

## Study of Results of Bipolar Hemi Replacement Arthroplasty Versus Conventional Methods of Treatment in Cases of Unstable Proximal Femoral Fracture



### Medical Science

**KEYWORDS :** Unstable proximal femoral fracture, primary bipolar prosthesis, early weight bearing, stability in osteoporosis

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### ABSTRACT

*The management of unstable intertrochanteric fractures in elderly is challenging because of difficult anatomical reduction, poor bone quality, and sometimes a need to protect the fracture from stresses of weight bearing. The aim of this study was to find out which of these treatment options can lead to the best clinical and functional outcomes. Thirty patients with an unstable comminuted intertrochanteric femoral fracture (AO/OTA type 31-A2.2, A2.3, A3.1 and Boyd & Griffin type 2 & 3) were enrolled in the study. Functional outcomes were assessed with use of Harris hip score. The main clinical measures were early postoperative full weight bearing, postoperative complications and functional outcome. According to our results, we believe that cemented bipolar hemi arthroplasty is a treatment of choice in freely mobile elderly patients to allow earlier postoperative weight-bearing.*

### Introduction

Orthopaedics practice demands repetitive and complex decision making. All decisions are usually influenced by non-specific consideration such as limited facilities, financial constraints and noncompliance from patients etc. Despite these impediments we all strive towards accuracy in our decision making.

The goal of the fracture treatment has shifted from just union of the fracture to the maximal functional recovery of the limb as early as possible.

One of the most common fractures has been proximal femoral fracture as emphasized by this anecdote: "human beings come in the world through the pelvis and leave the world through the broken hips." Various operative procedures with different implants have been described for the treatment of intertrochanteric fractures.

Proximal femoral fractures are one of those mysteries which become more and more mysterious with advancing knowledge and better imaging modalities. For many decades; attempts have been made to overcome the difficulties which surgeons encounter in the treatment of proximal femoral fractures. Many questions have been raised regarding the configuration of a fixation device.

No matter how much we are successful in other faculties of life but in this technologically advancing world it is crucial that we upgrade our systems to cope with these fractures to serve the mankind better.

### CLASSIFICATION

#### OTA CLASSIFICATION

A1: Simple (2-fragment) pertrochanteric area fractures

A1.1 Fractures along the intertrochanteric line

A1.2 Fractures through the greater trochanter

A1.3 Fractures below the lesser trochanter

A2: Multifragmentary pertrochanteric fractures

A2.1 With one intermediate fragment (lesser trochanter detachment)

A2.2 With 2 intermediate fragments

A2.3 With more than 2 intermediate fragments

A3: Intertrochanteric fractures

A3.1 Simple, oblique

A3.2 Simple, transverse

A3.3 with a medial fragment

### MATERIALS & METHODS

#### INCLUSION CRITERIA:

> 50 year old age, with unstable IT femur fracture type 31- A2.2 and 31- A2.3, must be ambulatory before sustaining injury

#### EXCLUSION CRITERIA:

Chronically debilitated, bed ridden patients, Compound fracture, Medically compromised patients, Local infection, Stable fracture

### MANAGEMENT PROTOCOL

#### INITIAL ASSESSMENT OF PATIENT:

ABC management, general condition and vitals, Distal neurovascular status, Fracture assessment, Skin traction, Local part x-rays, Other associated injuries, I.v. analgesics

#### PREPARATION OF PATIENT FOR SURGERY:

Medical fitness for surgery, Local area preoperative: Shaving, wash. I.v. antibiotic at prior to surgery, Catheterization SOS.

#### POST-OPERATIVE TREATMENT:

Maintenance of fluid - electrolyte balance, I.v. analgesics & i.v. antibiotics, physiotherapy, Local wound care, management of osteoporosis.

#### FOLLOW UP:

Condition of wound at follow up, suture removal on average 10<sup>th</sup> post op day, Assessment of pain and evaluation of pt accordingly Harris hip score at 6 months interval, X-rays at monthly interval for minimum 6 months of duration

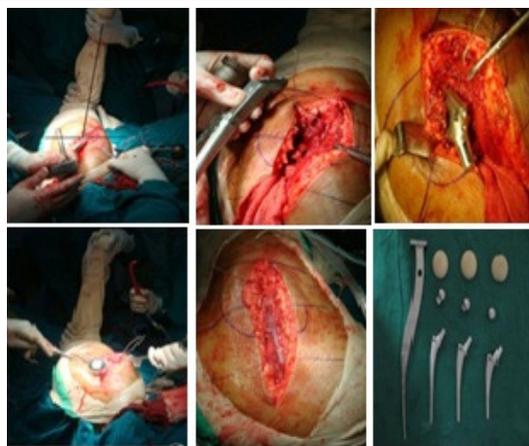
### SURGICAL TECHNIQUE FOR HEMIARTHROPLASTY

We have used Moore's posterior approach (also known as the southern approach) for all patients as this approach is most widely used less interfere with abductor mechanism of hip & post op ambulation is early. Joint is approached through the fracture without detaching short external rotators. Posterior aspect of the hip joint capsule is incised and joint is exposed.

The fracture anatomy was assessed and a cut was taken high up in the neck (almost subcapital level) to facilitate removal of the femoral head. With the removal of the head,

the fracture now had three main fragments namely the greater trochanter, the lesser trochanter, and the shaft with the retained portion of the neck of femur. In some cases, the lesser trochanter was in continuity with the neck of the femur and was reconstructed with the shaft and greater trochanter using steel wires. 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 with neck as a separate fragment; in these cases, it was difficult to reconstruct the calcar. In these cases, the lesser trochanter and the greater trochanter were fixed to the shaft using steel wires (Figure 1); however, most of the portion of the neck had to be sacrificed. 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 some cases, the greater trochanter was the fracture en masse and was reattached to the main shaft using steel wires. In 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 some 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 steel wires or ethibond sutures. In cases where both greater and lesser trochanters were comminuted, 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 steel wires, while only ethibond sutures were used cases which were severely comminuted.

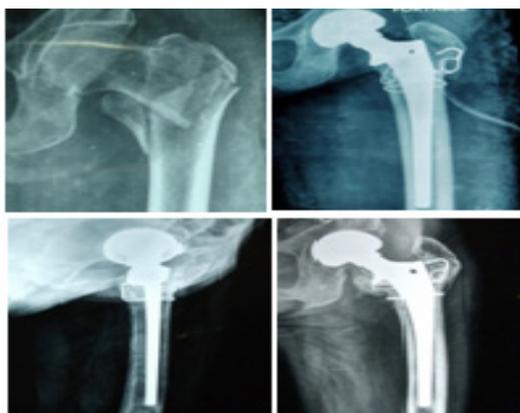
Version of the prosthesis is decided as a long axis of the leg is taken, a line is drawn perpendicular to its axis, and femoral rasping is done at 200-250 anteversion to it. The femoral canal was broached with appropriate anteversion. A trial bipolar prosthesis was then inserted and trial reduction was done. 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 implant was inserted into the femur and joint was reduced. Traction was then applied with 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. 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(Figure 1). This procedure was especially required in cases where the lesser trochanter was fractured separate from the neck portion. Cement was used for distal fixation also as the medullary canal was invariably found to be very wide. Once the prosthesis was fixed, the broken trochanter and calcar were again retightened by tensioning the wire cables. The short external rotators were then sutured back using bone tunnels in the greater trochanter with the closure of the superficial layers, as routine over a suction drain after achieving hemostasis(Figure 1).



**Figure 1:Technique of bipolar hemi replacement arthroplasty and implant used**

All patients underwent a routine postoperative physiotherapy protocol that included early gait training in form of walking with the help of a walker starting second day post-surgery. The rehabilitation then progressed as tolerated by the patients. Patients were examined postoperatively at 6 weeks, 3 months, 6 months, 1 year, and thereafter annually. At each follow-up visit, a clinical-radiological examination was done and the patient was evaluated using the Harris hip score (HHS) and were graded as <70 poor, 70-79 Fair, 80-89 Good and 90-100 Excellent.

**Case 1:**85 years old retired female fell down at home & had intertrochantric femur fracture AO/OTA classification A2.3 cemented modular bipolar was done. Serial follow up was done(Figure 2 & 3).



**Figure 2: Pre op & post op x-ray and 10 months follow up**



**Figure 3: ambulation on 3<sup>rd</sup> post op day, SLR possible, Abduction in lateral position, standing with support &no shortening**

**Case 2:** A male 58 years old, bus driver sustained a left sided intertrochanteric femur fracture AO/OTA classification A2.2. DHS with TSP was done. Patient complained of persistent pain & x-rays shows signs of nonunion. Bone grafting & removal of TSP was done. Final follow up was taken (Figure 4 & 5).

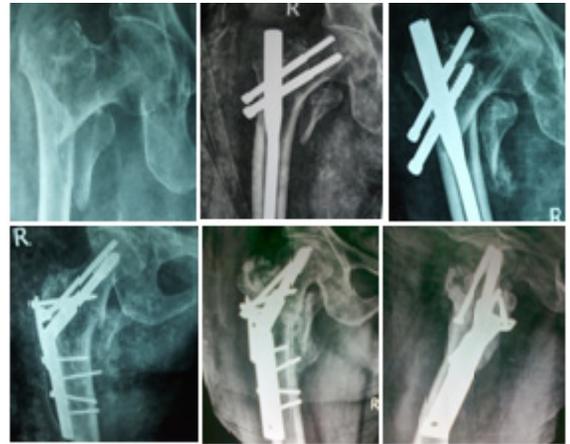


**Figure 4:** Pre op & post op AP & lateral View with 6 months follow up, removal of plate & bone grafting



**Figure 5:** 7 months total follow up & 1 month post bone graft & ROI plating, SLR, 2 cm shortening, no abduction possible

**Case 3:** 70 years retired hypertensive female fell down at home and sustained an intertrochanteric fracture (AO/OTA classification A2.3). PFN was done. At 1 month follow up, lag screw of PFN was cut through and back out. Revision DHS+TSP was done. Patient was ambulatory than after 6 weeks. At 6 months follow up, patient complained of severe pain in hip which increase on movement of hip joint. X ray shows, lag screw was cut through into hip joint. ROI was done. Fracture was united as seen intraoperatively. After 1 month of bed rest partial weight bearing was allowed. 2 cm shortening was observed (Figure 6 & 7).



**Figure 6:** Pre op & Immediate Post op x ray, 1 month follow up-back out cut through screws, ROI PFN & DHS +TSP done 6 months follow up



**Figure 7:** 8 & half months follow up- ROI DHS done, lag screw cut through into hip joint, fracture was united. SLR possible abduction possible, 2.5 cm shortening

**OBSERVATION & ANALYSIS**

Thirty patients with an unstable comminuted intertrochanteric femoral fracture (AO/OTA type 31-A2.2, A2.3, A3.1 and Boyd & Griffin type 2 & 3) were enrolled in the study, which was approved by our institutional review board. The patients were informed about the study in all respects and informed consent was obtained from each patient. The majority of patients fell at home.

Treatment option for the patients with unstable intertrochanteric fractures are the following,

**PFN.**

- DHS with or without trochanteric stabilizing plate.
- Ender's nailing.
- Cemented bipolar prosthesis.

Patients were divided in each group randomly. After they provided informed consent, the patients were randomized into two treatment groups with use of computer-generated random numbers. No patient refused to participate in the study. Sixteen patients (Group I) were treated with a calcar-replacement hemiarthroplasty. Sixteen patients (Group II) were treated with a conventional method of fixation. All the cases were followed up for a period ranging from 1 month to 2 year with an average of 6 months. The functional results were evaluated on the bases of Harris hip scoring system.

**AGE DISTRIBUTION**

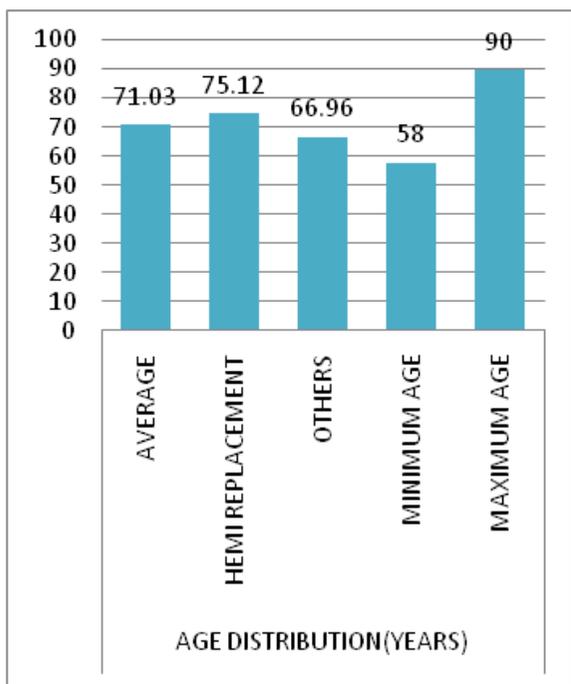
Average age of patients was 71.03 years. In hemireplacement

group was 75.13 years and in conventional group was 66.94 years which is lower than the replacement group suggesting lower osteoporotic index and lower mortality rate than hemireplacement group (Table 1).

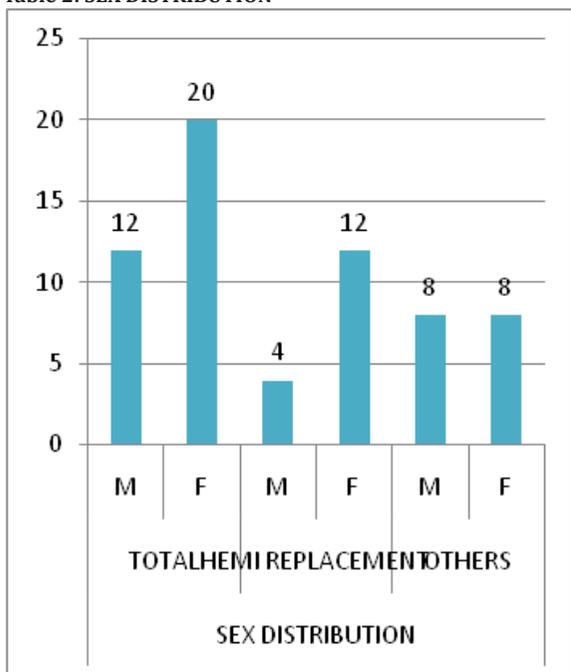
**SEX DISTRIBUTION**

There were total 32 patients, 16 patients in each group. Total numbers of females (20) were higher than total numbers of males (12). As per population data average female life expectancy is more than males suggesting more numbers of females as per age advance above 70 years. In hemireplacement group males were 4 and females were 12. In conventional group males and females were 8 (Table 2).

**Table 1: AGE DISTRIBUTION**



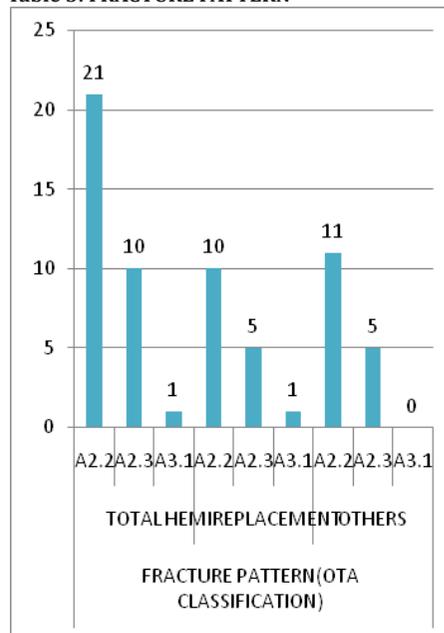
**Table 2: SEX DISTRIBUTION**



**FRACTURE PATTERN**

In our study we have excluded the fracture below A2.2 (OTA classification) and above A3.1. the distribution among both the group was almost same (Table 3).

**Table 3: FRACTURE PATTERN**



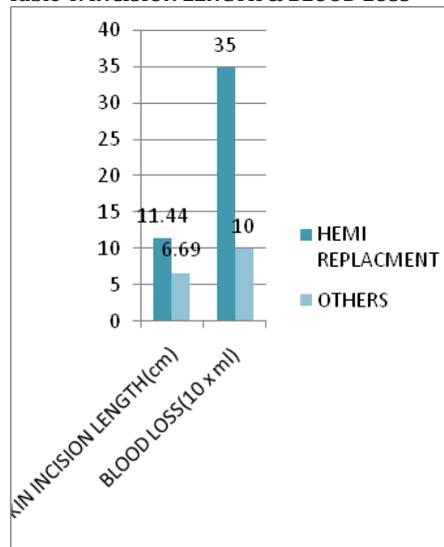
**INCISION LENGTH & BLOOD LOSS**

Average incision was longer in hemireplacement group (11.44cm) greater than the conventional group (6.67cm) indicating more dissection, more tissue trauma, more inflammatory reaction and more blood loss. The following blood loss figure was a sum of per op and post op drain. More blood loss in group 1 required blood transfusion in 6 patients. Skin incision length and blood loss was significantly more (p value <0.05) in group 1 (Table 4).

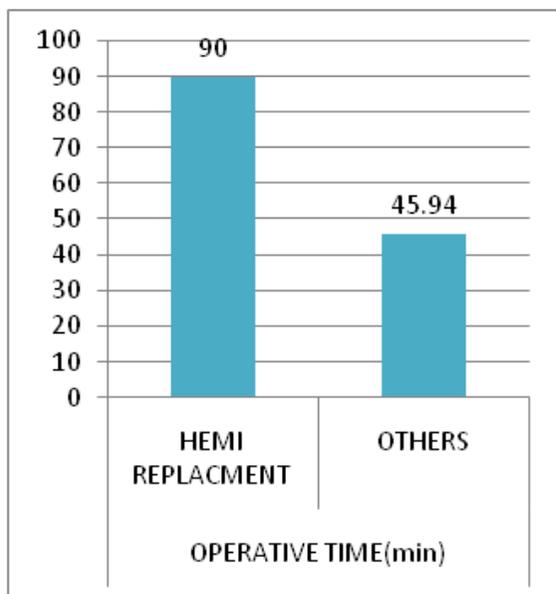
**OPERATIVE TIME**

Operative time was significantly more in hemi replacement group (90 min) as compared to conventional group (45.94 min) (p value <0.05). There were no increase in per op complication with increase in operative time and there were no increase in anesthesia related complication with increase in operative time (Table 5).

**Table 4: INCISION LENGTH & BLOOD LOSS**



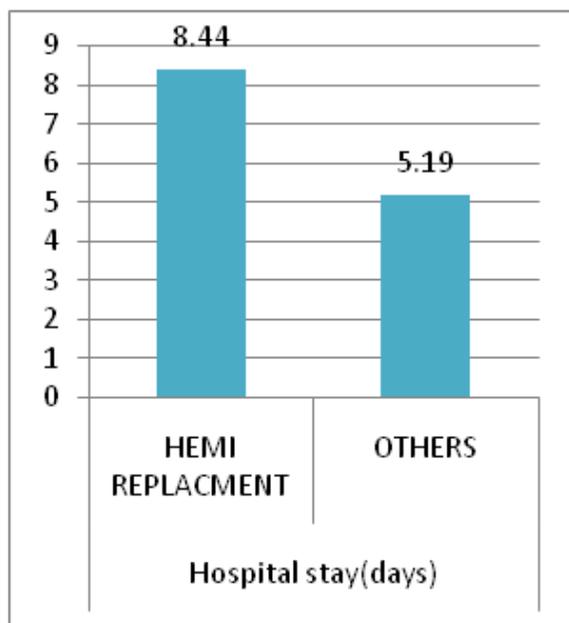
**Table 5: OPERATIVE TIME**



**HOSPITAL STAY**

Hospital stay was more in hemi replacement group (8.45 days) as compared to conventional group of fixation (5.19 days). Group 1 was given inject able antibiotic for at least 5 post op days. Injury operative interval for fresh trauma cases was average 2-3 days(Table 6).

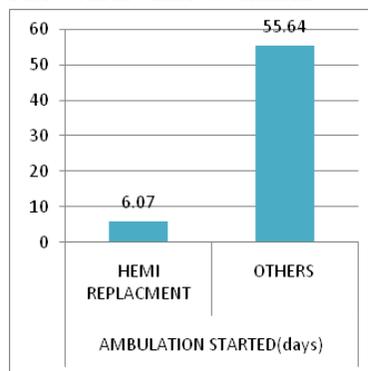
**Table 6: HOSPITAL STAY**



**7. AMBULATION STARTED**

Ambulation was started almost immediately in group 1 within 2-3 days except for the two patients in whom ambulation was started after 21 days. Both of these patients were of revision surgery for failed intramedullary fixation (Table 7).

**Table 7: AMBULATION STARTED**



**PER OP COMPLICATION**

No any per op complication observed in both of the groups.

**COMPLICATIONS**

Complications are divided as immediate and late complications.

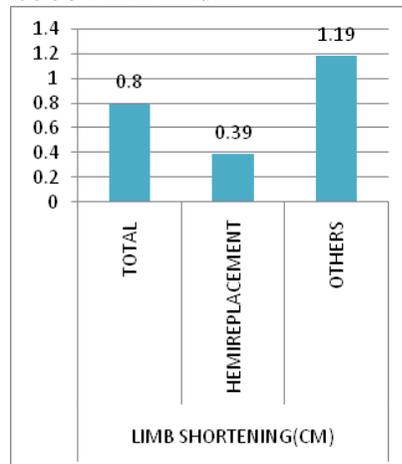
In immediate category, in group 1, two of bipolar prosthesis had deep infection requiring debridement and one patient had altered sensorium post operatively. One patient with deep infection had DM. Patient with altered sensorium was hypertensive taking three antihypertensive medications and expired after 1 month post-operative. One patient was expired on post-op day 1 due to cardiac arrest.

In delayed category, in group 1, two patients had deep wound infection requiring debridement. Both were diabetic taking insulin for the same. One of which require prosthesis removal for severe infection. In group 2, one patient operated for PFN had deep infection requiring repeated debridement and ultimately removal of PFN. Two patients operated for PFN had screw cut out and requiring revision surgery for the same. Two patients had nonunion and implant back out after DHS. One of which required a revision cemented bipolar prosthesis and one required bone grafting and augmentation of fixation. Thus total four patients had implant failure in group II, all of which required revision for the same. One patient had heterotrophic calcification in PFN. No patient in hemi replacement group had acetabular erosion, periprosthetic fractures, cement related anaphylaxis or dislocation. As per above data post op functional status of hemi replacement group was slightly better than conventional group. Shortening was more observed in conventional group.

**LIMB LENGTH**

Shortening was average 0.39 cm in group 1 and 1.19 cm in group 2 which was significantly higher than group 1. Shortening is associated with limping and overall increased morbidity to the patient (Table 8).

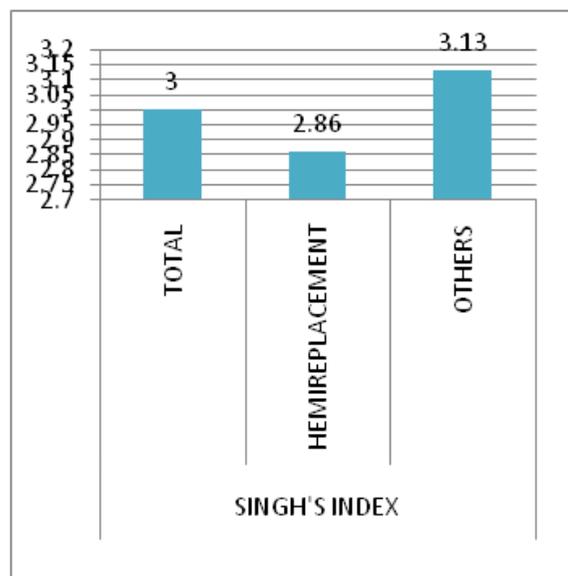
**Table 8 : LIMB LENGTH**



**SINGH'S INDEX**

Total average Singh's index was 3. In hemi replacement group was 2.86 which was lower than the total average index suggesting that there was more osteoporosis in hemi replacement group. In conventional group index was 3.13 (Table 9).

**Table 9: SINGH'S INDEX**



**HARRIS HIP SCORE**

Post op functional status of all patients was evaluated with Harris hip scoring system at the six months interval. Total four patients were not completed six months follow up. Two patients of group 1 were died within six months interval. Two patients of group 2 had revision surgery due to fixation failure within 3 months. As per this score functional outcome was almost similar in both groups except for shortening, which was more in conventional fixation group. Due to shortening limb was more observed in conventional fixation group (Table 10).

**Table 10: HARRIS HIP SCORE**

HARRIS HIP SCORE	HEMIREPLACEMENT	OTHERS
PAIN	37.1	31.3
LIMP	9.93	8.64
SUPPORT	7.29	6.43
DISTANCE WALKED	8.22	7.79
STAIRS	2	2.14
PUT ON SHOES	3.86	3.43
SITTING	5	4.71
PUBLIC TRANSPORT	0.93	0.79
DEFORMITY	4	3.43
ROM	4.29	4.14
TOTAL	82.8	72.9

**DISCUSSION**

The management of unstable osteoporotic intertrochantric fractures in elderly is challenging because of difficult anatomical reduction, poor bone quality, and sometimes a need to protect the fracture from stresses of weight bearing. Internal fixation in these cases usually involves prolonged bed rest or limited ambulation, to prevent implant failure secondary to osteoporosis. This might result in higher chances of complications like pulmonary embolism, deep vein thrombosis, pneumonia, and decubitus ulcer. The purpose of this study is to analyze the role of primary hemiarthroplasty in cases of unstable osteoporotic

intertrochanteric femur fractures. All fracture were A2.2 and above as per OTA classification. Fracture pattern was almost same in both groups.

Incision length and blood loss were significantly more in group I requiring 6 blood transfusions in group I. surgery was prolonged in group I (90 min) as compared to group II (45.94min). All this factors can lead to increase in intra operative complication and post-operative infection. No any intra operative complication developed in any patient in either of group. This was mostly due to better pre-operative medication and preparation of the patients. All patients were underwent medical fitness and necessary investigation before surgery. Total five patients, four in group I (25%) and one in group II (6.5%) had infection. One patient from each group required implant removal for the same.

Osteoporosis is a major risk factor responsible for fixation failure due to back out of implant, cut through of lag screw through head of femur, iatrogenic fractures while inserting nail, loss of reduction due to poor purchase in bone. This necessitate prolonged immobilization of patient in bed which in turn further increase osteoporosis and increase in medical co morbidities like pulmonary embolism secondary to deep vein thrombosis, poor diabetic control, respiratory infections, bed sore and septicemia in patients with already compromised reserve. In this study average Singh's index was 3, 2.86 in group I and 3.13 in group II. Total four patients in group II (25%) had implant failure and require revision surgery. Two of which had nonunion also. Ambulation was started late in group II (55.64 days) compared to group I (6.07 days). In our study, there were no increases in medical co morbidities in group II as compared to group I with delayed ambulation. But patient's feeling of wellbeing and confidence were gained with early ambulation. Cross leg sitting and squatting was not recommended in group I which was a concern for the Indian people life style as these are frequently used in daily living.

Unstable intertrochantric fracture had inherited tendency for difficult reduction due to fracture geometry and muscle pull, and excessive collapse lead to shortening of limb which in turn increase post-operative limp and poor functional outcome. Limb shortening was 0.39 cm in group I and 1.13 cm in group II.

Hemi replacement was associated with dislocation, intra-op fracture, stem loosening, cementing related complication, peri prosthetic fractures, acetabular erosions and lateral thigh pain. Dislocation was not occurred in our study, might be due to through fracture approach with preservation of the external rotators insertion, stem placement with proper ant version and desired angle, proper tensioning of the muscles, greater and lesser trochanter fixed into anatomical position with proper tensioning of attached muscles and post op care. Lateral thigh pain was not observed in any of patients in our study. Stem loosening, acetabular erosions and such other complication need a long term follows up which is the limitations of our study.

Harris hip score was evaluated at 6 months in both groups. Group I had 82.8 and group II had 72.9. Outcome was fair in group II and good in group I.

This study had several limitations also. These limitations are as follows,

**Sample size was small. Large sample size was necessary for better comparison.**

Longer follow up is required for observation of delayed complications and functional outcome. Potential long-term problems associated with prosthetic replacement, such as loosening, acetabular erosion, stem failure, late infection, and late dislocation, may yet occur.

Sample was not age matched. So correct rate of mortality associated with hemi replacement group was not obtained. Also osteoporosis was more with elderly group which had impact on outcome.

**Singh's index was not identical in both groups.**

This study was compared with similar study done by Shin-Yoon Kim, M.D.; Yong-Goo Kim, M.D.; and Jun-Kyung Hwang, M.D., a prospective randomized trial, performed at the Department of Orthopedic Surgery, Kyungpook National University School of Medicine, Daegu, South Korea in 2005.<sup>22</sup>

This study was also compared with the study done by, KH Sancheti, PK Sancheti, AK Shyam, S Patil, Q Dhariwal, R Joshi; Sancheti Institute of Orthopaedics and Rehabilitation, Pune, Maharashtra, India; Primary hemiarthroplasty for unstable osteoporotic intertrochanteric fractures in the elderly: A retrospective case series.<sup>23</sup> Functional outcome was similar to this study.

**CONCLUSION**

Excessive collapse, loss of fixation, and cut-out of the lag screw resulting in poor function remain problems associated with internal fixation of unstable intertrochanteric fractures in elderly patients with osteoporotic bone.

To allow earlier postoperative weight-bearing and to avoid excessive collapse at the fracture site, prosthetic replacement especially for the treatments of unstable intertrochanteric fracture is a good option.

**ABBREVIATIONS**

- SLR - Straight Leg Raising
- OTA - Orthopaedic Trauma Association
- ASA - American Society of Anesthesiologist
- ABC - Airway Breathing Circulation
- BP - Blood Pressure
- RR - Respiratory Rate
- I.V. - Intra Venous
- HHS - Harris Hip Score
- DHS - Dynamic Hip Screw
- TSP - Trochanteric Stabilization Plate
- ROI - Removal of Implant
- PFN - Proximal Femoral Nail
- ROM - Range of motion

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