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Original Research Article

A Comparison of Unipolar and Bipolar Hemiarthroplasty for Displaced Fracture Neck of Femur in Adults

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Conflict of interest: Nil

Abstract:

Background: Displaced fractures of the femoral neck in adults and their associated complications contribute significantly to morbidity and mortality. Early patient mobilization and extended productive life are facilitated through unipolar and bipolar hemiarthroplasty. The current study aimed to evaluate the short-term functional and radiological outcome of Unipolar and Bipolar hemiarthroplasty in displaced intracapsular fracture neck of the femur.

Methods: This study included 40 patients with intracapsular femoral neck fractures. Out of these, 20 patients underwent treatment with unipolar hemiarthroplasty, and the remaining 20 received bipolar hemiarthroplasty. Functional outcomes were assessed in both groups using the Harris Hip Score, and radiological evaluations were conducted.

Results: The postoperative Harris Hip Scores (HHS) of patients who underwent unipolar (UPHA) and bipolar (BPHA) hemiarthroplasty for displaced fracture neck of the femur in adults. The majority of patients in both groups had excellent (50% UPHA, 60% BPHA) or good (45% UPHA, 35% BPHA) HHS scores after surgery. A small percentage of patients in both groups had fair (5% UPHA, 5% BPHA) HHS scores after surgery. No patients in either group had poor HHS scores after surgery.

Conclusion: Based on our study findings, we concluded that uncemented bipolar hemiarthroplasty delivered superior outcomes compared to uncemented unipolar hemiarthroplasty. Additionally, our results indicated that cemented bipolar hemiarthroplasty yielded better clinical and radiological outcomes compared to cemented unipolar hemiarthroplasty.

Keywords: Intra-Capsular Femoral Neck Fractures, Displaced Femur Neck Fractures, Bipolar Hemiarthroplasty, Unipolar Hemiarthroplasty.

Introduction

The hip joint is a synovial joint of the ball-and-socket type, connecting the pelvis and femur. This pivotal joint links the axial skeleton to the lower extremity, allowing tri-planar movement of the entire lower limb and providing essential shock absorption for the upper body and torso. Hip fractures are a common occurrence and constitute a significant portion of an orthopedic trauma unit's operative workload, making up about 20%. [1] Intra-capsular fractures of the femoral neck account for half of all hip fractures. The lifetime risk of a hip fracture at 50 years of age is estimated to be 5.6% for men and 20% for women. [2] In cases of undisplaced intra-capsular hip fractures, which make up a mere 15%, fixation is the typical treatment. However, the majority of these fractures are displaced, occurring predominantly in elderly female patients. [3] Current treatment guidelines recommend arthroplasty procedures for treating displaced intra-capsular femoral neck fractures. Prosthetic replacement enables immediate weight-bearing, aiding in the swift return of elderly patients to their daily activities, thus reducing complications associated with prolonged recumbency and inactivity. [4] Prosthesis-related complications encompass peri-prosthetic fractures, dislocation, infection, aseptic loosening, acetabular wear, and the potential occurrence of bone cement implantation syndrome. [5] Given the challenges posed by persistent pain and protrusio-acetabuli with unipolar hemiarthroplasties, many surgeons favor the use of a bipolar system. The theoretical advantage of bipolar hemiarthroplasty lies in reduced acetabular wear due to the dual-bearing system. [6] However, a potential downside is the risk of polyethylene wear. This study aims to

compare the efficacy of two prosthetic options, namely, the unipolar and bipolar prostheses, in managing displaced intra-capsular femoral neck fractures in the age group of 46 to 75 years among elderly individuals.

Material and Methods

This cross-sectional study was done in the Department of Orthopedics, Prathima Institute of Medical Sciences, Naganoor, Karimnagar, Telangana State. Institutional Ethical approval was obtained for the study. Written consent was obtained from all the participants after explaining the nature of the study in the vernacular language.

Inclusion Criteria

1. Individuals of both genders aged between 45 and 75 years.
2. Displaced femoral neck fractures within the hip joint capsule with sufficient calcar.
3. Femoral neck fractures within the hip joint capsule present within 6 weeks of the injury.

Exclusion Criteria

1. Femoral neck fractures in individuals younger than 45 years.
2. Femoral neck fractures outside the hip joint capsule.
3. Patients diagnosed with neurological disorders.
4. Patients with concomitant ipsilateral or contralateral fractures of the upper and lower extremities.
5. Femoral neck fractures due to pathological causes.

This study included 40 patients with intracapsular femoral neck fractures. Out of these, 20 patients underwent treatment with unipolar hemiarthroplasty, and the remaining 20 received bipolar hemiarthroplasty. Functional outcomes were assessed in both groups using the Harris Hip Score, and radiological evaluations were conducted. Before the surgery, patients underwent a pre-operative assessment using the Harris Hip Score, which encompasses pain level, functional ability, absence of deformities, and range of motion. Additionally, the patient's overall medical condition, physical status, and ability to endure surgery were taken into account. Physical status evaluation included an assessment of both upper and lower extremities, the opposite hip, both knees, feet, and spine, considering any fixed deformities and discrepancies in limb length. A comprehensive pre-operative evaluation was conducted as a routine procedure, including complete blood count, ASO, ESR, CRP, urine analysis, chest X-ray, and ECG.

A preoperative radiographic evaluation was conducted, comprising an anteroposterior (AP) view X-ray of the pelvis with both hips. AP view X-ray of the affected hip in internal rotation

The objectives of pre-operative planning were:

1. Accurately determining the optimal site, size, and type of implant (uncemented/cemented).
2. Restoring the anatomical and biomechanical center of rotation within the hip joint.
3. Addressing any limb length discrepancy appropriately.
4. Restoring the correct muscle relationships.

Surgical Procedure: Patient Preparation On the day of the surgical procedure, the skin was sterilized using a povidone-iodine solution and covered with sterile drapes. Prophylactic antibiotics were administered before the surgery, with Cefoperazone + Sulbactam 1.5 gm given parenterally after the test dose. Operating Room All hemiarthroplasties were performed in operating rooms equipped with laminar airflow systems. Anesthesia, Positioning, and Surgical Approach Generally, either spinal or general anesthesia was administered. The patient was positioned in the lateral decubitus position. The posterior approach was utilized.

Preferred Approach Based on Patient Factors: Cemented hemiarthroplasty was our preference for patients older than 60 years with thin or osteoporotic femoral cortices, where a secure press-fit fixation was doubtful. Broaches were inserted at approximately 15 degrees of anteversion about the axis of the knee. Correct axial alignment was maintained during broach insertion. The broach was impacted and extracted alternately to facilitate its passage. Given that fixation would be achieved with cement, the broach's absolute stability was not crucial. A trial reduction was then performed to establish limb length with the cementless prosthesis. Since the stem was to be fixed with cement, the component's insertion depth was predetermined. The appropriate component sizes were then selected, and limb length and stability were assessed. Loose cancellous bone from the medial aspect of the proximal femur was removed using straight and angled curettes

Cemented Femoral Component Implantation: For a standard-sized femoral stem, two packages of cement were mixed. The cement was inserted into the canal using the index finger or thumb of the opposite hand. After filling the cavity, the cement was pressed with the thumb, and a mechanical impactor or plunger was used. The desired anteversion was determined, and the medial/lateral position of the stem was ascertained before insertion. The tip of the stem was inserted at the center of the cement mantle. Cement was cleared from the collar region. Firm pressure was maintained on the component's head as the cement hardened. The cement was trimmed around the edges of the prosthesis as it reached the doughy phase. The anterior aspect of the femoral neck was checked to ensure no protruding cement that could

cause impingement and dislocation. The position and stability of the femoral component were verified. If satisfactory, the hip was reduced, and stability was confirmed.

Uncemented Femoral Component Implantation: The reamer was inserted at a point corresponding to the piriformis fossa, kept slightly posterior and lateral on the neck of the femur's cut surface. After reamer insertion, the handle was directed laterally toward the greater trochanter. The reamer was aimed down the femur towards the medial femoral condyle. A groove was typically made in the medial aspect of the greater trochanter to enable proper axial reaming of the canal. The appropriate reamer insertion depth was determined, and stability within the canal was assessed. The residual cancellous bone along the medial aspect of the neck was removed using broaches. An appropriately sized femoral component was then inserted. Debris from the acetabulum was cleared, and the hip was reduced. The stability of the hemiarthroplasty was confirmed through a full range of motion.

Posterior Soft Tissue Envelope Repair: Following the hip reduction in both cemented and uncemented hemiarthroplasties, repair of the posterior soft tissue envelope was performed. If the capsule was preserved, it was repaired using heavy non-absorbable sutures. The tendons of short external rotators were reattached to the greater trochanter's posterior aspect. The wound was then closed in layers, with a drain in place.

Postoperative Care and Rehabilitation: Antibiotics Post-operatively, the patient received parental Cefaperaxone with Sulbactam 1.5 gm for the first 5 days.

Post-operative Care: The patient was placed in the post-operative ward under strictly aseptic conditions. The limb was protected with an abduction pillow placed between the legs and a small pad beneath the knee to maintain slight flexion. The drain was removed on Postoperative Day (POD) 2.

Rehabilitation Protocol: Pre-operative instructions on exercises were provided by the physiotherapist. Exercises such as ankle dorsiflexion and plantar flexion, quadriceps, and gluteal exercises were initiated once the pain subsided. Upper limb and deep breathing exercises were also commenced. Patients were assisted to sit in bed on POD 1. After drain removal, patients were made to stand and walk non-weight bearing with walker support if a cemented implant was used. Sutures were removed on POD 12.

Patient Instructions: Patients were advised to avoid adduction, flexion, and internal rotation. Activities like squatting and sitting cross-legged were also discouraged. Clinical evaluation was conducted post-surgery using the Harris Hip Score, and radiological evaluations were performed through plain X-ray pelvis, both hips and proximal femur AP view at regular intervals. For the uncemented group, non-weight bearing (NWB) gait with walker was initiated by POD 7, progressing to partial weight-bearing (PWB) at 4 weeks, and then to full weight-bearing (FWB) by 6 weeks.

Follow-up: Patients were regularly reviewed at 6 weeks, 3 months, 6 months, 1 year, and subsequent annual follow-ups.

Results

Table 1 shows the age group-wise distribution of cases included in the study, for both unipolar (UPHA) and bipolar (BPHA) hemiarthroplasty for displaced fracture neck of femur in adults.

Table 1: Age-wise distribution of cases included in the study

Age group	45 – 50	51 – 60	61 – 70	> 70	Total
UPHA	5	4	10	1	20
BPHA	3	6	11	0	20
Total	8	10	21	1	40

The majority of cases in both groups were in the 61-70 age group (UPHA: 50%, BPHA: 55%). This is followed by the 51-60 age group (UPHA: 20%, BPHA: 30%) and the 45-50 age group (UPHA: 25%, BPHA: 15%). The lowest number of cases in both groups was in the >70 age group (UPHA: 5%, BPHA: 0%).

Table 2: Post-Operative Harris Hip Scores

HHS score	Range	UPHA		BPHA	
		Frequency	Percentage	Frequency	Percentage
Excellent	90 – 100	10	50	12	60
Good	80 – 89	9	45	7	35
Fair	70 – 79	1	5	1	5
Poor	< 70	0	0	0	0
Total		20	100	20	100

Table 2 shows the postoperative Harris Hip Scores (HHS) of patients who underwent unipolar (UPHA) and bipolar (BPHA) hemiarthroplasty for displaced fracture neck of the femur in adults. The majority of patients in both groups had excellent (50% UPHA, 60% BPHA) or good (45% UPHA, 35% BPHA) HHS scores after surgery. A small percentage of patients in both groups had fair (5% UPHA, 5% BPHA) HHS scores after surgery. No patients in either group had poor HHS scores after surgery.

Radiological Assessment: Observations and measurements were performed on the anteroposterior radiograph of the hip. The radiographic assessment involved an examination of the following parameters.

1. Femoral Component Stability: None of our cases exhibited femoral component loosening.
2. Position of Femoral Stem: The positioning of the femoral component in the frontal plane was measured using anteroposterior radiographs. Our study yielded the following results.

Table 3 shows the stem position at the end of a one-year follow-up for unipolar (UPHA) and bipolar (BPHA) hemiarthroplasty for displaced fracture neck of the femur in adults. The majority of patients in both groups had a neutral stem position at the end of the one-year follow-up (UPHA: 75%, BPHA: 85%). A small percentage of patients in both groups had a varus (UPHA: 15%, BPHA: 5%) or valgus (UPHA: 10%, BPHA: 10%) stem position at the end of a one-year follow-up. It appears that bipolar hemiarthroplasty may be slightly better than unipolar hemiarthroplasty in terms of stem positioning.

Table 3: Stem position at the end of one-year follow-up

	UPHA		BPHA	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Neutral	15	75	17	85
Varus	3	15	1	5
Valgus	2	10	2	10

Table 3 shows the stem position at the end of a one-year follow-up for unipolar (UPHA) and bipolar (BPHA) hemiarthroplasty for displaced fracture neck of the femur in adults. The majority of patients in both groups had a neutral stem position at the end of the one-year follow-up (UPHA: 75%, BPHA: 85%). A small percentage of patients in both groups had a varus (UPHA: 15%, BPHA: 5%) or valgus (UPHA: 10%, BPHA: 10%) stem position at the end of a one-year follow-up. It appears that bipolar hemiarthroplasty may be slightly better than unipolar hemiarthroplasty in terms of stem positioning.

Table 4: The incidence of complications recorded in the cases of the study

Complications	***UPHA***		***BPHA***	
	Frequency	***Percentage***	***Frequency***	***Percentage***
Minor complications				
Superficial infection	1	5	1	5
Gaping	0	0	0	0
Total				
Major complications				
Painful hip	1	5	0	0
Posterior dislocation	0	0	1	5
Acetabular erosion	0	0	0	0
Restriction of movement	0	0	0	0
Total	1	5	1	5

Table 4 shows the incidence of complications recorded in the cases of the study for unipolar (UPHA) and bipolar (BPHA) hemiarthroplasty for displaced fracture neck of the femur in adults. The overall incidence of complications in both groups was low (5%). The most common complication in both groups was a superficial infection (5% in both groups). The only major complication that occurred in the study was a posterior dislocation in one patient in the BPHA group (5%). This shows that bipolar hemiarthroplasty may be slightly better than unipolar hemiarthroplasty in terms of the risk of major complications.

Discussion

Hemiarthroplasty considered an effective technique for addressing femoral neck fractures, facilitates early mobility and satisfactory functional recovery, gaining increasing popularity among surgeons. [7-9] However, a long-standing debate has persisted regarding the choice between bipolar and unipolar prostheses. This study proposes that: (1) Bipolar hemiarthroplasty exhibits comparable or superior

enhancements in hip functionality, hip pain relief, and overall quality of life in comparison to unipolar hemiarthroplasty, albeit at a higher cost; and (2) There are no significant disparities in operation duration, blood loss, blood transfusion, hospitalization duration, mortality, reoperation rates, dislocation incidents, and overall complications between bipolar and unipolar hemiarthroplasty. Furthermore, (3) Bipolar hemiarthroplasty does not seem to significantly reduce acetabular erosion rates over the long term when contrasted with unipolar hemiarthroplasty. In comparison to unipolar hemiarthroplasty, the bipolar prosthesis, featuring an additional inner articulation, presents potential advantages such as reduced acetabular erosion and decreased dislocation rates. [10, 11]

In our patient cohort, the average age was 68.5 years, aligning closely with the findings of Somashekar et al. [12], who reported an average age of 71.45 years. They found that the mean Harris Hip Score (HHS) for Bipolar Hemiarthroplasty (BPHA) was 86.18 and for Unipolar Hemiarthroplasty (UPHA) was 79.79. In our study, the mean HHS for BPHA was 92.3, and for UPHA, it was 87.5. Similar results were also reported by Yamagata et al. [13] also noted a higher HHS for BPHA compared to UPHA. This observation was corroborated by Lestrange et al. [14]. Within the UPHA group in our study, we encountered minor complications in 5% of cases and major complications in 5% of cases. In contrast, the BPHA group exhibited minor complications in 5% of cases and major complications in 5% of cases. Posterior dislocation of a prosthetic hip is relatively common within the first 6 weeks post-operation. To mitigate such occurrences, movements like adduction across the midline, hip flexion exceeding 80 degrees, and internal rotation should be avoided. D'Arcy et al. [15] reported an incidence of prosthetic dislocation ranging from 0.3% to 10%. Sikorski et al. [16] reported a dislocation rate of 10% in the UPHA group in their study.

The overall functional outcome demonstrated significant improvement in the Bipolar Hemiarthroplasty (BPHA) group. Lestrange et al. [14], in their extensive review of 496 patients, emphasized that BP prostheses, owing to their bipolar construct, offer enhanced stability, lower propensity for causing acetabular erosion, and result in improved functionality. Within the Unipolar Hemiarthroplasty (UPHA) group, we encountered 5% of cases of painful hips. This limitation of UPHA has also been underscored by Lunceford Jr. et al. [17], although he emphasized that it shouldn't serve as a basis for disapproving of this procedure. Slighter greater neck excision in UPHA can lead to alterations in the abductor mechanism, potentially causing limping or necessitating the use of a walking aid. In our study, 5% of UPHA cases required a walking stick at the 18-month follow-up; however, it's noteworthy that both these patients were above 70 years of age. Similar findings have been reported by Cornell et al. [18] and Sabnis et al. [19]. Hemiarthroplasty proves to be an outstanding treatment approach for intracapsular femoral neck fractures, effectively alleviating pain and restoring function and mobility to levels close to those before the injury. In our investigation, bipolar hemiarthroplasty for intracapsular femoral neck fractures exhibited superior functional and radiological outcomes when compared to unipolar hemiarthroplasty for the same type of fractures.

Conclusion

Based on our study findings, we concluded that uncemented bipolar hemiarthroplasty delivered superior outcomes compared to uncemented unipolar hemiarthroplasty. Additionally, our results indicated that cemented bipolar hemiarthroplasty yielded better clinical and radiological outcomes compared to cemented unipolar hemiarthroplasty. Hemiarthroplasty stands as an outstanding treatment for intracapsular femoral neck fractures, providing significant pain relief and facilitating the restoration of function and mobility as closely as possible to the pre-injury level. In our study, bipolar hemiarthroplasty for intracapsular femoral neck fractures demonstrated superior functional and radiological results when compared to unipolar hemiarthroplasty for the same type of fractures.

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