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Original Research Article

Comparison of Functional Outcomes of Metaphyseal versus Diaphyseal Fit Bipolar Hemiarthroplasty in Elderly Pertrochanteric Fractures

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Abstract

Background: Pertrochanteric fractures in elderly patients are associated with significant morbidity, mortality, and functional impairment. Bipolar hemiarthroplasty has emerged as an effective treatment option for unstable fractures in osteoporotic patients. However, evidence comparing metaphyseal and diaphyseal fit stems remains limited.

Aim: To compare the functional outcomes of metaphyseal and diaphyseal fit bipolar hemiarthroplasty in elderly patients with pertrochanteric fractures.

Methods: This prospective observational cohort study included 54 elderly patients with unstable pertrochanteric fractures treated with bipolar hemiarthroplasty. Patients were divided equally into diaphyseal stem and metaphyseal stem groups. Functional outcomes were assessed using Harris Hip Score (HHS) and Visual Analogue Scale (VAS) at multiple postoperative intervals. Operative time, blood loss, mobilization, and full weight-bearing status were also evaluated.

Results: The mean age of participants was 72.91 ± 9.35 years, with females constituting 61.1% of cases. Diaphyseal stem fixation demonstrated significantly higher HHS at 2 weeks, 6 weeks, 3 months, and 6 months compared to metaphyseal stems ($p<0.001$). Mean operative time and blood loss were significantly higher in the diaphyseal group (162.00 ± 51.59 minutes and 663.70 ± 280.40 mL respectively) compared to the metaphyseal group (114.67 ± 18.79 minutes and 411.48 ± 132.74 mL respectively). However, patients in the diaphyseal group achieved earlier full weight bearing.

Conclusion: Diaphyseal fit bipolar hemiarthroplasty demonstrated superior functional outcomes and earlier mobilization compared to metaphyseal fit stems despite increased operative time and blood loss. Diaphyseal fixation may therefore be preferred in elderly patients with unstable pertrochanteric fractures.

Keywords : Pertrochanteric fracture; Bipolar hemiarthroplasty; Diaphyseal stem; Metaphyseal stem; Harris Hip Score; Elderly patients.

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Introduction

Hip fractures in elderly patients remain a major orthopedic challenge due to increasing life expectancy, osteoporosis, and associated comorbidities. Pertrochanteric fractures constitute a significant proportion of these injuries and are associated with high morbidity, mortality, prolonged hospitalization, and reduced quality of life. [1,2]

Management of unstable pertrochanteric fractures in elderly individuals is particularly difficult because osteoporotic bone compromises implant fixation and increases the risk of fixation failure. Conventional internal fixation methods such as dynamic hip screws and proximal femoral nails may not provide adequate stability in severely osteoporotic bone. [3,4] Bipolar hemiarthroplasty has emerged as a valuable alternative for unstable intertrochanteric fractures in elderly patients. This procedure allows early mobilization, immediate weight bearing, reduced risk of implant failure, and improved postoperative rehabilitation. [5,6]Furthermore, hemiarthroplasty bypasses fracture healing dependence and reduces complications associated with prolonged immobilization such as deep vein thrombosis, pulmonary infections, and pressure ulcers. [7]

The success of bipolar hemiarthroplasty largely depends upon stem fixation and implant stability.

Metaphyseal fit stems primarily obtain fixation in the proximal femur, whereas diaphyseal fit stems achieve distal fixation within the femoral canal. Biomechanically, diaphyseal fixation may provide superior stability in osteoporotic bone and unstable fracture patterns. [8,9]

Previous studies have evaluated the role of hemiarthroplasty in unstable intertrochanteric fractures; however, direct comparisons between metaphyseal and diaphyseal fit bipolar prostheses remain scarce. [10,11] Understanding differences in operative parameters, postoperative recovery, pain relief, and functional outcomes between these two fixation methods is essential for optimizing surgical decision-making.

Therefore, the present study was conducted to compare functional outcomes between metaphyseal and diaphyseal fit bipolar hemiarthroplasty in elderly patients with pertrochanteric fractures using Harris Hip Score, Visual Analogue Scale, operative parameters, and mobilization outcomes. [12–15]

Materials and Methods

This prospective observational cohort study was conducted in the Department of Orthopedics, VMMC and Safdarjung Hospital over a period of 18 months. A total of 54 elderly patients with unstable pertrochanteric fractures were enrolled after obtaining informed written consent. Institutional Ethical Committee approval was obtained before commencement of the study.

Inclusion Criteria

- Patients aged more than 65 years
- Patients with traumatic unstable pertrochanteric fractures

Exclusion Criteria

- Pathological fractures
- Rheumatoid arthritis
- Hip dysplasia
- Associated acetabular fractures
- Shaft femur fractures
- Polytrauma
- Conservatively managed fractures
- Open fractures and neurovascular injuries

Patients were divided into two equal groups:

- Diaphyseal fit bipolar hemiarthroplasty group (n=27)
- Metaphyseal fit bipolar hemiarthroplasty group (n=27)

All patients underwent detailed clinical examination and radiographic evaluation using anteroposterior and lateral radiographs.

Surgical Technique: A posterior approach was utilized in all cases. Exposure was achieved through splitting the gluteus maximus fibers and division of short external rotators. Sequential osteotomy of the femoral neck was performed, followed by femoral canal preparation. Cemented bipolar prosthesis insertion was carried out using standard cementing techniques with restoration of limb length and anteversion.

Outcome Assessment: Patients were assessed postoperatively using:

- Harris Hip Score (HHS)
- Visual Analogue Scale (VAS)
- Day of mobilization
- Full weight-bearing status
- Operative time
- Blood loss

Follow-up evaluations were performed at:

- 2 weeks
- 6 weeks
- 3 months
- 6 months

Statistical Analysis: Data were analyzed using STATA version 14.2. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequency and percentage. Independent t-test, Chi-square test, Fisher's exact test, Wilcoxon-Mann-Whitney U test, Friedman test, and Generalized Estimating Equations were applied as appropriate. A p-value <0.05 was considered statistically significant.

Results

A total of 54 elderly patients with unstable pertrochanteric fractures were included, with 27 patients each in the diaphyseal and metaphyseal stem groups. The mean age was 72.91 ± 9.35 years, with female predominance (61.1%). Right-sided fractures were more common (53.7%), and AO type A3.1 fractures were the most frequent (27.8%).

The diaphyseal stem group had significantly higher operative time (162.00 ± 51.59 min vs 114.67 ± 18.79 min) and blood loss (663.70 ± 280.40 mL vs 411.48 ± 132.74 mL) compared to the metaphyseal group ($p<0.001$). However, patients in the diaphyseal group achieved earlier full weight bearing (3.04 ± 0.19 days vs 4.63 ± 0.49 days; $p<0.001$).

Harris Hip Score improved significantly in both groups during follow-up, with consistently higher scores in the diaphyseal group at all intervals. At 6 months, the mean HHS was 92.70 ± 0.78 in the diaphyseal group compared to 88.85 ± 1.23 in the metaphyseal group ($p<0.001$). VAS scores progressively decreased in both groups over time. At 6 months, the mean VAS score was 2.85 ± 0.77 in the diaphyseal group and 1.00 ± 0.48 in the metaphyseal group ($p<0.001$). Although

improvement in HHS from baseline was significantly greater in the diaphyseal stem group at all follow-up intervals, the metaphyseal stem group showed less post-operative pain.

Table 1: Baseline Characteristics of Study Participants

Parameter	Value
Mean age	72.91 ± 9.35 years
Female gender	61.1%
Right-sided fractures	53.7%
AO Type A3.1	27.8%
AO Type A3.2	25.9%

Table 2: Operative Parameters Comparison

Parameter	Diaphyseal Stem	Metaphyseal Stem	p-value
Operative time (min)	162.00 ± 51.59	114.67 ± 18.79	<0.001
Blood loss (mL)	663.70 ± 280.40	411.48 ± 132.74	<0.001
Day of full weight bearing	3.04 ± 0.19	4.63 ± 0.49	<0.001

Table 3: Harris Hip Score Comparison

Follow-up	Diaphyseal Stem	Metaphyseal Stem	p-value
Preoperative	36.52 ± 4.16	41.00 ± 4.26	<0.001
2 weeks	79.89 ± 2.41	77.07 ± 2.70	<0.001
6 weeks	86.26 ± 1.35	83.04 ± 1.65	<0.001
3 months	89.56 ± 0.89	86.26 ± 1.20	<0.001
6 months	92.70 ± 0.78	88.85 ± 1.23	<0.001

Table 4: Visual Analogue Scale (VAS) Comparison

Follow-up	Diaphyseal Stem	Metaphyseal Stem	p-value
2 weeks	4.85 ± 0.53	2.70 ± 0.91	<0.001
6 weeks	3.89 ± 1.01	1.74 ± 1.16	<0.001
3 months	3.33 ± 0.92	1.15 ± 0.91	<0.001
6 months	2.85 ± 0.77	1.00 ± 0.48	<0.001

Table 5: Improvement in HHS from Baseline

Time point	Diaphyseal Stem	Metaphyseal Stem	p-value
2 weeks	43.37 ± 5.60	36.07 ± 5.83	<0.001
6 weeks	49.74 ± 4.90	42.04 ± 5.16	<0.001
3 months	53.04 ± 4.40	45.26 ± 4.79	<0.001
6 months	56.19 ± 4.34	47.85 ± 4.62	<0.001

Discussion

Management of unstable pertrochanteric fractures in elderly patients remains challenging due to poor bone quality, comorbidities, and high risk of postoperative complications. Bipolar hemiarthroplasty provides immediate stability and facilitates early mobilization, thereby reducing morbidity associated with prolonged immobilization. [5,6] In the present study, females predominated, consistent with the higher prevalence of osteoporosis among elderly women reported in previous literature. [7,8] The mean age of patients was 72.91 years, which is comparable to earlier studies evaluating hemiarthroplasty in intertrochanteric fractures. [9] The present study demonstrated significantly better functional outcomes with diaphyseal fit stems compared to metaphyseal stems. Harris Hip Scores were significantly higher in the diaphyseal group at all postoperative intervals. Similar findings have been reported in previous biomechanical and arthroplasty studies suggesting that distal fixation provides improved implant stability in osteoporotic femurs. [10,11]

Patients in the diaphyseal group also achieved earlier full weight bearing. Early mobilization is critical in elderly patients because it decreases risks of thromboembolic events, pulmonary complications, and muscle wasting. [12] Although operative time and intraoperative blood loss were significantly greater in the diaphyseal group, these disadvantages were offset by superior postoperative recovery and functional outcomes. The present findings support the hypothesis that diaphyseal fixation offers superior biomechanical stability in unstable pertrochanteric fractures. Diaphyseal stems distribute stress more effectively along the

femoral shaft and reduce micromotion in osteoporotic bone. [13,14]

This study has several strengths, including prospective design, equal group allocation, and serial postoperative assessment. However, certain limitations should be acknowledged. The sample size was relatively small, and long-term complications such as implant loosening and revision surgery were not evaluated beyond six months. Further multicentric studies with larger sample sizes and longer follow-up are recommended.

Conclusion

Diaphyseal fit bipolar hemiarthroplasty demonstrated significantly superior functional outcomes compared to metaphyseal fit stems in elderly patients with unstable pertrochanteric fractures. Although associated with longer operative time, vas score and greater blood loss, diaphyseal fixation enabled earlier full weight bearing and better Harris Hip Scores during follow-up. Therefore, diaphyseal fit bipolar hemiarthroplasty may be considered a preferable treatment option for unstable pertrochanteric fractures in elderly patients.

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