and mechanical complications were more common in the DHS group, Khaldon et al [9] in a comparative study concluded that, The Harris Hip Score at 3 months postoperatively was significantly higher in patients who underwent bipolar arthroplasty (76.15± 6.11) compared to those in the internal fixation group (64.89± 5.66) Broos et al. [10] concluded that the operative time, blood loss, and mortality rates were comparable between the two groups, with a slightly higher percentage (73% versus 63%) of those receiving a prosthesis considered to be pain free.
Various studies has been done using cemented, uncemented and comparisons of cemented and uncemented bipolar in I.T. fractures.
Kim et al [7] in 2014 published study of 143 hips of unstable I. T. fractures treated with uncemented stems with good results (mean HSS-82) , with stem subsidence 4.8+/- 3.4 mm in unstable reductions .
Keizo Wada et al [12] studied Cementless calcar-replacement stem in old age patients with 50 % patients ambulatory at 1 yr follow up. Young-Kyun Lee et al [13] studied effect of uncemented stem with encirclage for GT with good results and stem subsidence in two patients.
C J thakkar et al [6] studied Calcar femorale grafting in the hemiarthroplasty of the hip for unstable I.T. fractures and cemented stems with 94% acceptance of graft. Sivabalan T et al [14] used medial calcar augmentation with bone graft with cemented implant with 71% patients showing excellent to good results.
Sancheti et al [4] studied 35 patients of unstable I.T. # treated with fixed bipolar and making cement collar proximally to maintain length with mean HSS of 84.8. Osman Rodop et al [15] in a study of cemented bipolar obtained excellent and good results in about 80% of cases.

although the inner motion of the bipolar head decreased 70% by the end of the third year postoperatively, Kiran Kumar et al [16] observed These unstable I.T. fractures are better treated with cemented hemi-arthroplasty than with internal fixation. It has advantage of an early ambulation and less hospital stay. Thakur A et al [17], in study on 42 patients with average age at 80.7 and HSS of 86.7 at 3 yr follow up. Skender Ukaj [18] in their series observed suitable improved quality of life in terms of FIM and HHS with cemented hemi replacement.

Deniz Çankaya et al [19] compared results of cemented calcar replacement stem to uncemented stem in unstable intertrochanteric fractures and concluded that, there is no difference HSS at one year follow up but perioperative mortality is higher in cemented groups. Jun-Il Yoo et al [20] in a meta-cemented and cementless bipolar in inter-trochanteric fractures and concluded Cemented bipolar hemiarthroplasty and cementless bipolar hemiarthroplasty performed on elderly patients with unstable inter-trochanteric fracture revealed similar mortality and complication rates; however, the rate of LLD greater than 1 cm was significantly higher in the cemented group compared with the cementless group.

But with cement collar, weight bearing forces are transmitted through cement to cement bone or cement implant interface increasing chances of loosening in future. Reconstruction of calcar with bone graft do not guarantee us of it's union to shaft specially in cemented stem and also will not allow immediate wt bearing. Uncemented distal fitting stem though is one of the options it is expensive, has very narrow margin of error in osteoporotic bones of this age as risk of fracture while implantation or chances of sinking in future.

We selected calcar replacement stem in our patients due to it's advantages where,

A) Lost proximal bone is incorporated in proximal stem

B) No risk of sinking as proximal stem is broad

C) Load sharing construct in which weight is transmitted through proximal femur uniformly

D) Being modular it has advantages of length adjustment after stem insertion

E) It has holes in proximally helps in anchoring GT reconstruction

F) It allows early full wt bearing

G) Cost effective compared to uncemented stems

Thus in conclusion, primary hemiarthroplasty does provide a stable, pain-free, and mobile joint allowing early mobilization with acceptable complication rate as seen in our study; however, comparing the use of internal fixation devices against primary hemiarthroplasty for unstable osteoporotic fractures will be needed.

Limitations of study:

(1) Current study does not compare internal fixation with hemiarthroplasty, (2) Long follow ups are difficult to maintain with this age group of patients. (3) Post discharge physiotherapy was not available in most of patients which might have accelerated recovery. (4) No Bone densitometry scan was performed in our patients in order to assess bone density, and patients were deemed osteoporotic on the basis of standard radiographs.

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