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The functional outcome of hemiarthroplasty with cemented modular bipolar prosthesis in comminuted fracture intertrochanteric femur in elderly population

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ABSTRACT

Background: There are several surgical treatment options available for comminuted intertrochanteric fractures but still, many controversies persist, as the postoperative complications increase with increased age. So, it is necessary to evaluate the role of hemiarthroplasty with cemented modular bipolar prosthesis in treating comminuted intertrochanteric fractures in elderly patients. The study aimed to analyse the functional outcomes of hemiarthroplasty with cemented modular bipolar prosthesis in comminuted fracture intertrochanteric femur in 42 elderly patients.
Methods: In this observational prospective study, all patients were taken up for surgery within seven days of their injury. Assessment was done by the modified Harris Hip Score (HHS) during discharge and follow-up visits and results are analysed by paired t test.
Results: There were 26 male and 16 female patients and a 50-50 % side distribution, with mean blood loss of 363.63 ml. Pre-injury ambulation, hypertension distribution analysis, diabetes distribution, hospital stay distribution analysis was done. Complications included superficial infection (14.29%), re-surgery (9.52%), limb length discrepancy seen in none of 76.19%, with a mean duration of surgery 95.86 minutes.
The primary focus was the functional recovery as measured by the HHS. The average HHS improved progressively from 58.24 at discharge to 85.9 at 6 months, reflecting sustained recovery across all follow-up intervals.
Conclusions: Cemented modular bipolar hemiarthroplasty is a highly effective treatment modality for elderly patients with unstable intertrochanteric fractures facilitating excellent functional recovery and minimizes complication rates.

Keywords: Hemiarthroplasty, Harris score, Intertrochanteric fractures, Modular bipolar prosthesis

INTRODUCTION

Intertrochanteric fractures are defined as extracapsular fractures of the proximal femur that occur between the greater and lesser trochanter.[1] It represents about 50% of all hip fractures. These fractures occur both in the elderly and in the young, but they are more common in the elderly population with osteoporosis due to a low-energy mechanism.[1-3] The female-to-male ratio is between 2:1 and 8:1. These patients are also typically older than patients suffering from femoral neck fractures. In the younger population, these fractures typically result from a high-energy mechanism. Nonoperative treatment is rarely indicated and should only be considered for non-ambulatory patients and patients with a high risk of perioperative mortality or those pursuing comfort care measures.

The outcomes of this method of treatment are poor due to an increased risk of pneumonia, urinary tract infection and deep vein thrombosis. According to stability they can be divided into stable and unstable fractures. Unstable

fractures are having comminution in the posteromedial cortex. Stable trochanteric fractures can be treated with internal fixation with predictable results.

The management of unstable osteoporotic fractures is still debatable. Initially, in the past, fixation of unstable fractures with fixed blade plate and enders nail had a high rate of cut-through and fracture displacement.[4,5] Subsequently sliding hip screw was used with much success and became the predominant method of fixation of these fractures. Unfortunately, all the aforesaid methods are associated with poor compliance due to restrictions to weight bearing and mobilization.[6]

Very often, prolonged immobilization results in atelectasis, pneumonia, bedsore, deep vein thrombosis in elderly patients.[7,8] Whereas hemiarthroplasty with cemented modular bipolar prosthesis has advantages in view of early mobilization.[16] Though many studies have been conducted to choose the treatment of choice for comminuted fracture intertrochanter in the elderly population but it is still controversial. Thus, in this era of evidence-based medicine, it is necessary to evaluate the role of hemiarthroplasty with cemented modular bipolar prosthesis in treating comminuted intertrochanteric fractures in elderly patients.

Aim

The aim of study was to analyse the functional outcomes of hemiarthroplasty with cemented modular bipolar prosthesis in comminuted fracture intertrochanteric femur.

Objectives of the study

To analyse the clinical and functional outcomes of patients with an unstable intertrochanteric fracture treated by hemiarthroplasty. To evaluate the early benefits following surgery and analyse the complications.

METHODS

Study design

The study was observational and prospective study.

Study population and study location

Patients of comminuted fracture intertrochanter of 60 years and above aged admitted in the new medical college and associated group of hospital were considered for this study. All patients were taken up for surgery within seven days of their injury. Informed consents were taken from all patients before surgery.

Study duration

Study period of this study was of 14 months (November 2023 to December 2024).

Sample size

42 patients Minimum sample size of the study was determined by using the formula $N = (Z\alpha/22 \times p \times q) \div L2$, at 5% level of significance, tolerating 10% allowable error and considering the prevalence of excellent to fair result as 91%.[18]

Here p= 91 q=1-p= 9; L =10% of p = 9.1; $Z\alpha/22 = (1.96)2$ Hence sample size $N=(1.96)2\times 91 \times 9\div (9.1)2 = 37$. After adding 10% extra for incomplete responses, sample size 42.

Inclusion criteria

Closed comminuted fracture intertrochanteric femur (unstable fracture Evans type). Elderly patients aged 60 years and above. Patients willing for surgery. Patients fit for surgery.

Exclusion criteria

Non ambulatory patient before trauma. Simple undisplaced fracture trochanter. Patients with unstable comorbidities. Pathological fractures. Other associated fractures.

After getting approval from institutional ethical committee (IEC) this prospective observational study was conducted to evaluate the functional outcome of hemiarthroplasty with cemented modular bipolar prosthesis in elderly patients (≥60 years) who sustained comminuted intertrochanteric fractures of the femur. A total of 42 patients were enrolled over 14 months according to the inclusion and exclusion criteria. Under all aseptic precautions and anaesthesia, all patients were operated through posterior approach by same surgeon using implant and cement of the same brand. They were assessed using the Harris Hip Score (HHS) at multiple postoperative time points to determine clinical recovery and functional improvement. Results are analysed using normality testing Shapiro-wilk test, paired t test and ROC curve analysis with help of SPSS Statistics 31.

RESULTS

The results offer insights into surgical efficacy, recovery trajectory and associated complications in this high-risk geriatric population.

The mean age of the patients was 71.05 years, with a range from 60 to 85 years. The sex distribution showed a male predominance (61.9% male vs. 38.1% female). 90.5% of patients were ambulatory without support before injury. The laterality of fractures was equally distributed, with 21 patients having left-sided and 21 having right-sided fractures, indicating no bias toward fracture side.

The mean blood loss was 363.63 ml, with a minimum of 207 ml and a maximum of 487 ml. The mean surgical

duration was 95.86 minutes, with a median of 93 minutes and ranged from 75 to 118 minutes. Among the patients, 66.7% had hypertension and 42.9% had diabetes mellitus, confirming the high comorbidity burden in this age group. Authors evaluated the HHS at six key time points-discharge, 2 weeks, 4 weeks, 8 weeks, 3 months and 6 months following hemiarthroplasties with a cemented modular bipolar prosthesis in elderly patients with comminuted intertrochanteric femur fractures.

To assess whether the observed improvements in HHS over time were statistically significant, a stepwise pairwise comparison was performed across successive intervals using the most appropriate statistical test. Initially, we conducted normality testing using the Shapiro-Wilk test to determine whether the distribution of the difference scores between paired time points followed a normal distribution. As the majority of the differences demonstrated a normal pattern, the paired t-test was selected for all intervals to compare the mean HHS scores.

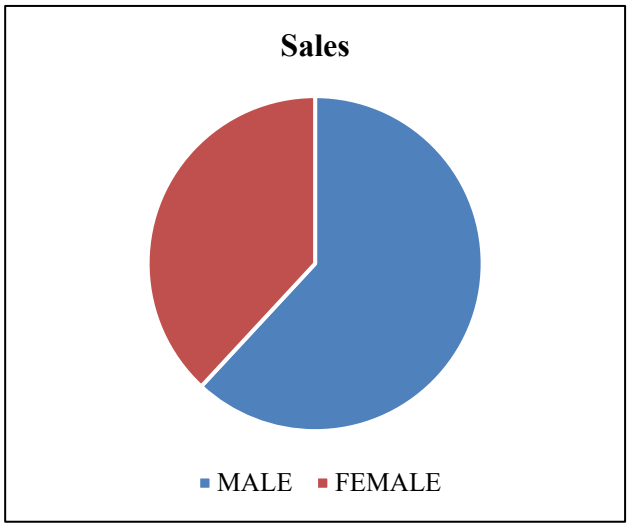

Figure 1: Sex distribution of the study.

Figure 2: Pre-op X-ray showing comminuted fracture intertrochanteric femur.

Figure 3: Intra-op photos during hemiarthroplasty with cemented modular bipolar prosthesis.

Figure 4: Post-op X-ray at post-op day 2 following hemiarthroplasty.

The first comparison, between discharge and 2 weeks, yielded a test statistic of -1.997 and a p value of 0.05388. Although close to the conventional threshold of 0.05, this result was not statistically significant. This finding reflects the reality of the early postoperative period. During the initial two weeks, patients are typically limited in mobility due to surgical site pain, stiffness and general postoperative weakness. Most patients would still be dependent on walking aids or assistance and hence do not demonstrate substantial improvement in HHS in this interval. Clinically, this highlights the need for realistic goal-setting and targeted pain control in the immediate recovery phase. The subsequent comparisons showed marked functional improvement with high statistical significance. From 2 weeks to 4 weeks, the mean HHS scores increased significantly, with a test statistic of -5.283 and a p-value<0.00001. This result aligns with the known trajectory of recovery, as most patients begin active physiotherapy and ambulation training during this interval.

Pain control improves and patients regain confidence in weight-bearing. The observed data clearly support the thesis objective of evaluating early functional benefits after hemiarthroplasty. The 4 weeks to 8 weeks interval also showed highly significant improvement ($p<0.00001$), with further increases in HHS scores. This period often coincides with independent ambulation, transition from walker to stick and improvement in balance and joint mobility. Functional milestones such as climbing stairs, toilet independence and unaided short distance walking are often achieved here.

From 8 weeks to 3 months, the HHS scores continued to improve significantly ($p<0.00001$), showing sustained gains even beyond the intensive physiotherapy period. The recovery in this phase likely represents cumulative benefits from prior rehabilitation, psychological adaptation and enhanced muscle conditioning. Additionally, as complications such as infection or implant malalignment are rare in this cohort, no setbacks interrupted the progress. The final comparison between 3 months and 6 months also demonstrated statistically significant improvement ($p=0.00015$). However, the rate of increase in mean scores was lower than in earlier intervals.

This plateau effect is well-documented in orthopaedic recovery and represents the point at which most patients have regained their maximum functional potential. While small improvements continue in strength and endurance, they do not manifest as large jumps in the HHS score. These findings are important from a clinical as well as research standpoint. They help set expectations for both surgeons and patients regarding recovery phases. Statistically validated functional gains reinforce the credibility of hemiarthroplasty as a treatment for unstable intertrochanteric fractures in elderly individuals. Additionally, these results support the core objectives of this study-namely, to assess clinical and functional outcomes and to evaluate early benefits postoperatively. The consistent use of paired t-tests with appropriate normality checks ensures the methodological robustness of this statistical analysis. Each p-value derived is a measure of whether the mean difference in scores between two intervals is likely due to chance or represents a true improvement attributable to surgery and rehabilitation. The results thus help rule out random variation and lend strong support to the effectiveness of this surgical approach. Furthermore, these findings can be integrated into patient education, discharge planning and protocol development for physiotherapy. They validate the need for aggressive early rehabilitation beginning after the second postoperative week and help anticipate the natural plateau in recovery after the third month. Such data are also useful in designing multicentric studies or meta-analyses that compare various types of implants or surgical techniques. In conclusion, this p value analysis of Modified Harris Hip Score progression demonstrates a statistically significant improvement in functional outcomes from 2 weeks onward after hemiarthroplasty. The improvement pattern is steepest between 2 and 8 weeks and continues gradually through 6 months. The statistically insignificant change in the first 2 weeks underscores the biological limitations of early recovery. Collectively, these results substantiate the use of cemented modular bipolar prosthesis in elderly patients with unstable femoral fractures as an effective and predictable surgical intervention with substantial and sustained functional benefits.

Postoperative complications

Monitoring revealed superficial infections in 6 patients (14.3%), while 36 patients (85.7%) had no infection. All infections were managed conservatively without the need for implant removal. The re-surgery rate was low, with only 4 patients (9.5%) requiring additional procedures, indicating acceptable surgical reliability. Furthermore, limb length discrepancy was noted in 10 patients (23.8%), all categorized as mild. There were no cases of severe discrepancy or gait-altering limb inequality.

Table 1: HHS analysis during discharge and follow-up.

Time point	Average HHS
HHS discharge	58.24
HHS 2 weeks	62.45
HHS 4 weeks	70.57
HHS 8 weeks	77.4
HHS 3 months	82.88
HHS 6 months	85.9

Table 2: P value analysis of HHS progression.

Comparison	Test used	Statistic	P-value
HHS discharge vs HHS 2 weeks	Paired t-test	-1.997	0.05388
HHS 2 weeks vs HHS 4 weeks	Paired t-test	-5.283	<0.00001
HHS 4 weeks vs HHS 8 weeks	Paired t-test	-6.639	<0.00001
HHS 8 weeks vs HHS 3 months	Paired t-test	-5.227	<0.00001
HHS 3 months vs HHS 6 months	Paired t-test	-4.268	0.00015

DISCUSSION

Intertrochanteric fractures in elderly patients continue to be a major source of morbidity and mortality due to osteoporosis, frailty and associated comorbidities. The management of comminuted, unstable patterns remains controversial, as conventional internal fixation methods often fail to achieve early mobilization in osteoporotic bone. The present prospective study evaluated the role of cemented modular bipolar hemiarthroplasty in 42 elderly patients with unstable intertrochanteric fractures, analyzing both functional and clinical outcomes.

In this study, the mean age of the patients was 71.05 years, consistent with previous reports by Sancheti et al and Kayali et al where the majority of patients were in the seventh to eighth decade of life.[16,18] The male predominance in our cohort contrasts with global epidemiological data showing a female preponderance due to higher rates of osteoporosis among women.[13] This may reflect demographic or referral variations in region. The mean blood loss (363.63 ml) and mean operative time (95.86 minutes) were within acceptable surgical ranges and comparable to studies by Kumar et al and Patil et al who reported operative times around 90–100 minutes.[23,24] The hospital stay averaged 11 days, reflecting early rehabilitation and discharge compared with traditional fixation methods that often require longer immobilization.

The functional outcome, assessed using the HHS, showed a steady and statistically significant improvement from a mean of 58.24 at discharge to 85.9 at 6 months. The early postoperative period (first 2 weeks) showed minimal change, which aligns with the natural recovery curve as pain, swelling and initial immobility limit rapid gains. The steepest improvement occurred between 2 and 8 weeks, corresponding to active physiotherapy and initiation of weight-bearing a pattern also observed by Chan et al and Rodop et al.[13,14] By 6 months, the mean HHS (85.9) in our series was comparable to results from other Indian and international studies, such as Sancheti et al (mean 84.3) and Siwach et al (mean 83.7).[18,21] This reflects the reproducibility and reliability of cemented modular bipolar prosthesis in restoring near-normal function in elderly patients. The statistically significant improvement across successive intervals ($p<0.00001$ after 2 weeks) confirms that early hemiarthroplasty not only provides stable fixation but also facilitates safe early ambulation. Early mobilization is crucial in preventing complications such as pneumonia, deep vein thrombosis and pressure ulcers, which are common with prolonged bed rest in the elderly.[6,7] Thus, our findings reinforce the growing consensus that functional recovery rather than radiological union should guide the choice of surgical management in this population. The complication rate in our study was low and comparable with existing literature. Superficial infection occurred in 14.29% of patients, all managed conservatively. No deep infections or implant-related complications occurred. The re-surgery rate (9.52%) and limb length discrepancy (23.8%, mild) were also within acceptable limits. These rates are similar to those reported by Green et al and Rodop et al further supporting the safety of this procedure.[11,14] The absence of major prosthetic dislocation or periprosthetic fracture in our cohort underlines the importance of meticulous surgical technique and cement fixation. Interestingly, our ROC analysis revealed that HHS at discharge was a moderate predictor (AUC 0.7279) of excellent long-term outcome. This suggests that early functional assessment may help clinicians identify patients likely to achieve superior recovery, enabling targeted rehabilitation. This observation is consistent with modern orthopaedic rehabilitation paradigms emphasizing early mobility and function-based metrics over purely radiological parameters.

Overall, the findings from this study are consistent with international evidence supporting cemented modular bipolar hemiarthroplasty as a reliable and effective treatment for unstable intertrochanteric fractures in elderly patients. It ensures stable fixation, early mobilization and excellent short-term functional recovery with a low complication rate. These results reinforce the paradigm shift from fixation to replacement in managing such fractures among the elderly osteoporotic population. The study is limited by a modest sample size, single-centre design and short-term follow-up of six months. Long-term evaluation, including radiological parameters such as stem subsidence and acetabular erosion, is essential to fully validate the durability of this approach. Comparative trials involving cementless stems, dual mobility components or total hip arthroplasty could further refine implant selection in this demographic. Additionally, multicentric prospective trials with longer follow-up could enhance generalizability.

CONCLUSION

In conclusion, cemented modular bipolar hemiarthroplasty is a highly effective treatment modality for elderly patients with unstable intertrochanteric fractures. It facilitates early ambulation, promotes excellent functional recovery and minimizes complication rates. The findings support its routine use in suitable candidates and also recommend early HHS scoring as a strong predictor of long-term success. With timely surgery, structured rehabilitation and close monitoring, excellent outcomes can be consistently achieved in this vulnerable patient population.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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