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Functional and radiological outcomes between cemented and uncemented partial hip replacement in the elderly

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ABSTRACT

Background: Hemiarthroplasty (HA) is the treatment of choice for displaced intracapsular femoral neck fractures (FNFs) in elderly patients. However, the optimal method of fixation-cemented or uncemented-remains controversial, particularly in the Indian population. This study aimed to compare the functional and radiological outcomes of cemented versus uncemented HA (UCHA) in elderly patients.
Methods: A retro-prospective comparative study was conducted at a tertiary care centre from January 2021 to September 2024. Sixty-seven patients aged above 60 years with intracapsular FNFs treated with HA were included. Patients were divided into cemented (n=44) and uncemented (n=23) groups. Functional outcome was assessed using the Harris hip score (HHS), and radiological evaluation focused on prosthetic subsidence at 6 months postoperatively. Statistical analysis was performed using SPSS version 29.0 with $p<0.05$ considered significant.
Results: The mean age of patients was 72.37±8.1 years, with females comprising 55% of the cohort. At 6 months, no statistically significant difference was observed in HHS between the cemented and uncemented groups (p=0.132). Good functional outcomes were seen in 52.6% of the cemented group and 54.5% of the uncemented group. Prosthetic subsidence was higher in the uncemented group (13.04%) compared to the cemented group (2.63%), though the difference was not statistically significant (p=0.135). No major complications were reported.
Conclusions: Cemented and UCHA showed comparable short-term functional outcomes. However, uncemented fixation demonstrated a higher trend toward prosthetic subsidence. Larger studies with longer follow-up recommended.

Keywords: Hemiarthroplasty, Femoral neck fracture, Cemented, Uncemented, Harris hip score, Prosthetic subsidence, Elderly patients, Orthopaedic surgery

INTRODUCTION

Hip fractures represent a significant global health burden, with an estimated 6 million cases projected to occur across Asian nations between 1990 and 2050.[1] The lifetime risk of hip fracture is approximately 5.6% for men and 20% for women, making it a substantial concern for the aging population.[2] FNFs constitute approximately 50% of all hip fractures, with most elderly patients receiving partial hip replacement, known as HA, to replace the femoral head with a metal implant.[3]

The treatment approach for intracapsular FNFs in elderly patients has evolved significantly, with HA emerging as the preferred surgical intervention for displaced fractures in this population. This procedure enables early mobilization and functional recovery while avoiding the complexities associated with total hip arthroplasty in frail elderly patients.[4] However, the optimal fixation method for HA remains a subject of ongoing debate within the orthopedic community.

Two primary fixation techniques are employed in HA: CHA and UCHA.[5] Each approach presents distinct

advantages and disadvantages that must be carefully considered in the context of patient-specific factors and surgical outcomes. CHA utilizes bone cement to enhance implant fixation and may reduce the risk of periprosthetic fractures and prosthetic loosening. However, it is associated with potential complications including bone cement implantation syndrome (BCIS), increased intraoperative blood loss, and reduced cardiac output during the cementation process.[6,7]

Conversely, UCHA offers advantages such as shorter operative times and reduced intraoperative blood loss. Nevertheless, this approach is associated with higher rates of postoperative complications, including aseptic prosthetic loosening, periprosthetic fractures, and prosthetic subsidence, particularly in patients with poor bone quality.[8]

Previous meta-analyses comparing these two approaches have yielded inconsistent results. While some studies report lower complication rates with cemented prostheses, others have found comparable outcomes between the two techniques.[9,10] The majority of existing research has faced limitations including insufficient sample sizes and reliance on pooled analyses from heterogeneous studies, resulting in inconclusive findings. Furthermore, there is a notable absence of Indian studies in the current literature, making it difficult to extrapolate results to the Indian population.

The present study aims to address this knowledge gap by conducting a comprehensive comparison of functional and radiological outcomes between cemented and UCH in elderly patients with intracapsular neck of femur fractures within an Indian healthcare setting. Understanding the optimal fixation method is crucial for improving patient outcomes, reducing revision rates, and minimizing healthcare costs in this vulnerable population.

Given the aging demographic trends and the increasing incidence of hip fractures globally, establishing evidence-based guidelines for HA fixation techniques is of paramount importance.

This study seeks to contribute valuable insights to the existing literature while providing region-specific data that may inform clinical decision-making in similar healthcare contexts.

METHODS

Study design and setting

This retro-prospective comparative study was conducted at the department of orthopaedics, Bharati Vidyapeeth (Deemed to be university) medical college, Dhankawadi, Pune, which serves as a tertiary care hospital. The study design incorporated both retrospective analysis of cases from January 2021 to January 2023 and prospective enrollment of patients from February 2023 to September 2024, spanning a total duration of 30 months.

Ethical considerations

The study protocol received approval from the institutional ethics committee of Bharati Vidyapeeth (Deemed to be university) medical college, Pune (Reference: BVDUMC/IEC/118, date: 14/06/2023). All participants or their legally acceptable representatives provided written informed consent before enrollment. The study was conducted in accordance with the principles of the declaration of Helsinki and good clinical practice guidelines.

Sample size calculation

Sample size was calculated using the formula:

$n=(Z\alpha+Z\beta)^2\times[P1(100-P1)+P2(100-P2)]/d^2$

Where:

$Z\alpha$ (Z value associated with alpha level, one-sided)=1.96

$Z\beta$ (Z value associated with beta level)=0.84

P1=50% and P2=73.3%

d (absolute precision/allowable error)=23

Based on this calculation, a sample size of 67 patients was determined to be adequate for detecting clinically significant differences between the two treatment groups.

Inclusion criteria

Patients aged more than 60 years, diagnosis of intracapsular neck of femur fracture and patients undergoing partial hip HA were included in the study.

Exclusion criteria

Patients with intertrochanteric femur fractures, pre-existing arthritis of the hip joint, patients with neurological disorders and presence of tumors in the proximal femur.

Data collection and patient management

Patients presenting to the inpatient department (IPD) or outpatient department (OPD) of the orthopaedics department were screened for eligibility. A detailed medical history was obtained from all enrolled patients using a specially designed proforma. All patients underwent comprehensive preoperative evaluation including radiological and hematological investigations as per standard institutional protocols.

The choice between cemented and UCHA was made based on surgeon preference, patient factors, and institutional guidelines rather than randomization, reflecting real-world clinical practice patterns. All surgical procedures were

performed by experienced orthopaedic surgeons using standardized techniques.

Primary outcome measures

Functional assessment

HHS: A validated scoring system assessing pain, function, activities of daily living, and range of motion. Scores were categorized as: Poor: <70, fair: 70-80, good: 81-90 and excellent: >90.

VAS: Pain assessment using a 0-10 numeric rating scale, where 0 represents no pain and 10 represents worst possible pain.

Radiological assessment

Immediate postoperative radiographs (anteroposterior and lateral views), assessment of prosthetic subsidence, loosening, and heterotopic ossification, evaluation of bone-cement interface (for cemented prostheses) and assessment of bone ingrowth patterns (for uncemented prostheses).

Secondary outcome measures

Incidence of complications including: Prosthetic subsidence, periprosthetic fractures, dislocation, infection and revision surgery requirements.

Follow-up protocol

All patients were followed up at predetermined intervals: 6 weeks post-surgery, 3 months post-surgery, 6 months post-surgery and 1 year post-surgery.

At each follow-up visit, patients underwent clinical assessment using HHS and VAS, along with radiological evaluation. A total of seven patients were lost to follow-up at the six-week mark, comprising six from the cemented group and one from the uncemented group.

Statistical analysis

Data were coded and entered into Microsoft Excel spreadsheet and subsequently analyzed using statistical package for social sciences (SPSS) version 29.0. Descriptive statistics including frequencies, percentages, means, and standard deviations were calculated for all variables. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean±standard deviation.

Comparative analysis between cemented and uncemented groups was performed using appropriate statistical tests. Chi-square test was used for categorical variables, while independent t-test was employed for continuous variables. A $p<0.05$ was considered statistically significant for all analyses.

Quality control measures

To ensure data quality and minimize bias: Standardized data collection forms were used for all patients, regular training sessions were conducted for data collectors, radiological assessments were performed by experienced radiologists, double data entry was performed for 10% of cases to check for accuracy and regular monitoring of data completeness and consistency was undertaken.

RESULTS

A total of 67 patients with intracapsular neck of femur fractures undergoing HA were included in this study. Seven patients were lost to follow-up at six weeks, comprising six from the cemented group and one from the uncemented group, resulting in a follow-up rate of 89.6%.

Demographic characteristics

The mean age of the study population was 72.37±8.1 years (Table 1). The cohort comprised 30 males (45%) and 37 females (55%), demonstrating typical gender distribution seen in elderly hip fracture populations (Table 1).

Table 1: Demographic characteristics of study population, (n=67).

Parameters	Total
Mean age±SD (in years)	72.37±8.1
Gender, n (%)	
Male	30 (45)
Female	37 (55)

Fracture side distribution

Analysis of fracture laterality revealed differences between the treatment groups (Table 2). In the cemented group, left-sided fractures were more common (24 patients, 54.55%) compared to right-sided fractures (20 patients, 45.45%). Conversely, in the uncemented group, right-sided fractures predominated (15 patients, 65.22%) over left-sided fractures (8 patients, 34.78%).

Table 2: Distribution of fracture side by treatment group.

Fracture side	Cemented group, N (%)	Uncemented group, N (%)
Left	24 (54.55)	8 (34.78)
Right	20 (45.45)	15 (65.22)
Total	44 (100)	23 (100)

Functional outcomes

HHS at 6 months post-surgery

Functional outcomes were assessed using the HHS at 6 months post-surgery (Table 3). In the cemented group, the

majority of patients achieved good outcomes (20 patients, 52.6%), followed by fair outcomes (16 patients, 42.1%). Only one patient each had poor and excellent outcomes.

In the uncemented group, good outcomes were achieved by 12 patients (54.5%), while 6 patients (27.3%) had fair outcomes. Notably, 4 patients (18.2%) in the uncemented group had poor outcomes, and no patients achieved excellent outcomes.

Radiological outcomes

Prosthetic subsidence at 6 months

Radiological assessment at 6 months post-surgery revealed differences in prosthetic subsidence between the treatment groups (Table 4). In cemented group, 37 patients (97.37%) showed no evidence of subsidence, while only 1 patient (2.63%) experienced prosthetic subsidence. In contrast, uncemented group demonstrated higher rate of subsidence, with 3 patients (13.04%) experiencing this complication, while 19 patients (82.61%) showed no subsidence.

Safety and complications

The study monitored various complications throughout the follow-up period. The primary complications assessed included prosthetic subsidence, as detailed above. No cases of prosthetic dislocation, deep infection, or periprosthetic fractures were reported in either group during the study period.

Follow-up compliance

Patient compliance with the follow-up schedule was generally good, with 89.6% of patients completing the 6-week follow-up assessment. The loss to follow-up was marginally higher in the cemented group (6 patients, 13.6%) compared to the uncemented group (1 patient, 4.3%).

Summary of key findings

Demographics

Mean age 72.37±8.1 years with slight female predominance (55%)

Functional outcomes

No statistically significant difference in HHS at 6 months (p=0.132).

Radiological outcomes

Higher subsidence rate in uncemented group (13.04% vs 2.63%) but not statistically significant (p=0.135).

Safety

No major complications reported in either group.

Follow-up

Good compliance with 89.6% completion rate at the 6 months.

The results demonstrate comparable functional outcomes between cemented and UCHA at 6 months post-surgery, with a trend toward lower subsidence rates in the cemented group, though statistical significance was not achieved for the primary endpoints.

Table 3: HHS categories at 6 months post-surgery.

HHS category	Cemented group, (n=38) (%)	Uncemented group, (n=22) (%)	P value
Poor (<70)	1 (2.6)	4 (18.2)	0.132
Fair (70-80)	16 (42.1)	6 (27.3)	
Good (81-90)	20 (52.6)	12 (54.5)	
Excellent (>90)	1 (2.6)	0 (0)	

*The difference in functional outcomes between the two groups was not statistically significant (p=0.132).

Table 4: Prosthetic subsidence at 6 months post-surgery.

Subsidence status	Cemented group (n=38) (%)	Uncemented group (n=22) (%)	P value
No subsidence	37 (97.37)	19 (82.61)	0.135
Subsidence present	1 (2.63)	3 (13.04)	

*Although the uncemented group showed a higher incidence of subsidence (13.04% vs 2.63%), this difference was not statistically significant (p=0.135).

Table 5: Follow-up compliance.

Parameters	Cemented group, N (%)	Uncemented group, N (%)	Total
Initial enrollment	44	23	67
Lost to follow-up at 6 weeks	6 (13.6)	1 (4.3)	7 (10.4)
Completed 6-month follow-up	38 (86.4)	22 (95.7)	60 (89.6)

DISCUSSION

This retro-prospective comparative study represents one of the few investigations comparing cemented and UCHA outcomes in an Indian population. Our findings provide valuable insights into the functional and radiological outcomes of these two fixation techniques in elderly patients with intracapsular neck of femur fractures.

Demographic profile and study population

The demographic characteristics of our study population align well with previously published literature. The mean age of 72.37±8.1 years in our cohort is consistent with findings from Raja, who reported an average age of 72 years in their study population.[13] This similarity strengthens the external validity of our findings. However, our age distribution differs from some international studies; Bhandari et al. reported that 80.2% of patients were ≥70 years of age with 70.1% being female, while our study showed a more balanced gender distribution with 55% females.[14]

The slight female predominance (55%) observed in our study is less pronounced than typically reported in hip fracture populations. This may reflect regional variations in bone health, activity patterns, or referral patterns to our tertiary care center. Liu reported that all patients in their study were over 65 years with a mean age between 70-85.3 years, which encompasses our study population and supports the generalizability of findings across similar age groups.[15]

Functional outcomes: HHS analysis

Our primary finding of no statistically significant difference in HHS between cemented and uncemented groups (p=0.132) at 6 months is both clinically relevant and consistent with some recent literature. This finding contrasts with several larger studies that have demonstrated superiority of cemented fixation.

The Norwegian hip fracture register, analyzing 22,639 cemented versus 7,539 uncemented procedures, found no significant differences in pain levels or quality of life scores after one year of surgery.[16] This large-scale registry data supports our finding of comparable functional outcomes between the two techniques. Similarly, Malwinder Singh reported no statistically significant difference in HHS at regular follow-up intervals, with functional results at final follow-up being comparable between groups.[17]

However, our findings differ from some international studies. A meta-analysis by Yue et al encompassing 24 randomized controlled trials with 3,471 patients, demonstrated that patients undergoing CHA achieved significantly better hip function as measured by HHS at various postoperative intervals.[18] They reported superior outcomes for cemented groups at six weeks (p<0.001), three months (p<0.001), four months (p<0.001), and six months (p<0.001). The discrepancy between our findings and this meta-analysis may be attributed to several factors including sample size limitations, regional variations in surgical technique, patient selection criteria, and rehabilitation protocols.

Interestingly, a study by Patil et al conducted in India with 120 patients, reported slightly higher HHS in cemented group (90.2) compared to uncemented (87.9).[19] While this Indian study showed trend similar to international literature favoring cemented fixation, the difference was not as pronounced as reported in Western populations, which aligns with our findings of comparable outcomes.

The Cochrane review analyzing all randomized controlled trials comparing arthroplasty approaches for FNFs found substantial evidence supporting cemented prostheses. Results from six trials involving 899 patients out of 2,861 total patients showed that those receiving cemented prostheses experienced decreased pain after one year or more and demonstrated better mobility compared to uncemented prostheses.[20] Our study's follow-up period of 6 months may not be sufficient to detect these longer-term differences, suggesting the need for extended follow-up in future studies.

Radiological outcomes: prosthetic subsidence

One of the most clinically significant findings in our study was the higher rate of prosthetic subsidence in the uncemented group (13.04%) compared to the cemented group (2.63%), although this difference did not reach statistical significance (p=0.135). This trend is consistent with the established understanding of fixation mechanics and has important clinical implications.

Our subsidence rates are comparable to those reported by Sapienza, who found that 88.75% of patients experienced minor subsidence while 11.25% showed notable subsidence, with no statistically significant difference between groups (p>0.05).[21] The higher subsidence rate in our uncemented group aligns with biomechanical principles, as uncemented prostheses rely on initial press-fit fixation and subsequent osseointegration, during which some degree of settling is expected.

The clinical significance of this finding extends beyond mere radiological appearance. Prosthetic subsidence can lead to leg length discrepancy, altered biomechanics, increased wear, and potentially higher revision rates in the long term. The Norwegian hip fracture register data supports this concern, showing that patients receiving UCHA had a higher chance of requiring reoperation, particularly due to periprosthetic fractures (p<0.001).[16]

Comparison with international literature

Our findings provide a nuanced perspective when compared to major international studies. Emery et al in

their study of 53 patients with displaced FNFs randomized to cemented or UCHA, reported that the uncemented group had higher hip pain and greater dependency on walking aids compared to those who received cemented prostheses at a mean follow-up of 17 months.[22] While our study did not show significant functional differences at 6 months, this suggests that differences may become more apparent with longer follow-up periods.

The meta-analysis by Yue et al demonstrated several advantages for CHA, including better hip function, lower rates of postoperative pain (p=0.013), fewer prosthetic fractures (p<0.001), reduced subsidence or loosening (p=0.014), lower revision surgery rates (p=0.012), and decreased incidence of pressure ulcers (p=0.01).[18] The only significant disadvantage identified was longer operative time for cemented procedures (7.87 minutes longer, p<0.001).

Clinical implications and regional considerations

The lack of statistically significant differences in our study may reflect several important factors specific to the Indian healthcare context. First, the patient population in India may have different bone quality characteristics, activity levels, and expectations compared to Western populations. Second, variations in surgical technique, implant selection, and postoperative rehabilitation protocols may influence outcomes.

The higher subsidence rate in the uncemented group, while not statistically significant, represents a clinically important trend that warrants consideration in surgical decision-making. Given that prosthetic subsidence can lead to functional deterioration over time, the trend toward lower subsidence rates with cemented fixation may translate into clinically meaningful differences with longer follow-up.

Study strengths and limitations

Our study contributes valuable data to the limited literature on HA outcomes in the Indian population. The retro-prospective design allowed for efficient patient recruitment while maintaining prospective data collection for key outcome measures. The use of validated scoring systems (HHS) and standardized radiological assessment protocols enhances the reliability of our findings.

However, several limitations must be acknowledged. The relatively small sample size (67 patients) may have limited our ability to detect statistically significant differences, particularly for secondary outcomes. The loss to follow-up of 7 patients (10.4%) at 6 weeks, while relatively low, may have introduced selection bias. Additionally, the 6-month follow-up period may be insufficient to capture long-term differences between the two fixation techniques, as some complications and functional differences may manifest over longer periods.

The non-randomized design, while reflecting real-world clinical practice, may have introduced selection bias in the choice between cemented and uncemented fixation. Surgeon preference, patient factors, and institutional protocols influenced treatment allocation, which may have confounded the results.

Future research directions

Our findings highlight the need for larger, long-term studies in the Indian population to definitively establish the optimal fixation technique for HA. Future research should focus on:

Extended follow-up

Studies with minimum 2–5-year follow-up periods to assess long-term functional outcomes, revision rates, and complications.

Larger sample sizes

Multi-center trials with adequate power to detect clinically meaningful differences.

Economic analysis

Cost-effectiveness studies comparing the two techniques, including revision surgery costs.

Quality of life assessment

Comprehensive evaluation using multiple validated instruments.

Regional variations

Studies examining outcomes across different geographic regions within India.

CONCLUSION

In conclusion, our study demonstrates comparable functional outcomes between cemented and UCHA at 6 months post-surgery in elderly Indian patients with intracapsular neck of femur fractures. While statistical significance was not achieved, the trend toward lower subsidence rates with cemented fixation warrants consideration in clinical decision-making. The findings contribute valuable regional data to the international literature and support the need for larger, longer-term studies to definitively guide treatment recommendations in this population.

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