International Journal of Orthopaedics Sciences

**ISSN:** 2395-1958
IJOS 2019; 5(3): 767-773

www.orthopaper.com
Received: 24-05-2019
Accepted: 28-06-2019

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# A study of clinical, functional and radiological outcome of unipolar versus bipolar hemiarthroplasty in displaced fracture neck of femur in adults

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**DOI:** https://doi.org/10.22271/ortho.2019.v5.i3m.1624

**Abstract**
Displaced neck of femur fracture in adults and its complications are responsible for a significant amount of morbidity and mortality. Unipolar and bipolar hemiarthroplasty helps in early mobilization of the patient as well as prolongs their productive life. 50 patients with intracapsular fracture neck of femur were included in this study. 25 patients were treated with unipolar hemiarthroplasty and 25 patients with bipolar hemiarthroplasty, respectively. Patients belonging to both the groups were evaluated for functional outcome by using the Harris Hip Score. Patients were also evaluated radiologically. Our overall mean Harris hip score pre-operatively for unipolar hemiarthroplasty was 37.5 and bipolar hemiarthroplasty was 41, which increased to a score of 88.2 for unipolar and 90.2 for bipolar hemiarthroplasty. While the overall clinical outcomes were closely comparable, the functional hip score was slightly better in the bipolar group. In our series we had 35% excellent result in the Bipolar whereas we had 15% excellent result in the unipolar Hemiarthroplasty group.

**Keywords:** Bipolar Hemiarthroplasty, unipolar Hemiarthroplasty, displaced fracture neck of femur, intra-capsular femoral neck fracture

## Introduction
The hip joint is a ball-and-socket type of synovial joint where the articulation is with the pelvis and femur. Hence the joint connects the axial skeleton with the lower extremity. This multiaxial ball and socket joint allows the entire lower extremity to move in three planes of motion, while providing an important shock absorption function to the torso and upper body. Hip fractures are common and comprise 20% of the operative workload of an orthopaedic trauma unit. Intra-capsular femoral neck fractures account for 50% of all hip fracture [1].The residual lifetime risk of hip fracture at 50 years of age was estimated to be 5.6%for men and 20% for women [1]. Undisplaced intra-capsular hip fracture, are almost invariably treated with fixation. However, only 15% of these fractures are undisplaced. The remaining are displaced and occur predominantly in the elderly female patients. The current treatment guidelines for hip fractures suggest that displaced intra-capsular neck of femur fractures should be treated with arthroplasty procedures. Prosthetic replacement allows the patients for immediate weight bearing and hence helps return the elderly patients to activity and avoid complications of recumbency and inactivity. The complications related to prosthesis include peri-prosthetic fracture, dislocation, infection, aseptic loosening, acetabular wear and possible bone cement implantation syndrome. Due to the complications of persistent pain and protrusio-acetabuli with unipolar hemiarthroplasties many surgeons prefer to choose a bipolar system. The theoretical advantage of the bipolar hemiarthroplasty is a reduction of acetabular wear due to the dual-bearing system. On the other hand, the disadvantage is the risk of polyethylene wear. The present study is designed to compare the efficiency of these two prosthesis Unipolar versus Bipolar prosthesis for the management of intra-capsular displaced fractures of neck of femur in elderly people in the age group of 46 to 75 years.

## AIM
To study the short term functional and radiological outcome of Unipolar and Bipolar

hemiarthroplasty in displaced intracapsular fracture neck of femur in the elderly.

## Materials and Method

This is a prospective study conducted in Sree Balaji Medical College and Hospital, Chennai between January 2016 to December 2018 (24 months of recruitment and 36 months of study). All the patients had given a written consent for publication of their clinical and radiological data and appropriate clearance was obtained from the institutions research and ethical committee.

We had 50 patients with intra-capsular neck of femur fractures, of which 25 patients underwent unipolar Hemiarthroplasty and 25 patients underwent Bipolar Hemiarthroplasty.

The patients were screened clinically and radiologically pre-operatively for knowing the geometry of the fracture.

### Inclusion criteria

1. Male and female patients of age between 46 years and 75 years.
2. Displaced intra-capsular neck of the femur fracture with adequate calcar.
3. Intra-capsular fractures of the neck of femur presenting within 6 weeks of injury.

### Exclusion criteria

1. Neck of the femur fracture in younger patients.
2. Extra-capsular neck of femur fractures.
3. Patient with neurological disorders.
4. Patients associated with any other ipsilateral or contralateral fracture of upper and lower extremities
5. Pathological neck of femur fracture.

### Pre-operative evaluation

#### Clinical

The patients were evaluated pre-operatively using the Harris Hip Score. This score takes into account pain, function, absence of deformity and range of motions. The general condition of the patient including his general medical condition, his physical status and ability to withstand surgery is considered. Physical status includes both upper and lower extremities as well as, opposite hip, both knees, feet and spine. Any fixed deformities and limb length discrepancies were noted.

The complete blood count, ASO, ESR, CRP, urine analysis, Chest X- ray and ECG was
done as a routine pre-operative evaluation.

### Preoperative radiographic assessment was done which included

- X ray Pelvis with both hips AP view
- X ray of affected hip AP in internal rotation.

### Goals of pre-operative planning were

1. To determine the correct site, size and implant (uncemented/cemented).
2. To restore the anatomic and biomechanical center of rotation of the hip joint. 3. To restore any limb length discrepancy.
3. To restore appropriate muscle relationships.

### Surgical procedure

#### Preparation of Patient

On the day of surgery, skin is prepared using povidone-iodine solution and covered with sterile drapes. Prophylactic antibiotic is given on the table. Cefaperazone+Sulbactam 1.5gm parentally is initiated after the test dose.

### Operation theatre

All the hemiarthroplasties were done in operation theatres with laminar air flow.

### Anesthesia, positioning and approach

Spinal or general anesthesia was usually employed. The patient was placed in the lateral position (Fig 1). We went through the posterior approach (Fig 2).

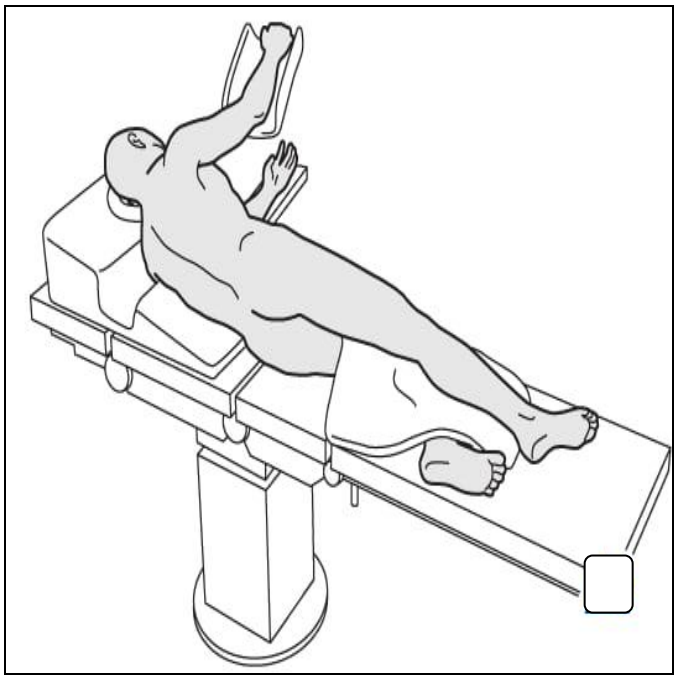

**Fig 1:** Lateral position

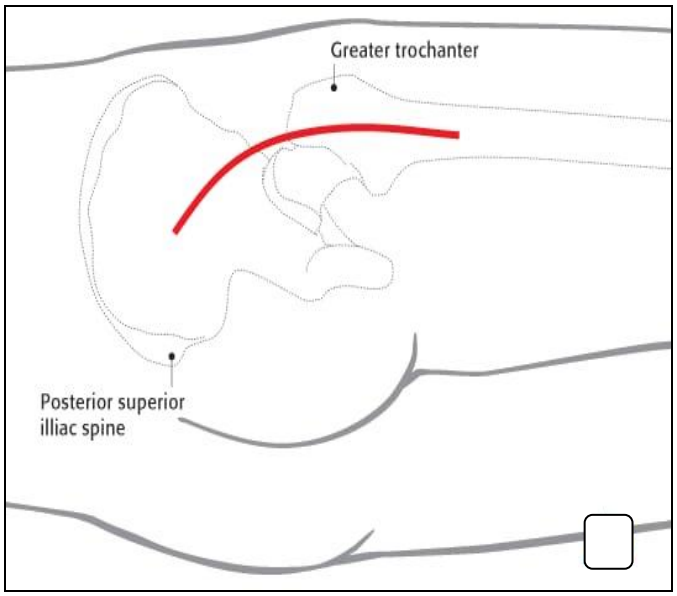


**Fig 2:** Posterior approach

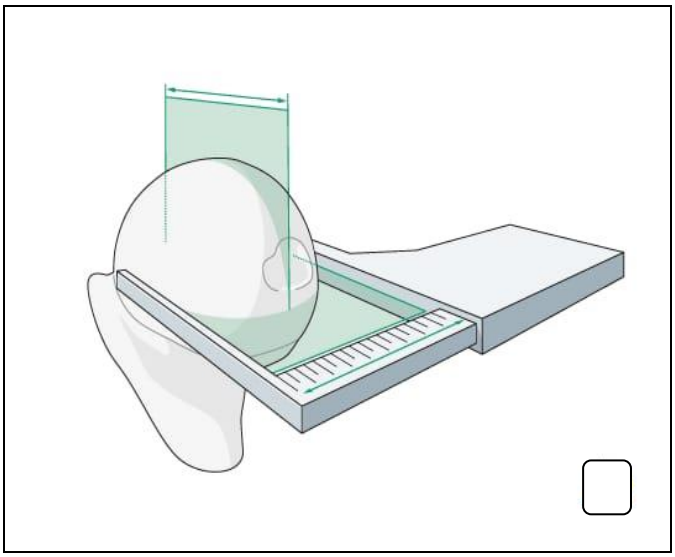

**Fig 3:** Determining size of femoral head component.

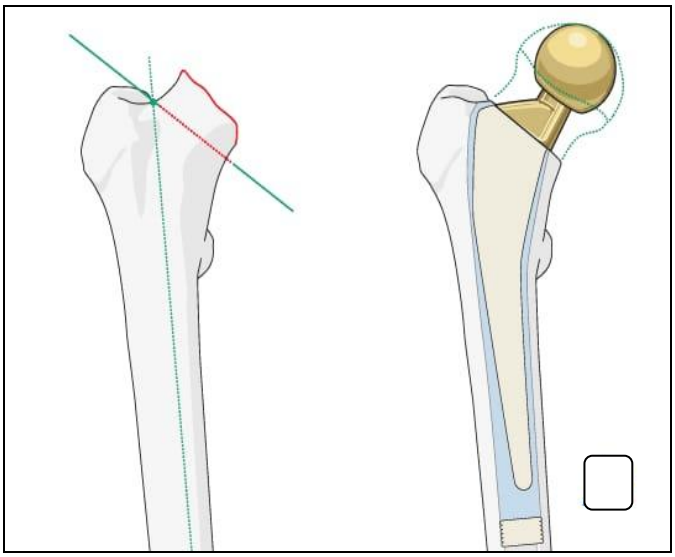

**Fig 4:** Osteotomy of femoral Neck for stem insertion.

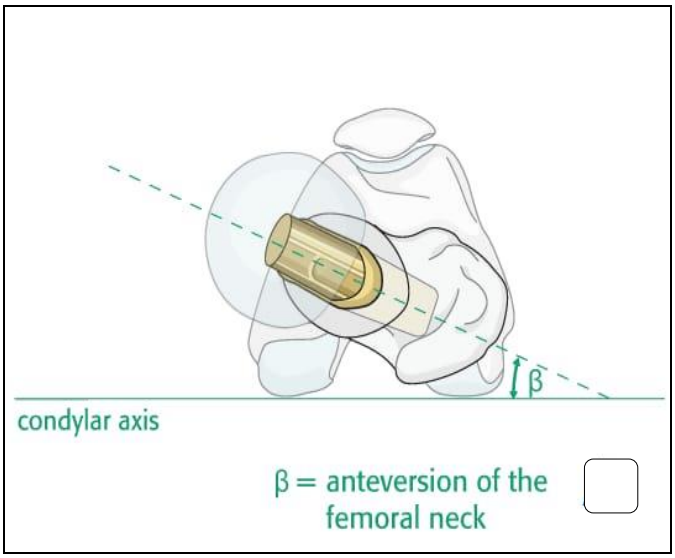


**Fig 5:** Ensure correct rotation of prosthesis.

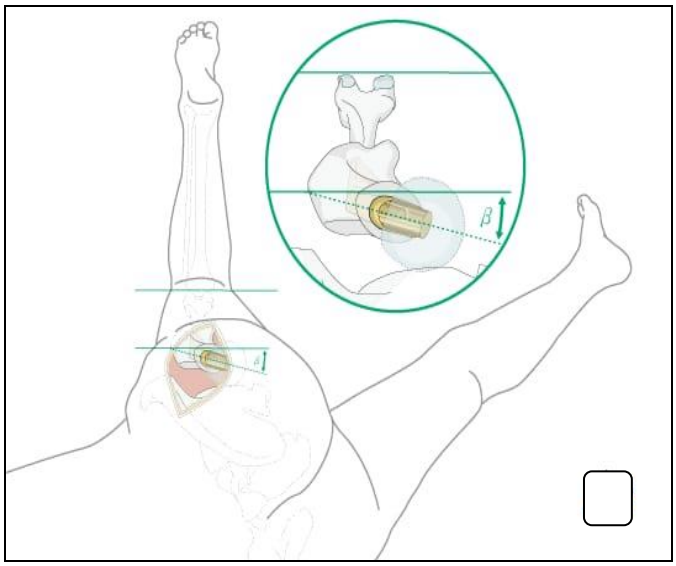


**Fig 6:** Lateral position with knee flexion to 90 degrees with internal rotation for correct orientation of prosthesis.

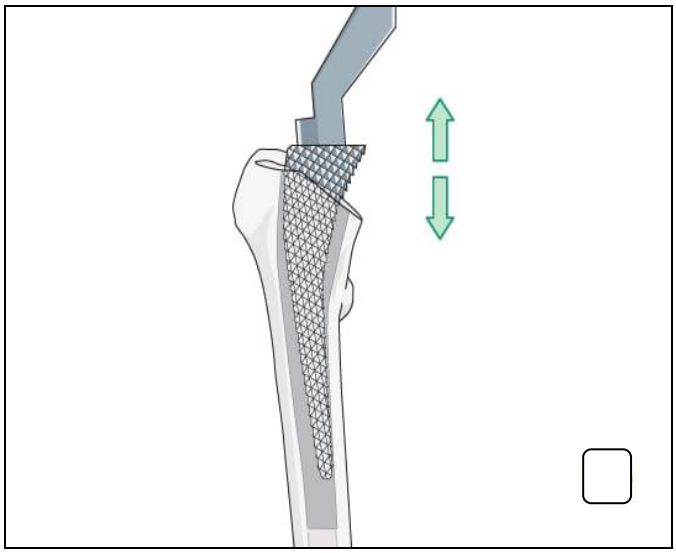

**Fig 7:** Medullary preparation.

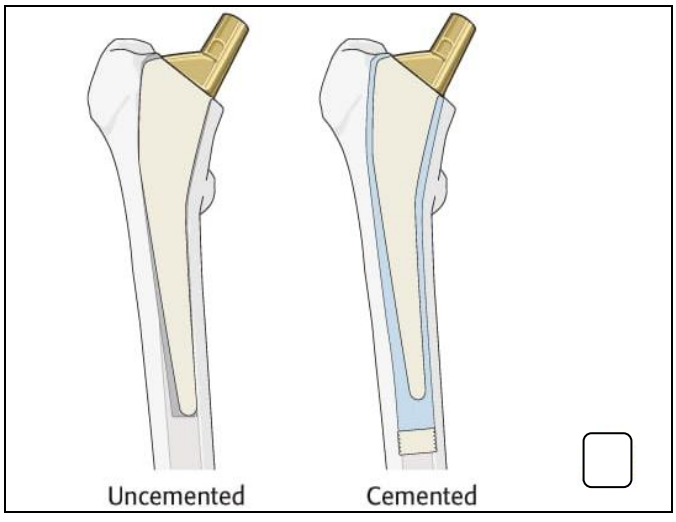


**Fig 8:** Choosing the right stem size.

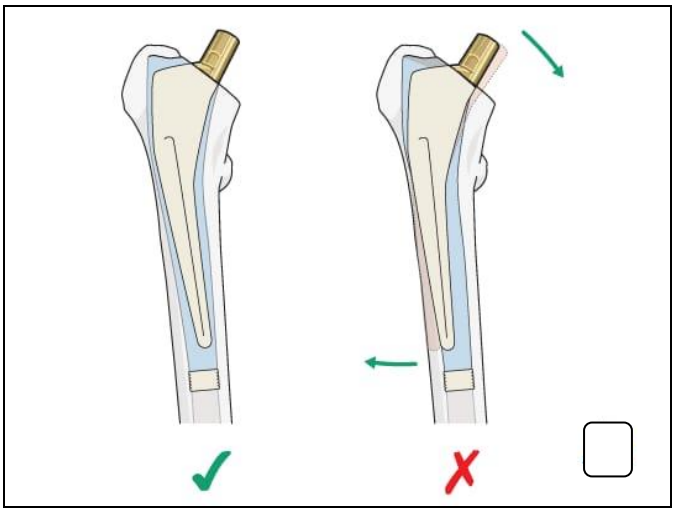

**Fig 9:** Cemented femoral stem with correct valgus alignment on the left and excessive varus on the right.

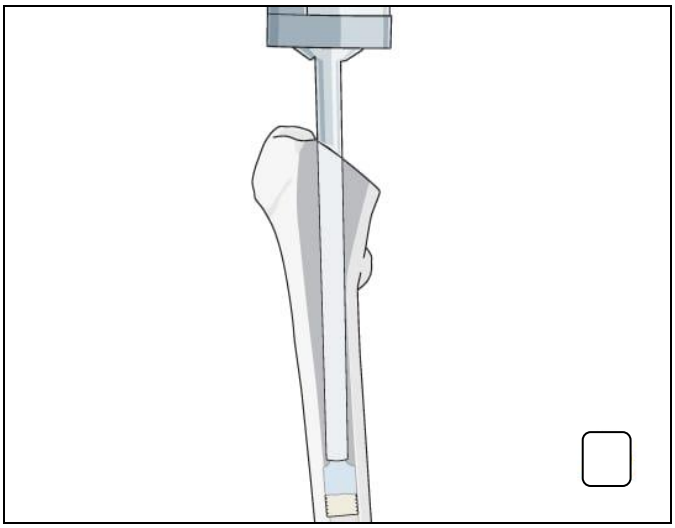

**Fig 10:** Cementing of the medullary canal.

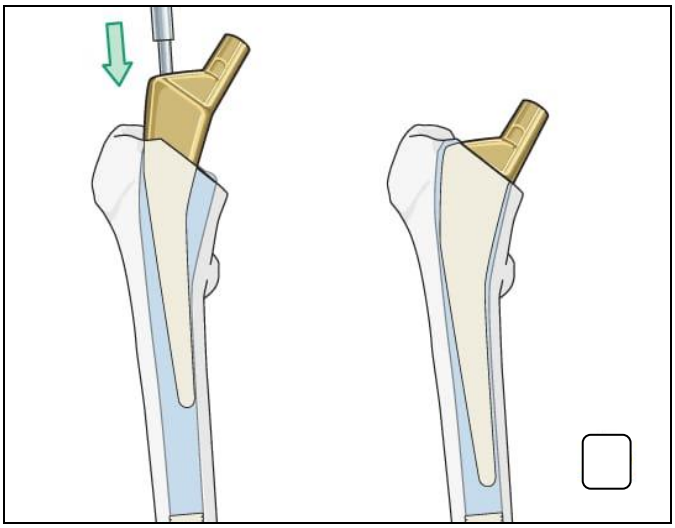

**Fig 11:** Prosthesis insertion with correct rotation and valgus alignment.

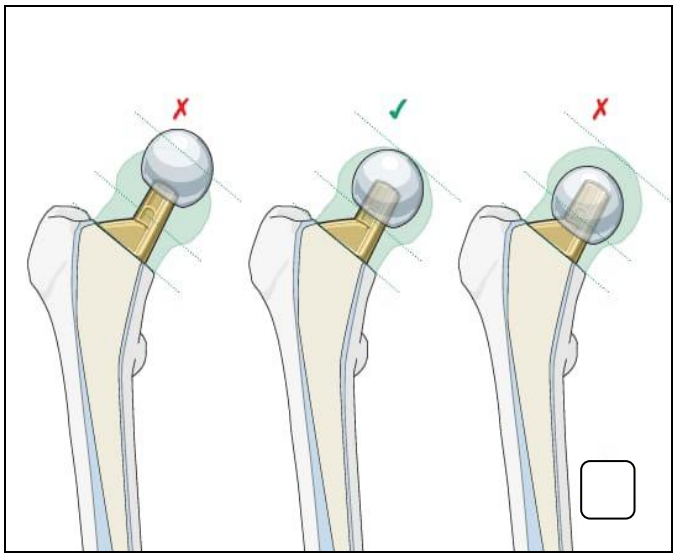

**Fig 12:** Correct assembly of the Prosthetic head.

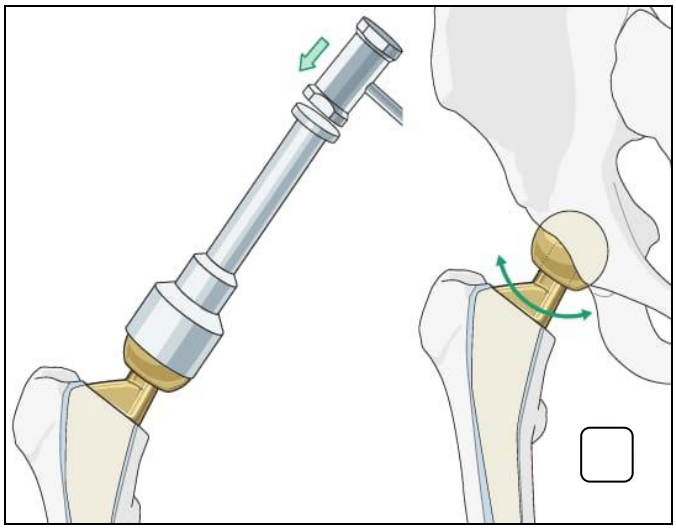

**Fig 13:** Final impaction of the head and subsequent reduction of the hip and checking range of motion and stability.

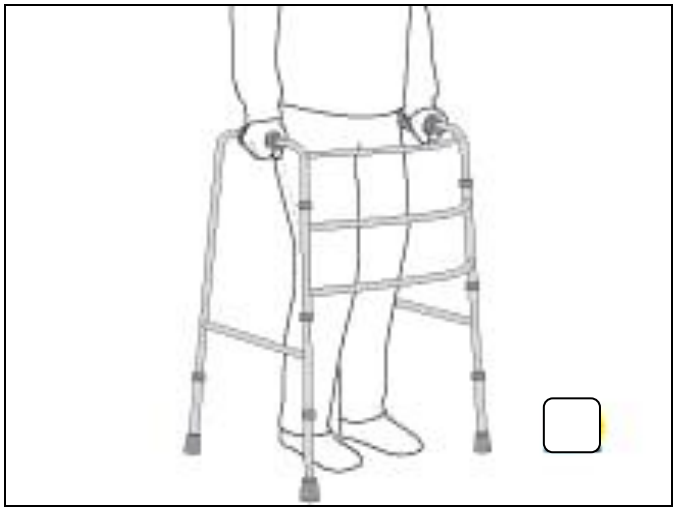

**Fig 14:** NWB with walker.

**Implantation of cemented femoral component**

We preferred cemented hemiarthroplasty in patients with a physiologic age greater than 60 years and where the femoral cortex was thin or osteoporotic and a secure press-fit fixation was unlikely. Then the broaches were inserted in approximately 15 degrees of anteversion in relation to the axis of the knee (Fig 5 and Fig 6). Correct axial alignment was maintained as the broach was inserted. Alternately we impact and extract the broach to facilitate its passage. Because fixation will be achieved with cement, the requirements for absolute stability of the broach are not rigorous a trial reduction was then carried out to determine the limb length with the prosthesis without cement. Since the stem was to be fixed with cement, the depth of insertion of the component was predetermined. The component sizes were then selected and limb length and stability was assessed (Fig 4 and Fig 8). The remaining loose cancellous bone from the medial aspect of the proximal femur was removed using straight and angled curettes.

Then 2 packages of cement were mixed for a standard size femoral stem. The cement was pushed into the canal with the index finger or thumb of the opposite hand. After the cavity was filled, the cement was pressed with the thumb. A mechanical impactor or plunger was used. The desired amount of anteversion was determined and the medial/lateral position of the stem was determined before insertion (Fig 9). The tip of the stem was inserted within the centre of the cement mantle (Fig 10). The cement was removed from the region of the collar. Firm pressure was maintained on the head of the component as the cement hardens. The cement was cut around the edges of the prosthesis's as it entered the doughy phase.

The anterior aspect of the femoral neck was inspected to be sure no cement protruded which could cause impingement and dislocation. The position and the stability of the femoral component was checked (Fig 11). If it appeared satisfactory, then the hip was reduced and the stability was checked (Fig 12).

**Implantation of un-cemented femoral component**

The reamer is inserted at a point corresponding to the piriformis fossa. The insertion point is kept slightly posterior and lateral on the cut surface of the neck of femur. After the point of the reamer has been inserted, the handle is directed laterally towards the greater trochanter. The reamer is aimed down the femur towards the medial femoral condyle. Generally, a groove must be made in the medial aspect of the greater trochanter to allow proper axial reaming of the canal. The proper depth of insertion of the reamer was determined. The stability of the axial reamer within the canal was assessed. The residual cancellous bone along the medial aspect of the neck was removed with the help of broaches.

Appropriate sized femoral component was then inserted. Debris from the acetabulum was removed and the hip was reduced. The stability of the hemiarthroplasty was confirmed through a full range of motion.

After reduction of the hip in both the cemented and uncemented hemiarthroplasties, repair of the posterior soft tissue envelope was done. The capsule if preserved was then repaired with heavy non-absorbable sutures. The tendons of short external rotators were reattached to the posterior aspect of the greater trochanter. The wound was then closed in layers with a drain in situ.

**Postoperative care and rehabilitation**

**Antibiotics**

The patient is given parental Cefaperaxone with Sulbactam 1.5 gm for the first 5 days post- operatively.

**Post-operative care**

The patient was treated in absolute aseptic conditions in the post-operative ward with the limb protected by an abduction pillow placed in between the legs and a small pad beneath the knee to maintain it in slight flexion. Drain was removed on POD 2.

**Rehabilitation protocol**

This began pre-operatively where the exercises to be practiced were taught by the physiotherapist. Exercises like ankle dorsiflexion and plantar flexion, Quadriceps and gluteal exercises were started as soon as pain subsided. Upper limb and deep breathing exercises were started. Patients were made to sit in bed on POD 1. After drain removal patient was made to stand and walk non-weight bearing with walker support, if a cemented implant was used. Sutures were removed on POD 12.

The patient was instructed to avoid adduction, flexion and internal rotation. The patient was also instructed not to squat, sit cross legged. After the surgery clinical evaluation was done with the help of Harris Hip Score and radiological evaluation with plain x-ray pelvis both hips and proximal femur AP view was done for all patients at regular intervals. In the un-cemented group, NWB gait with walker (Fig 14) were initiated by POD 7 and PWB initiated at 4 weeks proceeding to FWB by 6 weeks.

**Follow up**

The patients were reviewed regularly at 6 weeks, 3 months, 6 months, 1 year and then yearly follow-up.

**Results**

The 25 hips each for unipolar and bipolar were evaluated both clinically and radiologically. Clinical evaluation was done using Harris Hip Score which revealed the following results.

**Table 1:** Age and sex distribution.

| Age in years | 46-55 | | 56-65 | | 66-75 | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female | Male | Female |
| UPHA | 1 | 5 | 1 | 5 | 3 | 10 | 5 | 20 |
| BPHA | 1 | 2 | 2 | 4 | 4 | 12 | 7 | 18 |
| Total | 2 | 7 | 3 | 9 | 7 | 22 | 12 | 38 |

In our series we had 80% (n=20) females in the UPHA group and 72% (n=18) females in the BPHA group. Overall the maximum number of patients 58% (n=8) were in the age group 66 to 75 years.

**Table 2:** Post-operative harris hip score.

| HHS score range | UPHA 'n' | % age | BPHA 'n' | % age |
|---|---|---|---|---|
| Excellent 90-100 | 12 | 48% | 15 | 60% |
| Good 80-89 | 9 | 36% | 8 | 32% |
| Fair 70-79 | 4 | 16% | 2 | 8% |
| Poor < 70 | 0 | 0% | 0 | 0% |
| Total | 25 | 100% | 25 | 100% |

In our series, in the UPHA group 84% cases had excellent to good hip score and in the BPHA group 92% had excellent to

good hip score. In either group no patient belonged to the poor group.

**Radiological evaluation**

Observations and measurements were made on the antero-posterior radiograph of the hip. Radiographic evaluation included inspecting the following parameters.

1. **Loosening of the femoral components:** We had no case of femoral components loosening.
2. **Femoral stem position:** The position of the femoral component in the frontal plane was measured on the antero-posterior radiographs. In our study the results were as follows.

**Table 3:** Stem position at 12 months follow-up.

| | UPHA 'n' | % age | BPHA 'n' | % age |
|---|---|---|---|---|
| Neutral | 16 | 64% | 20 | 80% |
| Varus | 3 | 12% | 1 | 4% |
| Valgus | 6 | 24% | 4 | 16% |

3. **Vertical Stem Subsidence:** There was no incidence of vertical stem subsidence in either of our study groups.
4. **Heterotopic ossification:** Heterotopic bone when present was graded according to the classification of Brooker *et al*. [2]. 1 case in each Unipolar and Bipolar hemiarthroplasty group developed heterotopic type II ectopic ossification, when reviewed at 30 months post-op.

**Table 4A:** Minor complications.

| Complications | UPHA 'n' | % age | BPHA 'n' | % age |
|---|---|---|---|---|
| Superficial infection | 1 | 4% | 1 | 4% |
| Gaping | 1 | 4% | 0 | 0% |
| Total | 2 | 8% | 1 | 4% |

**Table 4B:** Major Complications.

| Complications | UPHA 'n' | % age | BPHA 'n' | % age |
|---|---|---|---|---|
| Painful Hip | 2 | 4% | 0 | 0% |
| Posterior Dislocation | 0 | 0% | 1 | 4% |
| Acetabular erosion | 0 | 0% | 0 | 0% |
| Restricted ROM | 0 | 0% | 0 | 0% |
| Periprosthetic fracture | 0 | 0% | 0 | 0% |
| Total | 2 | 4% | 1 | 4% |

**Case illustrations**

**Case 1:** Excellent result (unipolar hemiarthroplasty).

**Fig 15:** Pre-op x-ray.

**Fig 16:** Post-op x-ray.

**Case 2:** Excellent result (bipolar hemiarthroplasty)

**Fig 17:** Pre-op x-ray.

**Fig 18:** Post-op x-ray.

**Discussion**

In our series, the mean age of patients was 70.5 years, this is comparable to the study by Somashekar *et al*. [3] who gives a figure of 71.45 years. In the study by Somashekar *et al*. [3] mean HHS score for BPHA was 86.18 and for UPHA was 79.79. In our study the mean HHS score for the BPHA was 90.2 and for UPHA was 88.2. Yamagata *et al*. [4] also reported a higher HHS score for BPHA in comparison to UPHA. Lestrange *et al*. [5] also concurs with this finding. We had 8% of minor complications and 4% of major complications in the

UPHA group. In the BPHA group we had 4% of minor complications and 4% of major complications. We had 1 case of posterior dislocation in the BPHA group. Posterior dislocation of a prosthetic hip is rather common in the first 6 weeks post-op and hence to reduce the incidence, movements like adduction across the midline, hip flexion of more than 80 degrees and internal rotation should be avoided. D'Arcy and Devas [6] reported incidence of prosthetic dislocation ranging from 0.3% to 10%. Sikorski and Barrington [7] in their study reported a dislocation rate of 10% in the UPHA group.

Overall functional outcome was better in the BPHA group. Lestrange *et al*. [5] in a review of 496 patients reported that in view of the bipolar construct the BP prosthesis are more stable, less chance in causing acetabular erosion and give improved function. We had 8% (n=2) cases of painful hip in the UPHA group. This drawback of UPHA has also been highlighted by Lunceford Jr *et al*. [8] but he is quick to point out that this should not be the reason for condemning this procedure. Alteration in the abductor mechanism due to marginally greater neck excision can cause limping or the need to use a walking aid. In the UPHA group we had 8% (n=2) cases which required to use a walking stick at 18 months follow-up, but both these patients were aged above 70 years. Similar reports were filed by Cornell *et al*. [9] Sabnis and Brenker *et al*. [10].

## Conclusion

This is a short term follow up study of functional and radiological outcome of unipolar versus bipolar hemiarthroplasty for displaced intracapsular neck of femur fracture.

From our study, we concluded that uncemented bipolar hemiarthroplasty gave better results when compared with uncemented unipolar hemiarthroplasty. Our results also showed that, cemented bipolar hemiarthroplasty gave better results when compared with cemented unipolar hemiarthroplasty clinically and radiologically.

Hemiarthroplasty is an excellent treatment for intracapsular neck of femur fracture in terms of pain relief and restoration of function and mobility as near as possible to the pre injury level. The bipolar hemiarthroplasty done for intracapsular neck of femur fracture gave better functional and radiological results in our study in comparison to the unipolar hemiarthroplasty done for intracapsular neck of femur fracture.

Acetabular erosion is the most commonly encountered complication in unipolar hemiarthroplasty than the bipolar hemiarthroplasty which had less complication comparatively.

Our overall mean Harris hip score pre-operatively for unipolar hemiarthroplasty was 37.5 and bipolar hemiarthroplasty was 41 which increased to 88.2 for unipolar and 90.2 for bipolar hemiarthroplasty respectively.

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