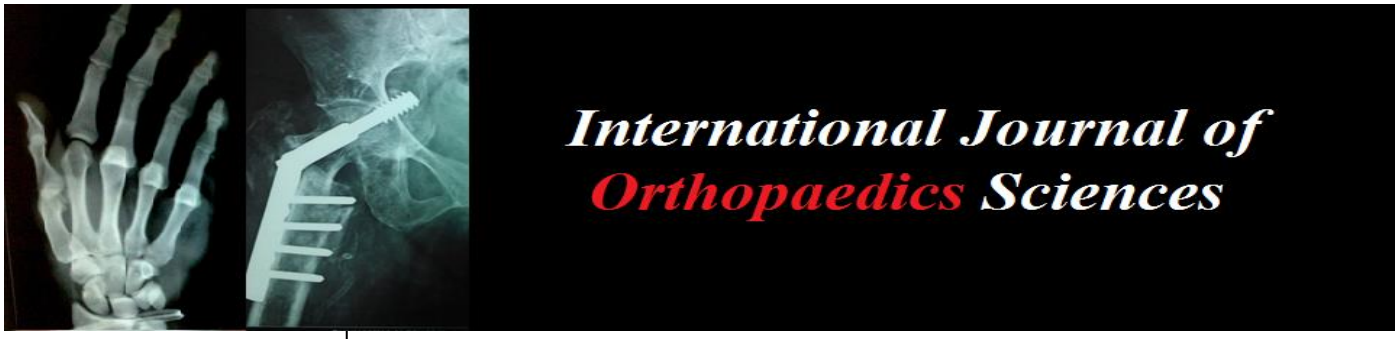


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# A comparative study of functional outcome of bipolar hemiarthroplasty versus total hip arthroplasty in fracture neck of femur in elderly patients

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**Abstract**
**Introduction:** Fractures of the femoral neck are an international public health problem mainly occurring in elderly patients and resulting in high mortality. With the aging population, the incidence of these fractures is steadily increasing. Treatment choices for the neck of femur fractures in the elderly age group includes hemiarthroplasty (HA) and total hip replacement (THR). The treatment option must be decided by the type of fracture, condition of the patient, functional demands, medical and mental ability to cope with the surgery. This study compares bipolar hemiarthroplasty (BH) and total hip replacement (THR) in elderly patients with neck of femur fracture.
**Aim:** To evaluate the functional outcome, complications and mortality of Bipolar Hemiarthroplasty and Total Hip Arthroplasty as a treatment modality in neck of femur fracture patients.
**Materials and Methods**: A prospective study was conducted in the Department of Orthopaedics, Rajah Muthiah medical college, in which 30 Patients of age 55 years and above who underwent hip arthroplasty (BHA or THA) for neck of femur fracture with follow up were included. Patients were separated into two groups by random allocation. Patients of group 1 (15 patients) were treated by bipolar hemiarthroplasty and group 2 (15 patients) by total hip arthroplasty. Both groups were followed up post-operatively for one year, at 6, 12 months, for surgical complications including dislocation, fracture, surgical site infection, and, one-year mortality and functional outcome using Modified Harris Hip Score.
**Results:** Modified Harris Hip Score was higher in Total hip arthroplasty group compared to bipolar hemiarthroplasty group, pain was similar in both groups post operatively. Gait and range of motion were higher in the Total Hip Arthroplasty group, no significant difference was seen in mortality and post-operative complications between the two groups.
**Conclusion:** In our study, we conclude that Total hip arthroplasty is ideal to treat femoral neck fractures in elderly patients with arthritic changes and has a lower risk of re operation when compared to Bipolar hemiarthroplasty, however bipolar hemiarthroplasty has a better outcome in cases of acute femoral neck fractures, based on our study.

**Keywords:** Total hip replacement, bipolar hemiarthroplasty, neck of femur fracture

## Introduction
Hip fracture is an international public health problem mainly occurring in elderly patients and resulting in a high mortality. With the aging population, the incidence of these fractures is steadily increasing. Indeed, decreased reflexes and visual impairment lead to a higher number of falls; in addition, osteoporosis is more common in the elderly. A femoral neck fracture is the most common hip fracture. Hip fracture is also associated with severe pain, increased risk of venous thromboembolism, avascular necrosis, and non-union. The 1-year mortality after hip fracture is 8% in women and 18% in men. Femoral neck fractures are common in developing countries. Femoral neck fracture in the elderly has become a worldwide health concern. The trend of rising in incidence with increasing age is alarming, and it is predicted that the prevalence of femoral fracture would rise to 6.26 million per year by 2050 worldwide [1]. Treatment choices for the neck of femur fractures in elderly patients includes total hip replacement (THR) and hemiarthroplasty (HA).

The treatment option should be decided by the type of fracture, the patients' condition, functional demands, medical and mental ability to cope up with the surgery [2, 3]. This study compares bipolar hemiarthroplasty (BH) and total hip replacement (THR) in elderly cases with the neck of femur fracture.

## Materials and Methods

A prospective randomized study including patients of neck of femur fractures reporting to Orthopaedic OPD and Orthopaedic Emergency unit of Rajah Muthiah Medical College, Annamalai University Chidambaram during the study period from May 2019 to October 2021. It was an open-ended prospective randomized study. Following were the inclusion and exclusion criteria for selecting patients in our study groups.

**Inclusion criteria**:

1. A femoral neck fracture, confirmed by X-ray;
2. Aged ≥55 years;
3. Being able to walk without aids (crutches, walkers) before the injury;

**Exclusion criteria**

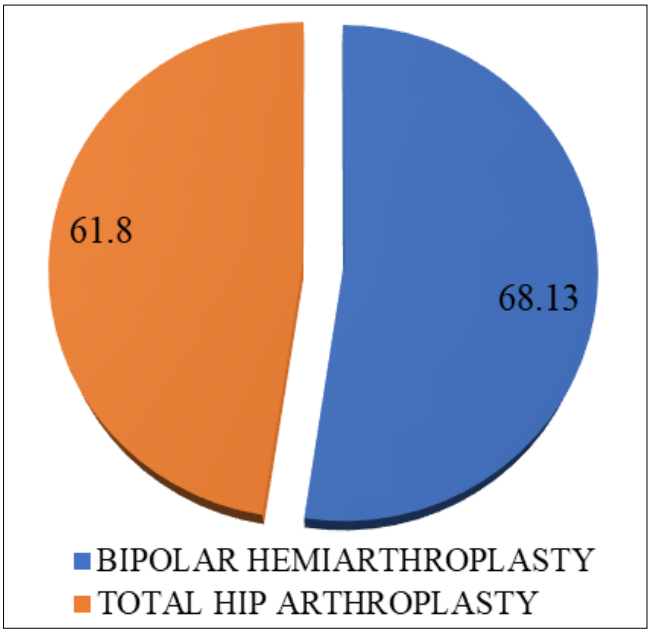
1. Active inflammatory disease;
2. Chronic hip pain and imaging revealing osteoarthritis or atrophic arthritis;
3. Any contraindication to surgery or anaesthesia;
4. Refusal to undergo surgery;

A detailed history was taken with particular importance on the mode of injury and associated medical illness. An in-depth clinical assessment was carried out in each case. In all patients, skin traction was applied pre-operatively to the affected limb for 2-3 days, to relieve pain, prevent shortening and to reduce movements of the injured limb. Analgesics were administered to relieve pain.

Patients were explained about the surgery and risk factors and written informed consent for the surgery was obtained from all patients. Antero-posterior radiographs of the affected hip joint of the pelvis with both hips and a 15 degrees internal rotation view to bringing the neck parallel to the radiograph film were taken for all the patients.

**Table 1:** Demographic Data of Study Groups

| Parameters | Bipolar hemiarthroplasty | Total hip arthroplasty |
|---|---|---|
| Mean age | 68.13 | 62.67 |
| **Gender** | | |
| Male | 08 | 07 |
| female | 07 | 08 |
| **Side** | | |
| Right | 07 | 09 |
| left | 08 | 06 |
| **Mode of trauma** | | |
| Self-fall | 11 | 09 |
| RTA | 04 | 06 |
| **Approach** | **Posterior southern moore** | **Posterior southern moore** |
| Cemented | 11 | 11 |
| Uncemented | 04 | 04 |




**Graph 1:** Mean Age

## Surgical technique and postoperative care

With tube to film distance of 40 inches to get standard magnification for templating, x-rays of both the hips with proximal half of femur-anteroposterior views in a neutral position and in 15 degrees of internal rotation and lateral views of both hips with upper half of thigh were taken. Computerized Tomography (CT) scan of both hips was required in some cases to attain more information regarding fibrous or bony ankylosis, cystic lesions in femoral heads, thickness of medial wall of acetabulum and defects in acetabular wall, particularly in cases of fracture-dislocations. Templating was done to choose appropriate implants and anticipating unusual needs during surgery. Prediction of size of acetabulum and femoral component were made out with the help of antero-posterior radiographs of the hip. All surgeries were performed by an experienced chief orthopaedic surgeon specialized in hip joint surgery. They were performed using the posterior southern moore approach with spinal anaesthesia (total hip replacement was performed with combined spinal/epidural anaesthesia) [16]. Both the surgical procedures were done using standard Moore's posterior approach.

**Fig 1:** Instruments in the armamentarium

**Fig 2:** Lateral position

**Fig 3:** Posterior southern moore approach

Starting an incision which is 10cm distal to the posterior superior iliac spine and extending it distally and laterally parallel with the fibers of the gluteus maximus towards the posterior margin of the greater trochanter, then directing the incision distally 10 to 13 cm, parallel to the femoral shaft.

- Expose and divide the deep fascia in line with the skin incision.
- The gluteus maximus fibers are separated by blunt dissection, taking care not to disturb the superior gluteal vessels in the proximal part of the exposure.
- By Retracting the proximal fibers of the gluteus maximus proximally, a greater trochanter is exposed and the distal fibers are retracted distally.
- Expose the sciatic nerve and retract it carefully. (After the surgeon becomes familiar with this approach, he or she rarely exposes the sciatic nerve). Divide a small branch of the sacral plexus to the quadratus femoris and inferior gemellus, containing sensory fibers in the joint capsule.
- Expose and divide the gemelli and obturator internus and, if desired, the piriformis tendon, place tag sutures in the tendons for later identification, and the muscles are retracted medially.
- The joint capsule is now exposed, using an inverted T-shaped incision, incise it from distal to proximal fashion along the line of the femoral neck to the rim of the acetabulum.
- The distal part of the capsule is detached from the femur.
- The fractured femoral head was delivered using a judet head extractor/corkscrew device aided with bone levers after cutting the ligamentum teres.

The anterior and posterior edges of the fascia are bluntly dissected from underlying gluteus medius fibers that insert into the undersurface of this fascia. Suture moist towels to the fascial edges anteriorly and posteriorly to exclude the skin, prevent dissection of the subcutaneous tissues, and collect cement and bone debris during the operation. Insert a Charnley self-retaining retractor beneath the fascia lata at the trochanter level. Excise residual soft tissue along the intertrochanteric line and expose the upper edge of lesser trochanter.

Mark the level at an angle of the proposed osteotomy of the femoral neck with the electrocautery or with a shallow cut with an osteotome. Many systems have a specific instrument for this purpose. If not, plan the osteotomy by using a trial prosthesis. Use the stem size and neck length trials determined by pre-operavite templating. Align the trial stem with the center of femoral shaft and match the center of trial femoral head with that of the patient. The level of the neck cut should be the same distance from the top of the lesser trochanter as determined by preoperative templating. Make the provisional femoral neck osteotomy 2 mm above this level. Carry out the osteotomy with an oscillating or

reciprocating power saw. If this cut passes below the junction of lateral aspect of the neck and greater trochanter, then a separate longitudinal cut will be required. Avoid notching the greater trochanter at the junction of these two cuts because this may predispose to fracture of the trochanter. Remove the remaining soft tissue attachments. Keep the head on the sterile field because it may be required for autogenous bone grafting.

**Exposure and Preparation of Acetabulum**

The femur is retracted anteriorly with a bone hook to place the capsule under tension. The anterior capsule is carefully divided. A curved cobra or Hohmann retractor is placed in between the anterior lip of the acetabulum and psoas tendon. Injury to femoral neurovascular structures should be avoided by carefully placing this retractor. The femur is retracted anteriorly and medially and rotated slightly to determine which position provides the best acetabular exposure. The rim of acetabulum's entire circumference is exposed to facilitate proper placement of the acetabular component. Any osteophytes that protrude beyond the bony limit of the true acetabulum are removed using an osteotome. The ligamentum teres is excised and any remaining soft tissues are curetted from region of the pulvinar. The medial wall of the acetabulum is located and assessed. The acetabulum is reamed with a bone-conserving cheese grater or mirra type reamer. Reaming is begum with the smallest size reamer and directed medially down to but not through the medial wall. The reaming depth is frequently checked to ensure that the medial wall is not breached. This will allow some millimeters of deepening of the acetabulum with improved lateral coverage of component. Larger reamers in 1 or 2 mm increments are used progressively. The femur is retracted well anteriorly so that reamers can be inserted from an anteroposterior direction without impingement. The acetabulum is irrigated frequently to assess the adequacy of reaming and make adjustments in the direction of reaming to make sure circumferential reaming takes place. Reaming is completed when all cartilage has been removed, the reamers have cut bone out to the periphery of acetabulum and a hemispherical shape has been produced. A bleeding subchondral bone bed is exposed but as much of the subchondral bone plate as possible is maintained. Before insertion of the acetabular component, true lateral position of the patient is ensured. If the pelvis has rotated anteriorly, the acetabular component can easily be placed in a retroverted position. Now trial acetabular component is inserted to determine the adequacy of fit, the presence of circumferential bone contact, and adequacy of bone coverage of the component.

**Fig 4:** Delivery of head

**Fig 5:** Acetabular reaming

**Fig 6:** Placing acetabular component

Most components incorporate a metal backing with surface texturing and a number of preformed PMMA pods that assure a uniform 3mm cement mantel. The components are not modular and therefore must be inserted as a single unit. Therefore the position of the offset must be selected before cementing the component. All polyethylene sockets usually are available in only a few sizes. The size of reamed acetabulum should be equal to the outside diameter of the component, which includes the spacers.

The implantable component is placed on the positioner so that it is immediately available when the cement is mixed. Multiple 6 mm holes are drilled through a subchondral bone plate of ilium and ischium is drilled for cement intrusion. But no holes are drilled through medial wall because it will allow cement intrusion into the pelvis. In case of accidental penetration through medial wall, it is obturated with bone grafts or a small wire mesh.

40 grams of cement is mixed for the acetabulum. Cement is best used in dough form and is inserted manually. Before handling the cement, a new pair of gloves is worn. The bolus of cement is placed into the acetabulum after it ceases to stick to the dry gloves and its surface becomes slightly wrinkled. Finger pack a smaller bolus of cement into each of previously prepared fixation holes. The cement is pressurized with an impact or plunger type device. Any blood on the surface of cement is removed with a dry sponge.

Now the acetabular component is inserted using the appropriate positioning device. The apex of the cup is placed in center of the cement mantle to evenly distribute the cement. No spacers are used; excessive pressure should be avoided since the cup can be bottomed out against the floor of the acetabulum producing a discoutinuity in the cement mantle. When the cement becomes moderately doughy, the positioning device replaced with a ball type pusher inserted into the socket to maintain the pressure as the cement hardens. The extruded cement around the edge of the component is trimmed with the knife.

After the cement has hardened completely, the stability of the newly implanted socket is checked by pushing on several points around the circumference with an impactor. If any motion is detected or blood or small bubbles extrude from the

interface then the component is loose and must be removed and replace.

**Exposure and preparation of femur**

The acetabulum is placed with a sponge to protect the acetabular component and prevent the introduction of debris during preparation and insertion of femoral component. By marked internal rotation, the proximal femur is exposed. Any soft tissue from lateral and posterior aspect of neck is removed. Remaining portions of the lateral aspect of neck should be removed to allow access to the center of femoral canal. A groove made in medial aspect of the greater trochanter allows proper axial reaming of the canal. If the proximal femoral cortex is thin or if stress risers are present, a cerclage wire can be placed around the femur above lesser trochanter level which will prevent inadvertent fracture.

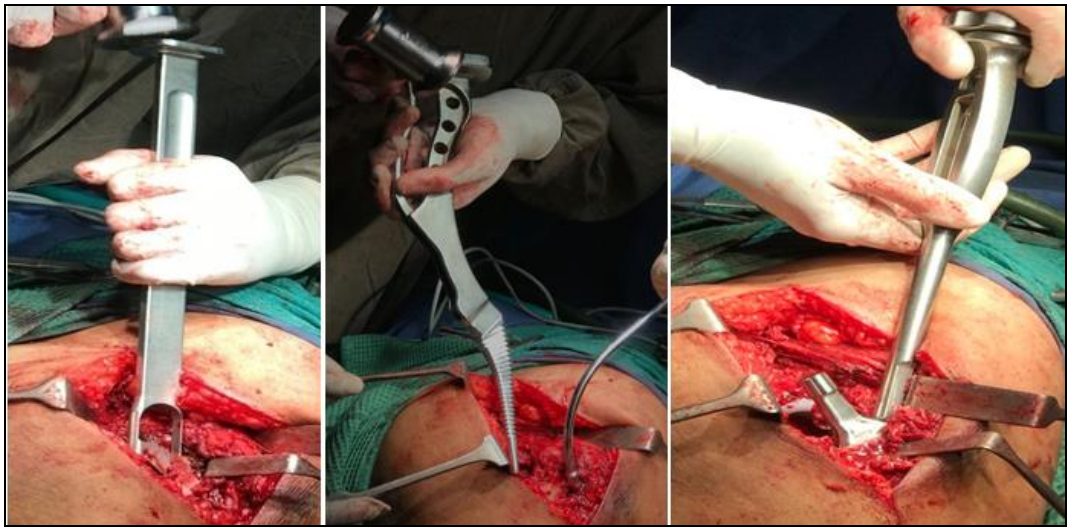


**Fig 7:** Femoral Preparation

**Implantation of cemented femoral component**

Cement fixation is indicated in patients with physiologic age greater 65 years and when the femoral cortex is thin or osteoporotic and secure press-fit fixation is unlikely.

A small tapered awl is inserted to locate the medullary canal. The tip of the awl is inserted into the lateral most aspect of the cut surface of the neck and then the awl is swung into the greater trochanter to point it toward the medial femoral condyle. This maneuver ensures neutral positioning of the femoral component. The proximal femur is reamed gradually with increasing size reamers. The trial component is introduced and reduction carried out to determine limb length. Depending on the discrepancy, the prosthesis is chosen.

The proximal femur is cleared of the debris. A vent is placed inside the medullary canal and connected to suction. After changing gloves, 40 grams of cement is mixed and the cement is moulded into the shape of a sausage and pushed into the canal using first generation cementing technique. After the cavity is filled, the cement is pressed with the thumb. If internal fixation devices have been removed from the femoral shaft during the same procedure, then the holes left in the femoral cortex must be occluded to allow pressurization of cement and to prevent egress into soft tissues.

Immediately following introduction of cement, the femoral component is kept ready with the desired amount of anteversion, the prosthesis is introduced manually. Fine pressure is maintained after impacting the prosthesis. The cement protruding out from the region of the collar should be removed so that the stem is inserted fully. The excess cement should be cut and removed and not pulled. Otherwise, the proximal support will be lost.

The acetabular pack is removed. All debris and blood collected should be removed carefully. Now the wound is irrigated with saline, after which the femoral head is reduced into place. Finally, the stability of the hip joint and movements are checked under direct vision.

Both acetabulum and femoral canal preparation is done in cases of Total hip Arthroplasty, whereas only femoral canal preparation is done in cases of Bipolar Hemiarthroplasty.

Soft tissues and capsules are sutured in layers. Two closed suction drainage tubes are inserted, one deep into the fascia and the other in the subcutaneous plane. The wound closed in the usual manner. After closure and dressing, the operated limb is maintained in abduction using a Charnley's wedge or two pillows.

**The post-operative regime and rehabilitation**

Surgery was done within 2-3 days after attaining fitness for anaesthesia in most of the patients. Similar post-surgical rehabilitation was followed for both the groups, which consisted of a joint-care programme rehabilitation protocol, they were started with functional exercises of the lower extremities on the day of the surgery, including isometric muscle contraction and relaxation, abduction, and hip flexion not exceeding 90° and knee extension. Activity intensity and frequency were based on individual tolerance. After X-ray verification and incision oozing disappearance, patients were instructed to walk with aids with partial weight loading. Patients were informed about risk factors for postoperative hip joint dislocation due to excessive internal rotation, excessive flexion, flexion adduction, internal rotation, and other positions. Active exercises and full weight-bearing were begun within the first three days after surgery as tolerated. Patients were discharged after 5-7 days and rehabilitated during the study period. Exercises for active muscle-strengthening were advised and range of motion was tested. On discharge, Some lifestyle modifications like not to squat and sit cross-legged, avoiding low-level chairs/sofas and sleeping on the operated limb were advised. Patients were advised to use a western type of seat in the toilet, maintain limb abduction, not to adduct, not to flex more than 90 degrees and internally rotate the hip. For functional assessment, Modified Harris Hip Score was assessed at 6, and 12 months post operatively

Excellent - 90- 100
Good – 80 - 89
Fair - 70 – 79
Poor - < 70

Pain:
___None/ignores (44points)
___Slight, occasional, no compromise in activity (40 points)
___Mild, no effect on ordinary activity, pain after activity, uses aspirin (30 points)
___Moderate, tolerable, makes concessions, occasional codeine (20 points)
___Marked, serious limitations (10 points)
___Totally disabled (0 points)

Function: Gait
Limp
___None (11 points)
___Slight (8 points)
___Moderate (5 points)
___Severe (0 points)
___Unable to walk (0 points)

Support
___None (11 points)
___Cane, long walks (7 points)
___Cane, full time (5 points)
___Crutch (4 points)
___2 canes (2 points)
___2 crutches (1 points)
___Unable to walk (0 points)

Distance Walked
___Unlimited (11 points)
___6 blocks (8 points)
___2-3 blocks (5 points)
___Indoors only (2 points)
___Bed and chair (0 points)

Functional Activities:
Stairs
___Normally (4 points)
___Normally with banister (2 points)
___Any method (1 points)
___Not able (0 points)

Socks/Shoes
___With ease (4 points)
___With difficulty (2 points)
___Unable (0 points)

Sitting
___Any chair, 1 hour (5 points)
___High chair, ½ hour (3 points)
___Unable to sit, ½ hour, any chair (0 points)

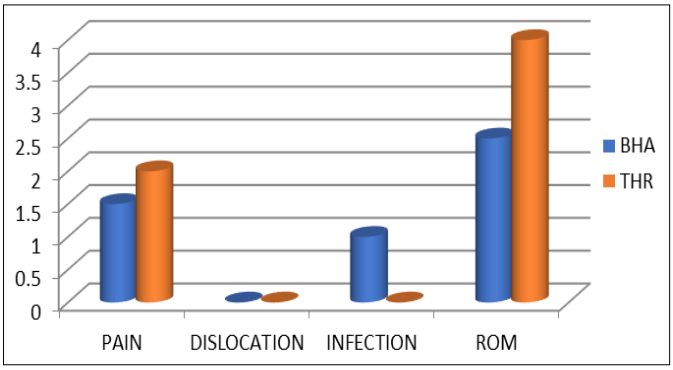
Public Transportation
___Able to enter public transportation (1 points)
___Unable to use public transportation (0 points)

**Modified Harris hip score**

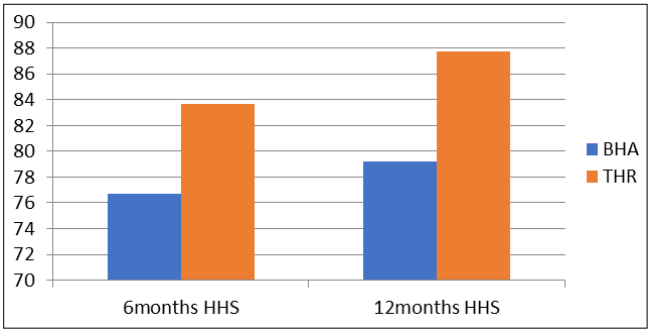
As one of the most important measurement tools, the Harris hip score was used to investigate the living status of patients. From three independent studies [14, 18, 19], we extracted that hip function reached its peak one year after surgery. All the cases in our series were assessed according to the modified Harris Hip Score and graded accordingly as Excellent, Good, Fair, Poor and Failure

**Discussion**

Our results favored total hip arthroplasty as hip function improved significantly when compared to the hemiarthroplasty group within 1year after surgery. Cadossi *et al*. noted from 3 m to 3 y postoperatively, the higher HHS transferred from B HA to THR and the dominance of Total Hip Arthroplasty seemed to be evident. A similar result was reported by Hedbeck with the same duration of follow-up.




**Graph 2:** Complications and range of motion observed



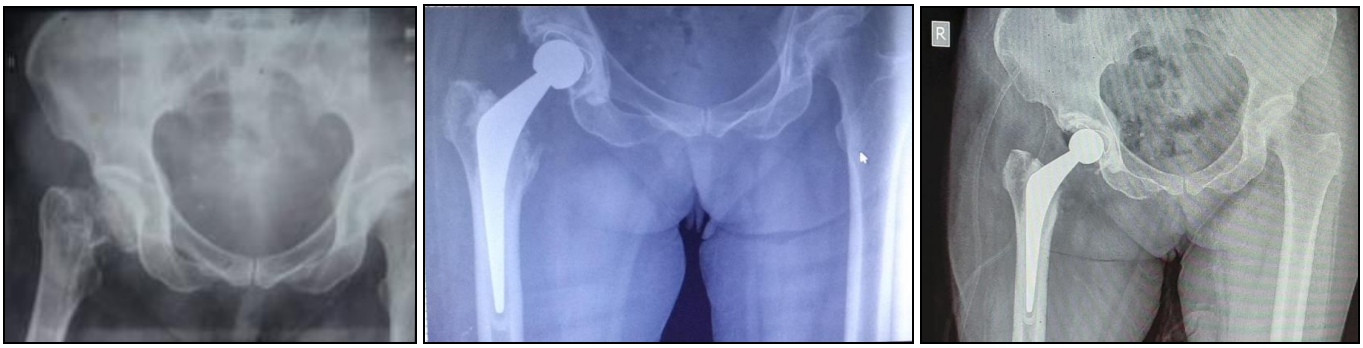

**Graph 3:** Follow up HHS

Mean duration of surgery in the THR group (110.00 min) was higher than the mean duration of surgery in the bipolar prosthesis group (82.12 min) ($p$< 0.0001). The mean blood loss in the Total Hip Arthroplasty group (468.18 ml) was higher than the mean blood loss in the bipolar prosthesis group (320.40) (p = 0.015). Thus, the bipolar prosthesis treatment was found better than THR in relation to duration of surgery and total blood loss during surgery. At six months, the modified Harris Hip Score was measured in both groups. The total score in the bipolar prosthesis group was 74.68 in comparison to 80.68 in the THR group. The difference was significant ($p$-value < 0.0001). At six months, the modified Harris Hip Score in the THR group was better than in the bipolar prosthesis group. There was no significant difference in mean pain score of bipolar prosthesis group or the THR group ($p$-value = 0.083). Gait score and activity score were significantly higher in THR than bipolar prosthesis group. At 12 months, the Harris Hip Score was measured in both the groups. The total score in the bipolar prosthesis group was 78.24 compared to 84.73 in the Total Hip Arthroplasty group. The difference was significant ($p$-value < 0.0001). At 12 months, Harris Hip Score in THR group was better than the bipolar prosthesis group.

In our study, we had one (4%) superficial infection in the bipolar group and one (4.5%) superficial infection in the Total Hip Arthroplasty group. Blomfeldt *et al.* [7] reported two cases of superficial infection in both the groups and one case of deep infection, which required wound debridement. No case of deep infection was noted in our study. Superficial infection was seen in the patients who were diabetic and anaemia. They developed signs of infection in the first post-operative week. They were treated with appropriate antibiotics and dressings. All these infections were found when the patients were still in the hospital and this resulted in the prolongation of their hospital stay. In our study, there was no incidence of peri-prosthetic fracture, while one patient of THR group developed a peri-prosthetic fracture in similar study by Blomfeldt *et al.* [7]. There were no dislocations in any patient in our study. This matches with the results of similar study by Blomfeldt *et al.* [7] This is in contrast to other reports on primary THR in patients with femoral neck fractures using the postero-lateral approach, the dislocation rate ranged between 13% and 22% 1,8-10. Our results were similar to the study by Blomfeldt *et al.* [7] who reported mean Harris Hip Score 77.5 in bipolar prosthesis and 82.5 in THR group, which was statistically significant with $p$-value 0.011 at four months and 79.4 in the bipolar prosthesis and 87.2 in the THR group, with $p$-value <0.0001.

**Case Illustration**

**Case 1**

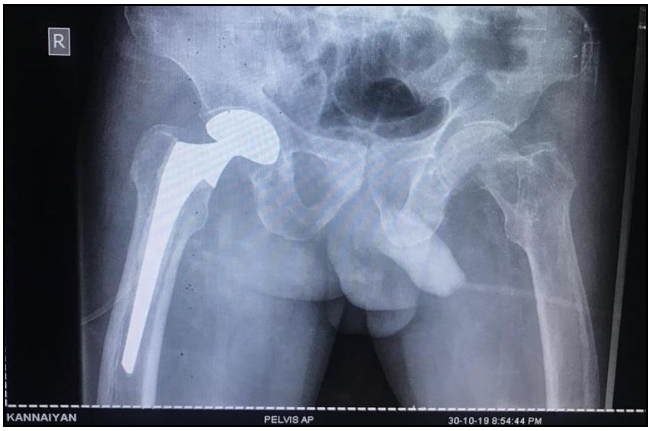


**Pre op x ray** **8 months follow up** **Immediate Post op x ray**

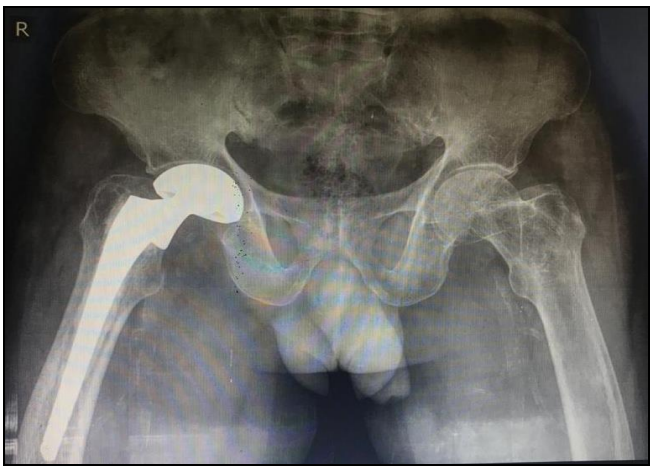
**Clinical follow up 8 months**

**Case 2**

**Pre-op x-ray**




**Immediate post-op x-ray**




**6 months follow up x-ray**

## Results

- Mean *duration of surgery* in the THR group was significantly higher than the mean duration of surgery in the bipolar prosthesis group ($p< 0.0001$).
- The mean blood loss in the THR group (468.18 ml) was higher than the mean blood loss in the bipolar prosthesis group (320.40) Thus, the bipolar prosthesis treatment was found to be better than THR in relation to duration of surgery and total blood loss during surgery.
- There was no significant difference in the mean pain score of bipolar prosthesis group or the THR group ($p$-value = 0.083).

## Conclusion

Based on our study, we conclude that THR was a better option to treat displaced fracture neck femur in elderly active patients.: In our study, Total hip arthroplasty provides the better hip functional outcome in terms of Gait and range of motion and does not increase mortality or morbidity and total hip arthroplasty has a lower risk of re operation as compared to Bipolar hemiarthroplasty, In our study, we conclude that Total hip arthroplasty is ideal to treat fracture neck of femur in active elderly patients and has a lower risk of re operation as compared to Bipolar hemiarthroplasty.

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