

Comparative Evaluation of Cemented and Uncemented Bipolar Hemiarthroplasty for Femoral Neck Fractures in Elderly Patients

Dr Akileshwar S^{*1}, Dr Madhukar², Dr Venkata Kiran Pillella³, Dr Hemanth Raj⁴, Dr Abraham M. Antony⁵

¹*MS Orthopaedics, Junior Resident, Final Year, Department of Orthopaedics, Bharath University, Sree Balaji Medical College and Hospital, Chennai – 600044, Tamil Nadu, India. ORCID ID: 0009-0001-1920-6346, Email: Akileshwar.senthil@gmail.com

²DNB Ortho, Professor & Unit Chief, Guide. Department of Orthopaedics, Bharath University, Sree Balaji Medical College and Hospital, Chennai – 600044, Tamil Nadu, India, ORCID ID: 0000-0002-0719-9679. Email: drmadhukarca@gmail.com

³Associate Professor, MS Orthopaedics, DNB Orthopaedics, Department of Orthopaedics, Bharath University, Sree Balaji Medical College and Hospital, Chennai – 600044, Tamil Nadu, India. Email: hemanthrajcmc86@gmail.com

⁴Associate Professor, MS Orthopaedics, Department of Orthopaedics, Bharath University, Sree Balaji Medical College and Hospital, Chennai–600044, Tamil Nadu, India. ORCID ID:0000-0003-0642-4990. Email: Vk0772145@gmail.com

⁵MS Ortho, Senior Resident. Department of Orthopaedics, Bharath University, Sree Balaji Medical College and Hospital, Chromepet, Chennai 600044, Tamil Nadu, India. ORCID ID:0000-0001-9107-0538. Email: drabrahammantony@gmail.com

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ABSTRACT:

Elderly people frequently suffer from expatriate femoral neck fractures, which are linked to significant morbidity, death, and functional disability. Although the best fixing technique is still up for debate, bipolar hemiarthroplasty is the recommended course of treatment. To assess the clinical, functional, radiological, and perioperative results of cemented and uncemented bipolar hemiarthroplasty in elderly patients with displaced femur neck fractures. Thirty patients—fifteen undergoing cemented and fifteen undergoing uncemented bipolar hemiarthroplasty—were included in prospective comparative observational research. Over the course of a six-month follow-up, hospital stays, blood loss, operating time, postoperative discomfort, range of motion, Harris Hip Score, walking abilities, radiological findings, and complications were evaluated. Cemented hemiarthroplasty was associated with significantly longer operative time and greater blood loss but demonstrated lower postoperative pain and better early hip range of motion. Functional recovery improved progressively in both groups, with comparable Harris Hip Scores and radiological outcomes at six months. Although independent ambulation was more frequent in the cemented group, overall complication rates did not differ significantly. Both cemented and uncemented bipolar hemiarthroplasty provided satisfactory outcomes. Cemented fixation offered superior early functional recovery, whereas uncemented fixation reduced operative time and blood loss, supporting individualized treatment selection

based on patient characteristics and surgical considerations.

Keywords: Uncertainty modeling, Uncertainty quantification, Probability theory, Bayesian inference, Monte Carlo simulation, Machine learning uncertainty

1. Introduction

Due to their high incidence, morbidity, mortality, and socioeconomic ramifications, femoral neck fractures are among the most debilitating musculoskeletal injuries in the elderly population and a significant global public health concern. The number of hip fractures in the world has also been rising, due in part to the increasing life expectancy and the rise in the prevalence of osteoporosis in recent years, with projections of this upward trend continuing in the coming decades (Cooper et al., 1992). Epidemiological studies have shown that hip fracture is a condition that mainly concerns older adults, especially females, due to age-related bone loss, reduced bone mineral density and increasing vulnerability to low-energy injuries, like through trivial falls (Kannus et al., 1996). Hip fractures are also linked to loss of independence, poor quality of life and even death, are a significant financial burden for healthcare systems and their effective management is a focus of contemporary orthopaedic practice (Brauer et al., 2009).

Due to the disruption of the femoral head's blood supply, patients with displaced intracapsular fractures of the femoral neck are at risk of avascular necrosis and non-union after surgery. Hence, arthroplasty has been favored as a treatment for the older patients with displaced femoral neck fractures for dependable pain management, prompt mobilisation, and functional rehabilitation. Bipolar hemiarthroplasty has become widely accepted because it can preserve the bone stock of the acetabulum and allows immediate weight bearing and minimizes risks of fixation related complications (Rogmark et al., 2002). Additionally, systematic evidence has shown that, for the right patient population, hemiarthroplasty is superior to other treatment modalities for proximal femoral fractures in elderly people (Parker & Gurusamy, 2006).

Although bipolar hemiarthroplasty is commonly

performed, the choice between cemented and uncemented femoral stem fixation is still up for debate. Cemented fixation offers the advantage of immediate stability of the implant, better load distribution and less postoperative thigh pain which could help a quicker recovery of function. Bone cement implantation syndrome (BCIS), including hypotension, hypoxia and, in some severe cases, cardiovascular collapse has been associated with the use of bone cement, especially in elderly patients with multiple comorbidities (Donaldson et al., 2009). Uncemented implants, on the other hand, do not have cement-related issues, and they may have lower operative times and less blood loss during surgery, but may be linked to higher postoperative thigh pain, and more periprosthetic fractures in osteoporotic bone in the early stages (Taylor et al., 2012).

Multiple comparative studies have been performed to find what method of fixation is best for bipolar hemiarthroplasty. Figved et al. (2009) found that cemented hemiarthroplasty resulted in better early functional results and lesser postoperative pain, but was not associated with greater major complications. Likewise, it has been shown that long-term follow-up of the same randomized group of patients showed that functional benefits were maintained and implant survival was satisfactory in the cemented fixation group (Langslet et al., 2014). However, variations in patient population, implant types, surgical procedures, and outcome measures have led to conflicting results in studies, and there has yet to be a clear consensus on the relative superiority of one fixation method over another. Thus, there is still room for additional institution-specific clinical evidence that helps answer the question of what is best to do with a patient's surgical options.

By analysing the following factors, operative parameters, postoperative recovery, functional

performance, radiological findings, and complications, this study seeks to demonstrate the relative efficacy and safety of both fixation procedures in the study population.

Research Objectives

- To evaluate the perioperative results of bipolar hemiarthroplasty, both cemented and uncemented, in older patients with femur neck fractures.
- To assess and contrast the radiological, functional, and clinical results of cemented versus uncemented bipolar hemiarthroplasty.
- To evaluate and contrast cemented and uncemented bipolar hemiarthroplasty-related postoperative sequelae.

2. Review of Literature

The treatment of elderly patients with displaced femur neck fractures has changed significantly during the last few decades. Due to the increased risk of non-union and avascular necrosis in addition to the increased expense of revision surgery, hip replacement surgery has become the preferred treatment for the majority of the most active elderly patients. The classic Garden classification is still used today to help guide treatment and is based on the fracture displacement and stability and will aid in the selection of the appropriate patient for arthroplasty (Garden, 1961). It has been the general consensus in standard orthopaedic texts that HA should be performed in elderly patients with displaced intracapsular fractures as it permits early mobilisation and provides good pain relief with reduced fixation-related complication rates (Rockwood et al., 2006). A complete meta-analysis by Lu-Yao et al. (1994) also revealed that the results of arthroplasty were improved than those of internal fixation in fractured femoral necks with displacement, especially in elderly patients with poor bone quality. Likewise, the Cochrane review by Parker and Gurusamy (2006) found that arthroplasty is more predictable in terms of functional recovery and less likely to require reoperation than is internal fixation.

The use of hemiarthroplasty is now well accepted, but there remains controversy about the

application of cemented versus uncemented femoral stem fixation. Cemented fixation offers immediate implant stability and will improve fixation in osteoporotic bone, whereas an uncemented stem will avoid cement-related complications and, often, reduce the complexity of the operation. In a meta-analysis of cemented vs uncemented hemiarthroplasty, Li et al. (2013) discovered that cemented fixation was linked to better hip function, less discomfort following surgery, and fewer implant-related problems, but it also resulted in more blood loss and longer operating times. This has been corroborated by the findings of Ning et al., (2014) who showed that cemented hemiarthroplasty led to better early functional outcomes and reduced postoperative thigh pain without adding to the number of major postoperative complications. In fact, a recent study by Elmenhawy and Salem (2021) revealed that in the elderly population, cemented bipolar hemiarthroplasty tends to be more functional and stable after surgery, but that the patient must be carefully selected.

Randomized controlled trials have also helped to elucidate the comparative effectiveness of the two fixation methods. In the large multicentre randomized trial by Fernandez et al. (2022), cemented hemiarthroplasty did result in improved quality of life and less periprosthetic fractures, with overall mortality being similar between both cemented and uncemented operations. However, in some special clinical situations, implant selection may be influenced. Both physiologic effects of cement and bone quality are important in determining surgical outcomes in patients with significant renal impairment so individual decisions have to be made, according to Tan et al (2019). Hamoudi et al (2025), more recently, showed that stem design also has an impact on postoperative outcomes, with the collared femoral stems showing significantly lower revision rates and fewer periprosthetic fracture rates, regardless of the fixation technique.

The decision for either hemiarthroplasty or THA has also been extensively studied. A hemiarthroplasty is still the procedure of choice for many elderly patients with a higher degree of frailty due to its shorter operation time, lower risk

of dislocation, and less surgical complexity, although Ekhtiari et al. (2020) reported that THA may achieve better long-term functional outcomes in well-selected elderly patients who are active. Better peri-operative care, evidence-based treatment pathways and the introduction of national hip fracture registries have also helped to improve the outcomes after hip fracture surgery. Such large registry databases, as discussed by Webster et al. (2025), are important to support clinical research and provide guidance for best practice, and Armstrong (2025) noted some of the difficulties in achieving evidence-based practice for hip fracture care in resource-limited settings.

Given the strong association between hip fractures and osteoporosis and ageing, the hip fractures remain a substantial public well-being problem. Osteoporotic fracture is a major cause of worldwide morbidity and disability; hip fracture represents a disproportionately large part of the long-term morbidity and health services consumption (Johnell & Kanis, 2006). In addition, these injuries are linked to a chronic loss of function and decreased quality of life, further highlighting the need to choose the best surgical approach for elderly people (Cummings & Melton, 2002). Many studies have focused on the differences between cemented and uncemented hemiarthroplasty, but different patient cohorts, implant designs, peri-operative protocols and healthcare systems have yielded conflicting results. Thus, more comparative studies are needed in the institution setting to assess the relative efficacy and safety of the two fixation techniques in various clinical populations.

3. Methodology

3.1 Study Design and Setting

The present study was performed in the “Department of Orthopaedics” in “Sree Balaji medical college and hospital, Chennai, Tamil Nadu” as a Prospective Comparative Observation Study. Since it received approval from the “Institutional Ethics Committee” the study was conducted from June 2024 to December 2025. Before being enrolled, each

eligible participant gave written informed consent. For clinical and functional evaluation, prospective follow-up was carried up for at least six months following surgery.

3.2 Study Population and Patient Selection

The learning involved thirty elderly individuals with neck fractures caused by displaced femurs. Two equal groups of 15 patients each were created from the patients. Group A had a cemented bipolar hemiarthroplasty, while Group B had an uncemented bipolar hemiarthroplasty. Patients between 55 and 80 years of age with an intracapsular fracture of the femur (Garden type III and IV) with the capacity to move prior to the break and were deemed medically fit for surgery were enrolled in the study. Patients with pathological fractures, polytrauma, prior surgery on the involved hip, current local or systemic inflammatory disease, major neurological diseases affecting ambulation and those who were medically unfit, or unwilling to participate were excluded.

3.3 Surgical Procedure and Data Collection

Bipolar hemiarthroplasty (BHA) was performed in all patients via a standardized posterior (Moore's) approach with a suitable anaesthetic. Study group was based on the implant fixation selected. In the cemented group, the femoral component was cemented with polymethyl methacrylate, and in the uncemented group a press fit femoral stem was placed uncemented. Perioperative antibiotic prophylaxis and postoperative thromboprophylaxis were performed as per institutional guidelines. Demographic, clinical, operative, intraoperative blood loss, operative duration and postoperative recovery parameters were prospectively documented using a structured data collection proforma during the study period. Figure 1 illustrates the surgical materials and instrumentation employed during bipolar hemiarthroplasty, including the bone cement used for cemented fixation and the standard instrument set required for femoral preparation and prosthesis implantation



Figure 1. Materials and Instrumentation Used for Bipolar Hemiarthroplasty

(a) High-viscosity antibiotic-loaded bone cement and associated components used for cemented fixation of the femoral prosthesis. (b) Sterilized orthopedic instrument set used during bipolar hemiarthroplasty, including femoral preparation instruments, trial components, and implant insertion tools.

3.4 Follow-up and Assessment Parameters

All patients underwent a uniform postoperative rehabilitation programme. Quadriceps and ankle pump exercises and respiratory exercises were begun on postoperative day 1 and progressive mobilization was allowed with walker support as tolerated. For six months, patients were monitored at regular intervals. Post-operative pain on the Visual Analogue Scale (VAS), hip

range of motion (ROM), walking ability and limb-length discrepancy were used for clinical evaluations. The Harris Hip Score (HHS) was used as the primary outcome measure for functional outcome. The radiological evaluation was carried out regarding the position of the implant, alignment of the stem, loosening, heterotopic ossification and other implant changes. Other postoperative complications measured included superficial or deep infection, dislocation, periprosthetic fracture, thigh pain, prosthetic loosening, pulmonary complications, deep venous thrombosis, and mortality. Figure 2 demonstrates the key intraoperative stages of bipolar hemiarthroplasty, from patient positioning and surgical site marking to prosthesis implantation and wound closure



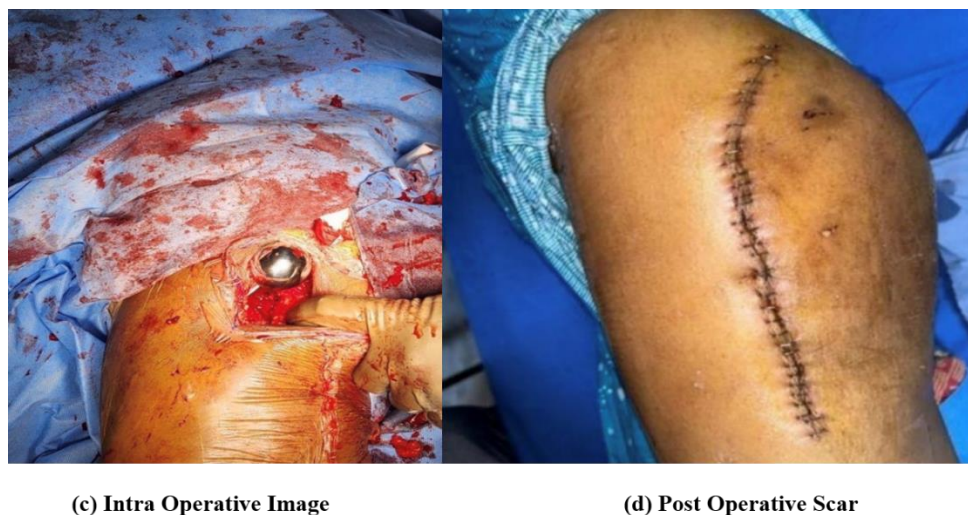


Figure 2. Operative Procedure for Bipolar Hemiarthroplasty

(a) Intraoperative exposure of the hip joint following surgical dissection, demonstrating preparation of the proximal femur and operative field. (b) Immediate postoperative appearance showing the closed surgical incision secured with skin staples. (c) Preoperative clinical appearance of the affected lower limb demonstrating deformity/positioning prior to surgery. (d) Preoperative marking of the planned surgical incision over the lateral aspect of the hip and proximal thigh.

3.5 Statistical Analysis

All patients underwent a uniform postoperative rehabilitation programme. Quadriceps and ankle pump exercises and respiratory exercises were begun on postoperative day 1 and progressive mobilization was allowed with walker support as tolerated. Patients were followed-up at regular times for “6 months”. Post-operative pain on the VAS, hip range of motion ROM, walking ability and limb-length discrepancy were used for clinical evaluations. HHS was used as the primary outcome measure for functional outcome. The radiological evaluation was carried out regarding the position of the implant, alignment of the stem, loosening, heterotopic ossification and other implant changes. Other postoperative complications measured included superficial or deep infection, dislocation, periprosthetic

fracture, thigh pain, prosthetic loosening, pulmonary complications, deep venous thrombosis, and mortality.

4. Results

4.1 Baseline Characteristics

Thirty elderly patients with femoral neck fractures were studied, divided into two groups, one of 15 patients receiving cemented bipolar hemiarthroplasty, and the other 15 patients, uncemented bipolar hemiarthroplasty. Demographic and clinical parameters were comparable at baseline in both groups, thus reducing the effects of confounding variables on the evaluation of postoperative outcome.

Age Distribution

The mean age for the cemented group was 68.93 ± 5.68 years, and for the uncemented group was 67.27 ± 4.57 years. The mean age for the study population was 68.10 ± 5.14 years. In terms of age distribution, there was no significant difference between the two groups ($p = 0.384$), suggesting that the two treatment groups were similar when it came to age. Table 1 presents the age distribution of patients in the cemented and uncemented groups. The mean age was comparable between the two groups, with no discernible statistical difference ($p = 0.384$), indicating similar baseline age characteristics

Table 1. Age Distribution by Group

Group	n	Age (years), Mean $\pm$ SD	Range
Cemented	15	68.93 $\pm$ 5.68	57–76
Uncemented	15	67.27 $\pm$ 4.57	60–76
Overall	30	68.10 $\pm$ 5.14	57–76

Independent Student's t-test, $p = 0.384$.

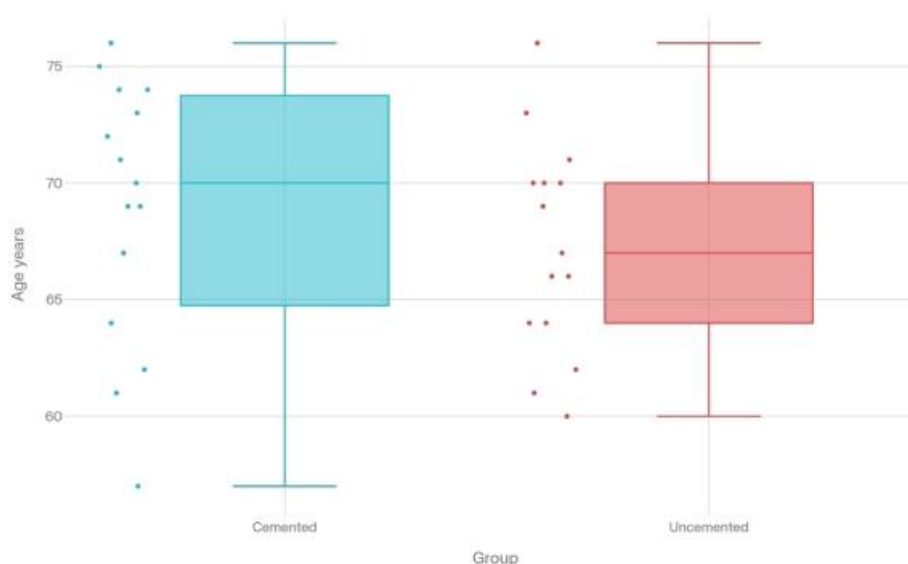
**Figure 3. Age Profile by Group**

Figure 3, demonstrates that the age distribution was nearly identical between the two treatment groups, confirming successful baseline matching.

Sex Distribution

In both study groups, the percentage of female patients was higher. Nine females (60.0%) and six males (40.0%) made up the cemented group, whilst eight females (53.3%) and seven males

(46.7%) made up the uncemented group. 56.7% of the study population was female overall. The sex did not significantly differ from one another distribution between the groups ($p = 1.000$). The distribution of patients' sexes in the cemented and uncemented groups is displayed in Table 2. In both groups, women made up the majority, and the sex distribution difference was not statistically substantial ($p = 1.000$), suggesting similar baseline demographics.

Table 2. Sex Distribution by Group

Sex	Cemented	Uncemented	Total
Female	9 (60.0%)	8 (53.3%)	17 (56.7%)
Male	6 (40.0%)	7 (46.7%)	13 (43.3%)

Chi-square test, $p = 1.000$.

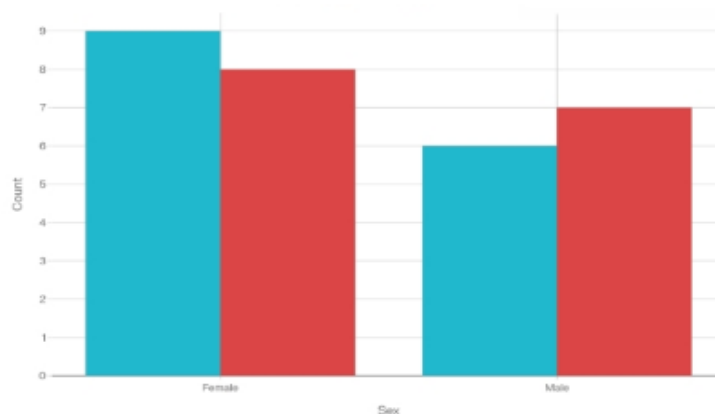


Figure 4. Sex Distribution by Group

Figure 4, illustrates the predominance of female patients in both groups, consistent with the higher prevalence of osteoporotic hip fractures among elderly women.

Mechanism of Injury

The most common mechanism of injury in both groups of patients was trivial falls (73.3% in the “cemented group” and 80.0% in the “uncemented group”). Slip and fall injuries and accidents on the road were rare. Results of a

statistical analysis revealed no discernible variation between the distribution of injury mechanisms ($p = 0.326$), which means that the levels of trauma were alike among the study groups. Table 3 presents the mechanism of injury among patients in both treatment groups. Trivial fall was the utmost shared cause of fracture of the femur neck in both the cemented and uncemented groups, and the distribution of injury mechanisms did not differ statistically knowingly among the groups ($p = 0.326$).

Table 3. Mechanism of Injury by Group

Mechanism of Injury	Cemented	Uncemented	Total
RTA	2 (13.3%)	0 (0.0%)	2
Slip and fall	2 (13.3%)	3 (20.0%)	5
Trivial fall	11 (73.3%)	12 (80.0%)	23

Comparison, $p = 0.326$.

Garden Classification

The majority of fractures were classified as displaced Garden type III and IV fractures. Garden type III fractures accounted for 46.7% of cases in both groups, whereas Garden type IV fractures were slightly more frequent in the uncemented group. No statistically significant difference was observed in fracture classification

between the two groups ($p = 0.881$). Table 4 presents the distribution of Garden fracture classification in the cemented and uncemented groups. Garden type III fractures were the most frequently encountered in both groups, followed by Garden type IV fractures. The groups' fracture categorization did not differ statistically significantly ($p = 0.881$), suggesting similar fracture severity at baseline.

Table 4. Garden Classification by Group

Garden Classification	Cemented	Uncemented	Total
II	4 (26.7%)	3 (20.0%)	7
III	7 (46.7%)	7 (46.7%)	14
IV	4 (26.7%)	5 (33.3%)	9

Comparison, $p = 0.881$.

4.2 Operative Outcomes

Operative parameters including surgical duration, the cemented and uncemented groups' expected blood loss and length of hospital stay were compared. Significant differences were observed in operative time and blood loss, whereas the duration of hospitalization remained comparable. Table 5 summarizes the

operative parameters of the cemented and uncemented bipolar hemiarthroplasty groups. The cemented group had significantly longer operative time and greater intraoperative blood loss than the uncemented group ($p = 0.003$ and $p = 0.002$, respectively), whereas the duration of hospital stay was comparable between the groups ($p = 0.897$).

Table 5. Operative Parameters by Group

Variable	Cemented (Mean $\pm$ SD)	Uncemented (Mean $\pm$ SD)	p value
Operative time (min)	93.35 $\pm$ 12.34	81.00 $\pm$ 6.72	0.003
Estimated blood loss (ml)	301.87 $\pm$ 44.14	235.33 $\pm$ 58.30	0.002
Hospital stay (days)	9.20 $\pm$ 1.19	9.13 $\pm$ 1.81	0.897

The cemented group required compared to the uncemented group, they had a considerably longer operating time and more intraoperative

blood loss. The length of hospital stay, however, did not change statistically significantly.

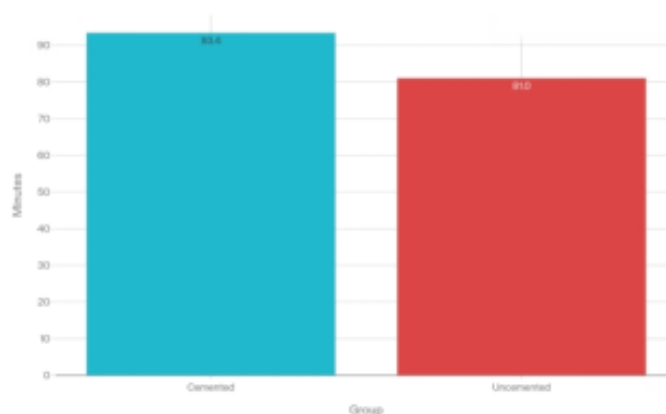


Figure 5. Operative Time by Group

Figure 5, illustrates the significantly longer operative duration associated with cemented

bipolar hemiarthroplasty.

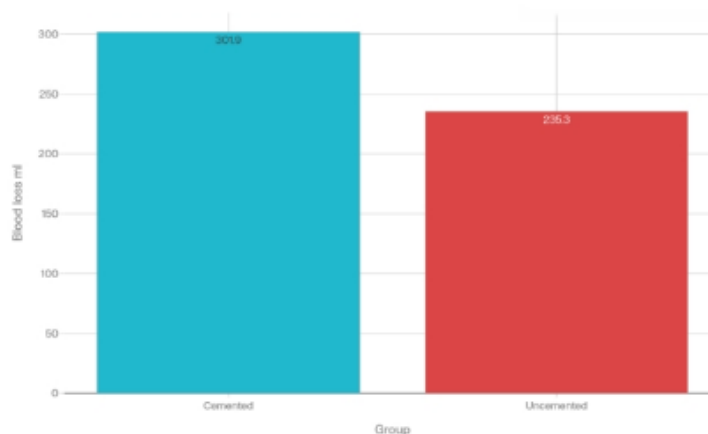


Figure 6. Estimated Blood Loss by Group

Figure 6 demonstrates greater intraoperative blood loss in patients undergoing cemented fixation.

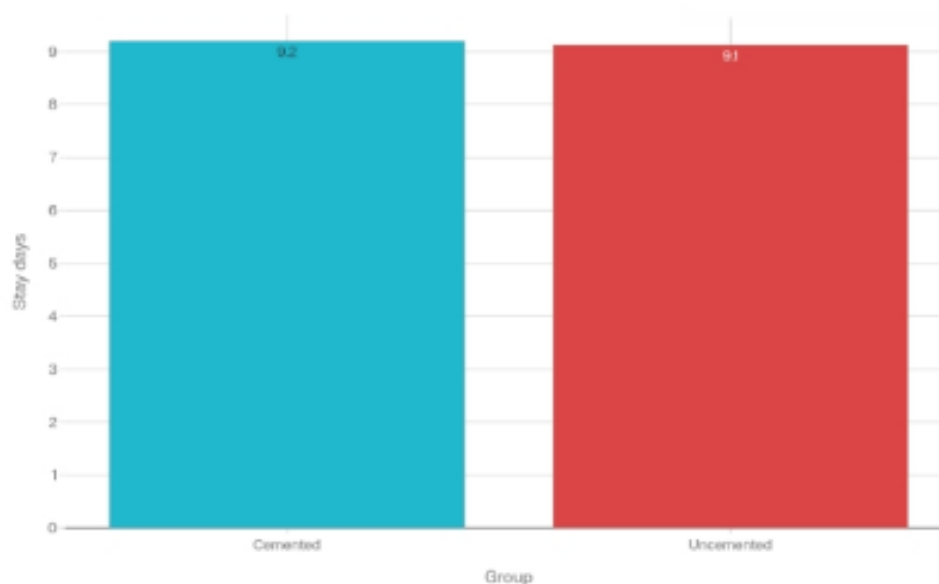


Figure 7. Hospital Stay by Group

Figure 7 shows that postoperative hospital stay was similar between the two treatment groups.

4.3 Clinical and Functional Outcomes

Postoperative pain, hip range of motion (ROM), limb-length discrepancy, Harris Hip Score (HHS), HHS categories, and walking ability over a six-month follow-up were used to evaluate clinical and functional outcomes. Progressive functional improvement was seen in both groups, and early postoperative results revealed better results in the cemented group.

Clinical Outcomes

The postoperative pain on day one was suggestively lower in the cemented group (VAS 4.18 ± 1.08) than in the uncemented group (VAS 5.32 ± 0.75 ; $p = 0.003$). Hip ROM at six

weeks was significantly greater in the cemented group ($190.33 \pm 19.49^\circ$ vs $168.67 \pm 21.19^\circ$; $p = 0.007$), whereas ROM at six months was comparable between groups ($p = 0.895$). Mean limb-length discrepancy was 3.74 ± 1.95 mm in the cemented group and 5.95 ± 1.96 mm in the uncemented group ($p = 0.004$). The clinical results for patients in the cemented and uncemented groups are shown in Table 6. At six weeks, the cemented group showed much less postoperative discomfort and improved hip range of motion; at six months, the groups' range of motion was similar. A statistically significant difference was also observed in limb-length discrepancy ($p < 0.05$).

Table 6. Clinical Outcomes by Group

Variable	Cemented (Mean $\pm$ SD)	Uncemented (Mean $\pm$ SD)	p value
Postoperative pain Day 1 (VAS)	4.18 ± 1.08	5.32 ± 0.75	0.003
ROM at 6 weeks ($^\circ$)	190.33 ± 19.49	168.67 ± 21.19	0.007
ROM at 6 months ($^\circ$)	217.93 ± 11.73	217.33 ± 13.02	0.895
Limb-length discrepancy (mm)	3.74 ± 1.95	5.95 ± 1.96	0.004

Harris Hip Score During Follow-up

A continual improvement of the mean HHS was observed for both groups. The cemented group had consistently higher mean scores at six weeks, three months, and six months, none of these were statistically significant. Table 7 presents the Harris Hip Score (HHS) of patients

at 6 weeks, 3 months, and 6 months following surgery. Both groups demonstrated progressive improvement in functional outcome throughout the follow-up period. Although the cemented group consistently achieved higher mean HHS values than the uncemented group, the differences were not statistically significant at any follow-up interval ($p > 0.05$).

Table 7. Harris Hip Score During Follow-up

Time Point	Cemented (Mean $\pm$ SD)	Uncemented (Mean $\pm$ SD)	p value
6 weeks	68.96 $\pm$ 7.24	64.68 $\pm$ 7.71	0.128
3 months	80.16 $\pm$ 4.69	77.77 $\pm$ 7.44	0.302
6 months	87.48 $\pm$ 4.89	83.88 $\pm$ 6.48	0.098



Figure 9. Harris Hip Score Trend During Follow-up

Figure 9 illustrates progressive functional improvement in both groups, with consistently higher HHS values in the cemented group throughout follow-up.

Harris Hip Score Categories at Six Months

Good to excellent functional outcomes were the majority in both groups at 6 months. Excellent results were obtained in 33.3% of the patients in the cemented group and 20.0% of those in the uncemented group, but the uncemented group experienced fair outcomes more frequently.

There was no significant difference in overall distribution ($p = 0.307$). Table 8 presents the distribution of HHS categories at six months following bipolar hemiarthroplasty. Good-to-excellent functional outcomes were achieved in the majority of patients in both groups, with a higher proportion of excellent outcomes observed in the cemented group. However, the overall distribution of HHS categories did not differ significantly between the groups ($p = 0.307$).

Table 8. Harris Hip Score Category at Six Months

HHS Category	Cemented	Uncemented	Total
Excellent	5 (33.3%)	3 (20.0%)	8
Good	9 (60.0%)	8 (53.3%)	17
Fair	1 (6.7%)	4 (26.7%)	5

Comparison, $p = 0.307$.

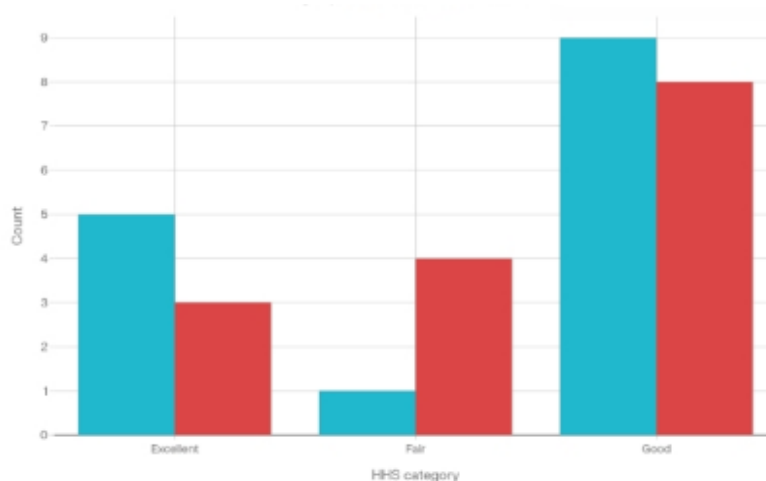


Figure 10. Harris Hip Score Categories at Six Months

Figure 10 demonstrates that most patients achieved good or excellent functional outcomes, with a higher proportion of excellent scores in the cemented group.

Walking Ability at Six Months

Independent walking rate was 66.7% in the cemented group, and 33.3% in the uncemented group. The uncemented group had more patients using walking sticks and very few patients in either group used a walker. No

difference in walking ability was found that was statistically significant ($p = 0.189$). Table 9 presents the walking ability of patients at the six-month follow-up. A greater proportion of patients in the cemented group achieved independent ambulation, whereas the use of walking aids was more common in the uncemented group. However, the difference in walking ability between the two groups was not statistically significant ($p = 0.189$).

Table 9. Walking Ability at Six Months

Walking Ability	Cemented	Uncemented	Total
Independent	10 (66.7%)	5 (33.3%)	15
Stick	4 (26.7%)	8 (53.3%)	12
Walker	1 (6.7%)	2 (13.3%)	3

Comparison, $p = 0.189$.

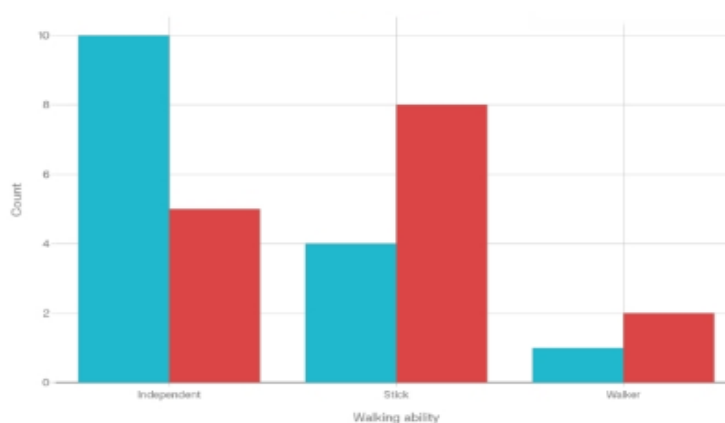


Figure 11. Walking Ability at Six Months

Figure 11 indicates better independent ambulation in the cemented group, although the difference between groups was not statistically significant.

4.4 Radiological Outcomes

Radiological evaluation comprised implant positioning, and the presence of heterotopic ossification. The cemented and uncemented groups did not differ significantly from one another.

Implant Position

In both groups, neutral implant alignment was obtained in 80.0% of the patients. Mild varus

alignment was found in 13.3% of the cemented and 20.0% of the uncemented group and mild valgus in one patient in the uncemented group. This difference was not statistically significant ($p = 0.549$). Table 10 presents the radiographic assessment of implant position at follow-up. Neutral stem alignment was achieved in the majority of patients in both the cemented and uncemented groups, while mild varus and valgus malalignment were infrequent. No statistically significant difference in implant positioning was observed between the two groups ($p = 0.549$).

Table 10. Implant Position on Follow-up Radiograph

Implant Position	Cemented	Uncemented	Total
Neutral	12 (80.0%)	12 (80.0%)	24
Mild Varus	2 (13.3%)	3 (20.0%)	5
Mild Valgus	0 (0.0%)	1 (6.7%)	1

Comparison, $p = 0.549$.

Heterotopic Ossification

Most of the patients were without heterotopic ossification (HOC) (13.3% of the cemented, 20.0% of the uncemented). This was not statistically significant ($p = 1.000$). Table 11 presents the incidence of heterotopic

ossification observed during follow-up. The majority of patients in both the cemented and uncemented groups showed no evidence of heterotopic ossification, and the difference between the groups was not statistically significant ($p = 1.000$).

Table 11. Heterotopic Ossification

Heterotopic Ossification	Cemented	Uncemented	Total
Absent	13 (86.7%)	12 (80.0%)	25
Present	2 (13.3%)	3 (20.0%)	5

Comparison, $p = 1.000$.

4.5 Postoperative Complications

Postoperative complications occurred in small numbers in both groups. There was no death or postoperative myocardial infarction during follow-up. Only the cemented group had patients with pneumonia, while the pulmonary embolism group was equal. There were slightly more wound infections and dislocations in the

cemented group and more thigh pain postoperatively in the uncemented group. All these differences were not significant. Table 12 summarizes the postoperative complications observed in both groups. No statistically significant differences were found in the incidence of complications between the cemented and uncemented bipolar hemiarthroplasty groups ($p > 0.05$).

Table 12. Postoperative Complication Profile by Group

Complication	Cemented n (%)	Uncemented n (%)	p value
Mortality at 6 months	0 (0.0%)	0 (0.0%)	1.000
Postoperative myocardial infarction	0 (0.0%)	0 (0.0%)	1.000
Pneumonia	2 (13.3%)	0 (0.0%)	0.483
Pulmonary embolism	2 (13.3%)	2 (13.3%)	1.000
Wound infection	3 (20.0%)	2 (13.3%)	1.000
Dislocation	3 (20.0%)	1 (6.7%)	0.598
Postoperative thigh pain	3 (20.0%)	6 (40.0%)	0.427

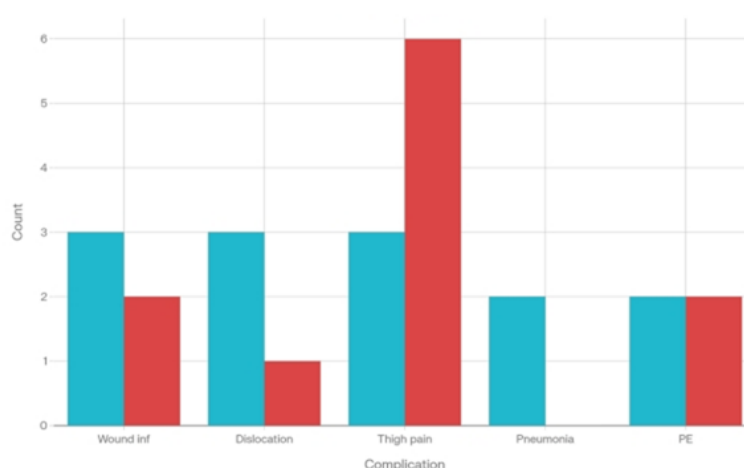
**Figure 12. Postoperative Complication Profile**

Figure 12 summarizes the postoperative complications observed in both groups, showing comparable overall complication rates despite differences in the frequency of individual complications.

5. Discussion

Despite the fact that the prevalence of one of the most frequent is a femoral neck fracture, fragility fractures among the elderly, it still imposes a significant clinical and economic burden, due to the high prevalence of osteoporosis, functional decline and death. The increasing life expectancy will cause the number of such fractures to grow and optimization of surgical management is an important priority (Riggs & Melton III, 1995; Dhanwal et al., 2011). In the current study, which compared cemented and uncemented bipolar hemiarthroplasty in elderly patients with a displaced femoral neck fracture, it was found that

although the cemented fixation required more time and blood during surgery, it did provide better early postoperative pain relief and functional recovery, with comparable long-term functional and radiological outcomes between the two groups.

The demographic characteristics of the current study were in line with the osteoporotic hip fracture epidemiology, with the mainstream of patients in the older age group and females making up the majority of patients. This distribution reflects the known epidemiology of hip fracture, and confirms that the findings of this study are generalisable to the typical hip fracture population (Riggs & Melton III, 1995; Dhanwal et al., 2011). Moreover, there were no significant differences in baseline demographics between the two treatment groups, reducing the impact of these factors on postoperative outcomes.

Operative results revealed that compared to the uncemented approach, the cemented bipolar hemiarthroplasty had a much longer operating time and more blood loss throughout the procedure. The results are similar to that of the recent meta-analysis by Ning et al. (2014) in which they found that cementation adds to the operating time due to preparation of the femoral canal and application of cement. These differences did not affect surgical time, and There was no discernible variation in the length of the hospital stay amongst the groups, suggesting the additional surgical time did not negatively influence early postoperative recovery. Whatever the mode of fixation, excellent preparation of the femur and proper positioning of the implant are still vital, as pointed out in general orthopaedic surgical principles and recommendations for pre-operative planning (Rockwood, 1991; Knight & Atwater, 1992).

In the early postoperative phase, the cemented group's hip range of motion and postoperative pain were significantly different from those of the non-cemented group, but these differences resolved by 6 months. There was a progressive increase in Harris Hip Scores in both groups with cemented fixation always having mean scores that were higher than the other group, but which did not achieve statistical significance at the last follow-up. The results of these studies are consistent with those found by Ning et al. (2014) who found that cemented hemiarthroplasty resulted in better early functional outcomes, but similar long term functional outcomes between both types of fixations. Similarly, the higher percentage of independently ambulatory patients in the cemented group might be due to better initial stability and lower postoperative discomfort associated with the cemented group. In addition to surgical treatment, age, pre-fracture mobility, rehabilitation, and comorbidities have been shown to be important factors influencing functional recovery after hip fracture (Magaziner et al., 1990).

Radiological assessment showed good implant positioning in both groups, with a majority of patients in a neutral stem position, and no significant differences in the incidence of

heterotopic ossification. These results suggest that both cemented and uncemented methods can be used to achieve satisfactory implant positioning provided meticulous surgical technique is used. The principles of preservation of proximal femoral anatomy and careful handling of the vascular structures around the femoral neck remain fundamental during hemiarthroplasty in order to ensure optimal implant placement and postoperative stability (Gautier et al., 2000). Likewise, prior reports on unipolar and bipolar hemiarthroplasty have demonstrated good radiographic results with the bipolar arthroplasty if proper principles are observed (Raia et al., 2003).

The incidence of postoperative complications was low in both groups. There were no deaths or postoperative myocardial infarction in the six months of follow-up, and the incidence of pulmonary complications, wound infection, dislocation and postoperative thigh pain was not significantly different between the groups. Postoperative thigh pain was more common following uncemented fixation but overall complication profile was similar. These results are similar to the literature, which suggests that both fixation methods are generally safe if proper patient selection and perioperative care is used. In addition, multidisciplinary postoperative care and structured rehabilitation have demonstrated significant impact on minimising complications and maximising recovery after hip fracture surgery (Schnell et al., 2010).

In the overall results of the present study, the cemented bipolar hemiarthroplasty seems to be superior for early clinical recovery without a significant difference in long-term functional or radiological results. Cemented fixation showed an increase in operative time and blood loss, but both methods had similar safety characteristics and results at six months. Thus, selection of fixation should be tailored to individual patient and bone quality, and experience of the surgeon, with careful surgical practice and extensive postoperative rehabilitation.

6. Conclusion

Due to its association with osteoporosis,

decreased mobility, and high morbidity in older patients, femur neck fractures continue to provide a significant issue in orthopaedics. In older patients with a displaced FN fracture, the current study compared the clinical, functional, radiological, and postoperative results of cemented and cementless bipolar hemiarthroplasty. The results showed that the cemented bipolar hemiarthroplasty group differed significantly from the other two groups in terms of intraoperative haemorrhage and operation time. However, it did provide better early postoperative outcomes, including improved hip range of motion and reduced discomfort. However, both treatment groups showed similar functional recovery at 6 months with no difference in Harris Hip Scores or radiographic findings or overall complication rates. The radiological assessment revealed adequate positioning of the implants in most of the patients and heterotopic ossification and postoperative complications were rare and showed no discernible differences between the

two groups. At the conclusion of the follow-up, a greater proportion of patients in the cemented group were able to walk independently; however, this difference was not statistically significant. According to our findings, both cemented and uncemented bipolar hemiarthroplasty are safe and effective for treating displaced femoral neck fractures in elderly patients, provided that patients are carefully chosen and that surgical technique and postoperative rehabilitation are carried out correctly. Overall, cemented bipolar hemiarthroplasty seems to be more beneficial with regard to post-operative pain and function, while uncemented hemiarthroplasty is more beneficial in terms of operating time and intraoperative blood loss. Future, multicentre studies with larger numbers of patients, and extended follow-up are recommended to further assess long-standing purposeful results, implant survivorship, and complication profiles to further support the evidence for fixation choice in elderly patients

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