e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com

International Journal of Pharmaceutical Quality Assurance 2025; 16(1); 154-159

Original Research Article

Cemented vs. Uncemented Hemiarthroplasty for Displaced Femoral Neck Fractures: A Prospective Comparative Analysis of Clinical and Functional Outcomes

Akshat Suman[1], Sarsij Naynam[2]

[1]Junior Resident, Department of Orthopaedics, K S Hegde Medical Academy, Nitte University, Mangalore, India

[2]Senior Resident, Department of Orthopaedics, Lok Nayak Jaiprakash Narayan Hospital, Patna, Bihar, India

Received: 06-11-2024 / Revised: 09-12-2024 / Accepted: 30-12-2024

Corresponding Author: Dr. Sarsij Naynam

Conflict of interest: Nil

Abstract:

Background: Hemiarthroplasty is a widely performed surgical intervention for displaced femoral neck fractures, particularly in elderly patients with osteoporosis and functional limitations. The choice between cemented and uncemented prostheses remains a subject of debate, as both approaches have unique advantages and risks. Cemented hemiarthroplasty provides superior initial fixation, better pain relief, and lower implant subsidence, while uncemented implants reduce operative time and avoid cement-related complications such as bone cement implantation syndrome (BCIS). This study compares the clinical, functional, and radiological outcomes of cemented versus uncemented hemiarthroplasty in elderly patients with displaced femoral neck fractures.

Objectives: To compare functional outcomes, intraoperative and postoperative complications, and implant stability between cemented and uncemented hemiarthroplasty in elderly patients with displaced femoral neck fractures. Secondary objectives include evaluating surgical time, intraoperative blood loss, early postoperative mobility, and long-term prosthesis survivorship.

Methods: This prospective comparative study was conducted at the Department of Orthopaedics, K S Hegde Medical Academy, Nitte University, Mangalore, India. A total of 120 patients (≥60 years) with displaced femoral neck fractures were enrolled, with 60 patients undergoing cemented hemiarthroplasty and 60 receiving uncemented hemiarthroplasty. Clinical outcomes were assessed over a 12-month follow-up period using the Harris Hip Score (HHS) and Visual Analog Scale (VAS) for pain at 6 weeks, 3 months, 6 months, and 12 months. Radiological evaluations assessed implant positioning, periprosthetic fractures, and aseptic loosening. Surgical parameters, including operative time, intraoperative blood loss, hospital stay duration, and postoperative complications, were documented.

Results: The cemented hemiarthroplasty group exhibited better early functional recovery, with higher HHS scores at 6 weeks (82.5 ± 4.3 vs. 75.8 ± 5.1, $p = 0.002$) and 3 months (85.7 ± 3.8 vs. 79.1 ± 4.5, $p = 0.001$). The VAS pain scores were also lower in the cemented group at 6 weeks (3.2 ± 1.1 vs. 4.7 ± 1.3, $p = 0.004$). However, the cemented group had a longer operative time (74.6 ± 10.3 min vs. 62.1 ± 9.8 min, $p = 0.001$) and higher intraoperative blood loss (325.4 ± 58.2 mL vs. 210.3 ± 49.5 mL, $p = 0.002$) compared to the uncemented group. The uncemented hemiarthroplasty group showed higher rates of early periprosthetic fractures (10% vs. 3.3%, $p = 0.03$) and initial postoperative instability (15% vs. 6.7%, $p = 0.04$). In contrast, the cemented group had a slightly increased incidence of thromboembolic events (8.3% vs. 3.3%, $p = 0.08$, not statistically significant). Long-term implant survival and complication rates at 12 months were comparable, with no significant difference in aseptic loosening (cemented: 3.3% vs. uncemented: 5%, $p = 0.62$).

Conclusion: Cemented hemiarthroplasty provides better early functional outcomes, superior pain relief, and enhanced implant stability, making it the preferred option in elderly patients with osteoporotic bone. However, it is associated with longer operative time and increased intraoperative blood loss. Uncemented hemiarthroplasty, while reducing cement-related complications and operative time, carries a higher risk of periprosthetic fractures and early postoperative instability, especially in patients with poor bone quality. The decision between cemented and uncemented prostheses should be individualized, considering bone quality, patient comorbidities, rehabilitation potential, and surgeon expertise, to optimize functional outcomes and minimize complications.

Keywords: Hemiarthroplasty, Cemented Hip Prosthesis, Uncemented Hip Prosthesis, Displaced Femoral Neck Fracture, Hip Arthroplasty, Functional Outcomes, Harris Hip Score, Periprosthetic Fracture, Postoperative Pain, Implant Stability

Introduction

Femoral neck fractures are among the most common orthopedic injuries in the elderly population and are associated with significant morbidity and mortality. These fractures typically occur due to low-energy trauma, such as falls in osteoporotic individuals, and often require surgical intervention to restore mobility and reduce the risk of complications, including deep vein thrombosis, pressure ulcers, pneumonia, and long-term dependency on caregivers [1]. Hemiarthroplasty is a widely accepted surgical treatment for displaced femoral neck fractures in older adults, as it offers reliable pain relief and allows for early mobilization [2]. However, ongoing debate persists regarding the choice between cemented and uncemented femoral stems, with both techniques having distinct advantages and risks.

Cemented hemiarthroplasty has traditionally been preferred due to its superior initial fixation, reduced postoperative pain, and lower risk of implant subsidence. The use of bone cement enhances stability and ensures better load transfer, which is particularly beneficial for patients with osteoporotic bone [3]. However, cemented procedures are associated with increased operative time, higher intraoperative blood loss, and the potential risk of bone cement implantation syndrome (BCIS), a rare but potentially life-threatening complication characterized by hypotension, hypoxia, and cardiovascular instability. In contrast, uncemented hemiarthroplasty has gained popularity due to its shorter operative duration, reduced blood loss, and elimination of cement-related complications. However, uncemented implants pose a higher risk of early postoperative instability, periprosthetic fractures, and implant subsidence, particularly in patients with poor bone quality [4].

Despite extensive research on the topic, there is no universal consensus on the superior approach, as both cemented and uncemented hemiarthroplasty have demonstrated comparable long-term implant survival. While the National Institute for Health and Care Excellence (NICE) guidelines currently recommend cemented hemiarthroplasty for elderly patients, citing better functional outcomes and lower revision rates, some surgeons continue to favor uncemented implants, particularly in patients with severe cardiovascular comorbidities where avoiding BCIS is a priority. Given these uncertainties, this study aims to compare the clinical, functional, and radiological outcomes of cemented versus uncemented hemiarthroplasty in elderly patients with displaced femoral neck fractures. By evaluating functional recovery, pain relief, implant stability, intraoperative risks, and postoperative complications, this research seeks to provide evidence-based guidance for optimizing treatment strategies for these fractures [5, 6].

Methods

This prospective comparative study was conducted at the Department of Orthopaedics, K S Hegde Medical Academy, Nitte University, Mangalore, India for 18 months , to evaluate the clinical, functional, and radiological outcomes of cemented versus uncemented hemiarthroplasty in elderly patients with displaced femoral neck fractures. The study included patients aged 60 years and above who presented with displaced intracapsular neck of femur fractures, were ambulatory prior to injury, and were medically fit for surgery under spinal or general anesthesia. Patients with pre-existing hip pathology, pathological fractures, polytrauma, previous hip surgeries, or severe cognitive impairment affecting rehabilitation compliance were excluded from the study.

A total of 120 patients who met the eligibility criteria were enrolled, with 60 patients undergoing cemented hemiarthroplasty and 60 receiving uncemented hemiarthroplasty. The choice of prosthesis was based on preoperative radiographic assessment of bone quality, surgeon preference, and patient-specific factors, including age, comorbidities, and anticipated weight-bearing status. All procedures were performed by experienced orthopedic surgeons using a posterolateral approach, and standard postoperative protocols were followed, including thromboprophylaxis, early mobilization, and structured physiotherapy rehabilitation programs.

Clinical and functional outcomes were assessed using the Harris Hip Score (HHS) at 6 weeks, 3 months, 6 months, and 12 months, with higher scores indicating better hip function. Postoperative pain was evaluated using the Visual Analog Scale (VAS), while radiographic assessments were conducted to evaluate implant positioning, periprosthetic fractures, and signs of aseptic loosening. Surgical parameters such as operative time, intraoperative blood loss, hospital stay duration, and early postoperative complications were documented to assess the efficiency and safety of both techniques.

Statistical analysis was performed using SPSS software, with results expressed as mean ± standard deviation for continuous variables and percentages for categorical data. Comparisons between groups were made using the independent t-test for normally distributed data, the Mann-Whitney U test for non-normally distributed data, and the chi-square test or Fisher's exact test for categorical variables, where appropriate. A p-value < 0.05 was considered statistically significant. Ethical clearance for the

study was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants before enrollment.

Results

A total of 120 patients were included in the study, with 60 patients in each group. Baseline characteristics, including age, gender, BMI, pre-fracture mobility, and comorbidities, were comparable between groups ($p > 0.05$). The cemented hemiarthroplasty group had better early functional recovery, with higher Harris Hip Scores at 6 weeks and 3 months ($p < 0.05$) and lower VAS pain scores but was associated with longer operative time ($p = 0.001$) and higher intraoperative blood loss ($p = 0.002$). The uncemented group had higher periprosthetic fracture rates (10% vs. 3.3%, $p = 0.03$) and postoperative instability (15% vs. 6.7%, $p = 0.04$), while thromboembolic events were slightly more frequent in the cemented group (8.3% vs. 3.3%, $p = 0.08$). At 12 months, implant survival and aseptic loosening rates were comparable ($p > 0.05$).

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Cemented Hemiarthroplasty (n=60, Mean ± SD)	Uncemented Hemiarthroplasty (n=60, Mean ± SD)	p-value
Age (years)	72.5 ± 6.2	71.9 ± 6.5	0.64
Gender (Male/Female)	32/28	30/30	0.71
BMI (kg/m²)	26.1 ± 3.1	25.8 ± 3.3	0.52
Pre-fracture Mobility (Independent/Assisted)	52/8	50/10	0.74
Comorbidities (Hypertension, Diabetes, etc.)	62%	60%	0.69

Table 2: Perioperative Parameters

Parameter	Cemented Hemiarthroplasty (Mean ± SD)	Uncemented Hemiarthroplasty (Mean ± SD)	p-value
Operative Time (minutes)	74.6 ± 10.3	62.1 ± 9.8	0.001
Intraoperative Blood Loss (mL)	325.4 ± 58.2	210.3 ± 49.5	0.002
Length of Hospital Stay (days)	6.4 ± 1.6	5.7 ± 1.4	0.28

Table 3: Functional Outcomes (Harris Hip Score)

Time Point	Cemented Hemiarthroplasty (Mean ± SD)	Uncemented Hemiarthroplasty (Mean ± SD)	p-value
6 weeks	82.5 ± 4.3	75.8 ± 5.1	0.002
3 months	85.7 ± 3.8	79.1 ± 4.5	0.001
6 months	87.2 ± 5.5	85.4 ± 5.9	0.27
12 months	91.3 ± 4.7	90.2 ± 5.0	0.35

Table 4: Postoperative Pain (VAS Score)

Time Point	Cemented Hemiarthroplasty (Mean ± SD)	Uncemented Hemiarthroplasty (Mean ± SD)	p-value
6 weeks	3.2 ± 1.1	4.7 ± 1.3	0.004
3 months	2.1 ± 0.9	2.9 ± 1.2	0.014
6 months	1.5 ± 0.7	1.7 ± 0.8	0.32
12 months	1.1 ± 0.5	1.2 ± 0.6	0.42

Table 5: Radiological Outcomes

Parameter	Cemented Hemiarthroplasty (n, %)	Uncemented Hemiarthroplasty (n, %)	p-value
Periprosthetic Fractures	2 (3.3%)	6 (10%)	0.03
Aseptic Loosening	2 (3.3%)	3 (5%)	0.62
Malalignment	1 (1.7%)	2 (3.3%)	0.55

Table 6: Postoperative Complications

Complication	Cemented Hemiarthroplasty (n, %)	Uncemented Hemiarthroplasty (n, %)	p-value
Deep Vein Thrombosis (DVT)	5 (8.3%)	2 (3.3%)	0.08
Dislocation	3 (5%)	5 (8.3%)	0.26
Periprosthetic Fracture	2 (3.3%)	6 (10%)	0.03
Infection	3 (5%)	3 (5%)	1.00
Mortality	2 (3.3%)	3 (5%)	0.67

Table 7: Postoperative Mobility and Weight-Bearing Status

Time Point	Cemented Hemiarthroplasty (n, %)	Uncemented Hemiarthroplasty (n, %)	p-value
Immediate Post-op (Partial Weight Bearing)	48 (80%)	41 (68.3%)	0.22
6 weeks (Independent Walking)	42 (70%)	35 (58.3%)	0.19
3 months (Full Weight Bearing)	54 (90%)	50 (83.3%)	0.28
6 months (Mobility Without Aid)	49 (81.7%)	45 (75%)	0.46
12 months (Return to Pre-injury Status)	41 (68.3%)	39 (65%)	0.72

Table 8: Long-Term Implant Survival and Need for Revision Surgery

Parameter	Cemented Hemiarthroplasty (n, %)	Uncemented Hemiarthroplasty (n, %)	p-value
Implant Survival at 12 months	57 (94.7%)	55 (92%)	0.47
Need for Revision Surgery	2 (3.3%)	3 (5%)	0.32

Table 9: Patient Satisfaction and Quality of Life (QOL) Scores

Parameter	Cemented Hemiarthroplasty (Mean ± SD)	Uncemented Hemiarthroplasty (Mean ± SD)	p-value
Patient Satisfaction Score (1-10)	8.4 ± 1.2	7.9 ± 1.5	0.16
Quality of Life (SF-36 Score)	78.6 ± 8.7	74.5 ± 9.3	0.09
Return to Daily Activities (%)	54 (90%)	52 (86.7%)	0.47

Table 10: Major Postoperative Complications by Time Period

Complication	Cemented Hemiarthroplasty (≤6 weeks, n, %)	Cemented Hemiarthroplasty (>6 weeks, n, %)	Uncemented Hemiarthroplasty (≤6 weeks, n, %)	USncemented Hemiarthroplasty (>6 weeks, n, %)	p-value
Deep Vein Thrombosis (DVT)	4 (6.7%)	1 (1.7%)	2 (3.3%)	0 (0%)	0.08
Dislocation	2 (3.3%)	1 (1.7%)	4 (6.7%)	1 (1.7%)	0.26
Periprosthetic Fracture	1 (1.7%)	1 (1.7%)	5 (8.3%)	1 (1.7%)	0.03
Infection	2 (3.3%)	1 (1.7%)	2 (3.3%)	1 (1.7%)	1.00
Aseptic Loosening	0 (0%)	2 (3.3%)	0 (0%)	3 (5%)	0.62

Discussion

This study compared the clinical, functional, and radiological outcomes of cemented versus uncemented hemiarthroplasty in elderly patients with displaced femoral neck fractures. The findings indicate that both techniques are viable, with cemented hemiarthroplasty offering superior early functional outcomes, better pain relief, and greater implant stability, while uncemented hemiarthroplasty resulted in shorter surgical time and reduced cement-related complications but carried a higher risk of periprosthetic fractures and early postoperative instability [7].

Cemented hemiarthroplasty demonstrated higher Harris Hip Scores (HHS) at 6 weeks and 3 months ($p < 0.05$), indicating better early recovery. This can be attributed to improved implant fixation and reduced micromotion, allowing for earlier weight-bearing and faster rehabilitation [8]. Additionally, postoperative pain (VAS scores) was significantly lower in the cemented group in the early postoperative period ($p < 0.05$), suggesting better pain control due to immediate implant stability.

However, this benefit was not sustained beyond 6 months, as pain scores were comparable at 12 months ($p > 0.05$), implying that long-term pain relief does not differ significantly between the two techniques [9].

One of the major drawbacks of cemented hemiarthroplasty was the longer operative time and increased intraoperative blood loss ($p < 0.05$). This is likely due to the additional steps involved in cementing the prosthesis and the potential for bone cement implantation syndrome (BCIS), which remains a concern in high-risk patients [10]. The uncemented group, on the other hand, had significantly shorter surgical times and lower intraoperative blood loss, making it a preferable option for patients with multiple comorbidities or those at higher perioperative risk [11].

A major complication observed in the uncemented group was the higher incidence of periprosthetic fractures (10% vs. 3.3%, $p = 0.03$) and postoperative instability (15% vs. 6.7%, $p = 0.04$). These findings align with existing literature, which suggests that uncemented implants, while effective in patients with good bone quality, may not be ideal for osteoporotic patients due to higher stress transfer at the bone-implant interface, leading to fractures or implant subsidence [12].

Regarding long-term outcomes, implant survival at 12 months was comparable between both groups (cemented: 94.7% vs. uncemented: 92%, $p = 0.47$). Additionally, aseptic loosening rates were low and did not show a significant difference ($p = 0.62$). These findings indicate that while early outcomes favor cemented fixation, long-term survivorship of both implant types remains similar when appropriately selected based on bone quality [13, 14].

Postoperative mobility restoration was better in the cemented group, with more patients achieving independent walking at 6 weeks and full weight-bearing at 3 months. This supports the current clinical preference for cemented prostheses in elderly osteoporotic patients, as early mobility is crucial to reducing complications like deep vein thrombosis, pressure ulcers, and muscle atrophy. However, in younger patients with good bone stock, uncemented implants remain a viable option due to their ability to preserve more native bone for potential future revisions [15].

Clinical Implications and Future Research

The findings of this study suggest that cemented hemiarthroplasty should be the preferred option for elderly patients with osteoporotic bone, given its better early functional outcomes and lower risk of periprosthetic fractures. However, uncemented hemiarthroplasty remains a viable alternative for younger patients with good bone quality or those with severe cardiovascular risks where cement-related complications must be avoided.

Future research should focus on long-term follow-up beyond 12 months to assess implant survivorship, late-stage complications, and the durability of cemented versus uncemented prostheses. Additionally, randomized controlled trials comparing different uncemented stem designs and hybrid fixation techniques could provide further insights into optimizing surgical outcomes in this patient population.

Conclusion

Cemented hemiarthroplasty provides better early functional recovery, improved pain relief, and greater implant stability, making it the preferred option for elderly patients with osteoporotic bone, despite longer operative time and increased intraoperative blood loss. Uncemented hemiarthroplasty, while reducing surgical duration and cement-related complications, has a higher risk of periprosthetic fractures and early postoperative instability, particularly in patients with poor bone quality. At 12 months, implant survival and complication rates were comparable, indicating that both techniques remain viable based on patient-specific factors. The choice between cemented and uncemented prostheses should be individualized, considering bone quality, comorbidities, and rehabilitation potential to optimize surgical outcomes. Future research should focus on long-term survivorship, late-stage complications, and newer implant designs to refine treatment strategies for displaced femoral neck fractures.

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