e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(3); 219-224

Original Research Article

Clinico-Radiological Evaluation of Cephalo-Medullary Nail with Helical Blade Fixation in Intertrochanteric Fractures of Femur in Elderly Patients

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Received: 24-01-2026 / Revised: 07-02-2026 / Accepted: 27-02-2026

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Conflict of interest: Nil

Abstract:

Background: Intertrochanteric fractures of the femur are increasingly common in the elderly due to osteoporosis and low-energy trauma. Early surgical fixation enabling stable reduction and early mobilization is the standard of care. Cephalo-medullary nails with helical blade fixation have been developed to enhance rotational stability and reduce cut-out rates, especially in osteoporotic bone. This study aimed to evaluate the clinico-radiological outcomes of this implant in elderly patients.

Methods: A prospective case series was conducted from September 2015 to August 2017, including 75 patients aged ≥45 years with osteoporotic intertrochanteric fractures. All underwent closed reduction and internal fixation using a cephalo-medullary nail with a helical blade. Patients were followed for 48 weeks. Clinical evaluation included pain assessment (VAS), HHS (Harris Hip Score), Jensen Social Function Score, and Parker Mobility Score. Radiological assessment included fracture union and TAD (Tip-Apex Distance). Statistical analysis was performed using SPSS version 20.

Results: The mean age was 65.67±10.63 years, with female predominance (65.3%). Mean surgical time was 69.01±13.74 minutes and mean blood loss was 167.33±66.52 ml. The mean TAD was 24.69±3.16 mm. Radiological union was observed in 97.2% by 12 weeks and 100% in patients completing follow-up at 48 weeks. Mean HHS improved significantly from 38.47±13.14 at 6 weeks to 98.68±1.84 at 48 weeks ($p<0.001$). Parker Mobility Score improved from 1.68±0.50 to 8.74±0.75, while the Jensen score decreased from 3.21±0.50 to 1.03±0.17 ($p<0.001$). Implant failure and non-union were noted in 2.8% each. At final follow-up, outcomes were good in 58.5%, average in 35.7%, and poor in 5.7% of cases.

Conclusion: Cephalo-medullary nail with helical blade fixation provides stable fixation, high union rates, significant functional recovery, and low complication rates in elderly patients with intertrochanteric fractures, making it a reliable treatment modality.

Keywords: Intertrochanteric Fracture, Cephalo-Medullary Nail, Helical Blade, Osteoporosis, Harris Hip Score, Functional Outcome.

DOI: 10.25258/ijcpr.18.3.35

Introduction

Trochanteric fractures are among the most common injuries around the hip joint in elderly patients.[1] The incidence of intertrochanteric fractures is increasing due to the growing elderly population and the rising prevalence of osteoporosis. Conservative management using skeletal or skin traction requires prolonged immobilization for 2–4 months,[2] and is associated with complications such as malunion, pin tract infections, and prolonged recumbency. Operative treatment, introduced in the 1950s, enabled early mobilization and reduced complications related to immobilization.[3]

Early extramedullary implants such as the Smith-Peterson nail, Thornton plate, and Austin Moore blade plate were used for fixation but were associated with complications including cut-through, joint penetration, bending, and implant breakage. The SHS (Sliding Hip Screw) subsequently became the standard treatment for nearly four decades. While SHS produces excellent results in stable fractures, unstable fractures with posteromedial comminution increase mechanical stress on extramedullary devices, leading to higher failure rates and cut-out.[4] Intertrochanteric fractures are also associated with significant morbidity, mortality, implant failure, and

socioeconomic burden, particularly in patients with comorbidities such as diabetes and hypertension.[2]

Stable internal fixation remains the cornerstone of management, with successful outcomes depending on fracture geometry, bone quality, reduction, implant selection, and surgical technique.[2] Intramedullary devices offer biomechanical advantages, including better load transfer, shorter lever arms, and controlled fracture impaction.[4] However, earlier intramedullary nails were technically demanding and associated with complications.[5]

PFNA (Proximal Femoral Nail Antirotation) systems were developed to improve fixation in osteoporotic bone. The helical blade design compacts cancellous bone, enhances rotational stability, and provides superior cut-out resistance compared to conventional screws. The PFNA2, tailored for smaller femoral anatomy, may be particularly suitable for Asian populations. [6,7]

Given these biomechanical advantages, the present study was undertaken to evaluate the clinico-radiological outcomes of cephalo-medullary nail with helical blade fixation in elderly patients with intertrochanteric fractures of the femur.

Aims and Objectives: The aim of the present study was to evaluate the clinico-radiological results of cephalo-medullary nail with helical blade fixation in intertrochanteric fractures of the femur in elderly patients. The objectives were to assess the changes in clinical parameters following the procedure during the post-operative and follow-up periods in comparison with the pre-operative status, and to evaluate the radiological changes observed after surgery during subsequent follow-up.

Materials and Methods

Study Design: This study was conducted as a prospective case series in the Department of Orthopaedic Surgery at Shri Guru Ram Rai Institute of Medical & Health Sciences and Shri MahantIndresh Hospital, Dehradun, a 1000-bed multi- and superspeciality teaching hospital catering to a diverse population from Dehradun, Rishikesh, Haridwar, and Mussoorie. The study population comprised patients with a clinico-radiological diagnosis of intertrochanteric fractures. The study was carried out over a two-year period from September 2015 to August 2017, allowing systematic enrolment, treatment, and follow-up of eligible patients.

Inclusion and Exclusion Criteria: Patients were included in the study if they had clinically and radiologically diagnosed intertrochanteric fractures of the femur, were aged above 50 years, and had radiological evidence of osteoporosis. Patients were excluded if they were younger than 50 years, had open intertrochanteric fractures, had pathological fractures other than those due to osteoporosis, or had associated multiple injuries.

Sample Size Calculation: Ina previous study, good radiological reduction was achieved in 94/111 (85.5%) of elderly patients treated with cephalomedullary nails with helical blades (PFNA). In the present study too, we would be targeting a similar success rate. The sample size has been calculated using the formula suggested by Snedecor and Cochran, (1989) [8]:

$$n = C^2 \frac{p(1-p)}{e^2}$$

where C is a constant with value 1.96 at 95% confidence and 80% power, p is the prevalence (success rate) = 85.5 ~ 86% = 0.86 and e is the error allowance, taken as 10% (0.10%) in the present study. Now placing these values in the above equation, we get:

$$= \quad 46.23 \sim 46$$

Thus, the calculated sample size is 46. After adding for a contingency of 10% and rounding off to the nearest ten, we targeted a sample size of 50. Thus, the minimum calculated sample size was 50.

Data Collection Procedure: At enrolment, detailed demographic information, mode and duration of injury, past medical history, and relevant personal history were recorded, followed by thorough clinical examination. All patients underwent radiographic evaluation, and fractures were classified according to AO classification criteria. Osteoporotic status was assessed using Singh's index, and routine laboratory investigations with pre-anesthetic evaluation were performed. Eligible patients underwent closed reduction and internal fixation with a cephalo-medullary nail with helical blade under spinal or general anaesthesia using a fracture table and image intensifier. Intraoperative parameters, including operative time and blood loss, were documented. Postoperatively, patients received intravenous antibiotics and analgesics for 48 hours, followed by oral medications, along with thromboembolic prophylaxis for three days. Early mobilization with weight bearing as tolerated was initiated from the first postoperative day. Patients were followed up at six-week intervals for the first six months and subsequently every twelve weeks, with a minimum follow-up of 12 months. Clinical evaluation included pain assessment using VAS, limb length discrepancy, range of motion, and gait assessment. Functional outcomes were assessed using the Harris Hip Score, Jensen's Social Function Scale, and Parker and Palmer Mobility Score. Radiological assessment included evaluation of fracture reduction, tip-apex distance, blade position (as per modified Baumgaertner's criteria), and follow-up

monitoring for union, loss of reduction, implant migration, sliding, and cut-out, with all radiographs independently reviewed by a blinded radiologist.

Statistical Analysis: Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) Version 20.0. Data were expressed as number (percentage) for categorical variables and mean ± standard deviation (SD) for continuous variables. Descriptive statistics including mean, median, and standard deviation were calculated. The paired "t" test was used to compare changes in parameters at different time intervals, while the Wilcoxon signed-rank test was applied for non-parametric comparisons. A p-value was considered statistically significant at <0.05, highly significant at <0.01, and very highly significant at <0.001, whereas p >0.05 was considered not significant.

Results

Table 1: Demographic Profile of Study Population (n = 75)

Variable	Category	No. of Patients	Percentage (%)
Age (in years)	45–54	10	13.33
	55–64	25	33.33
	65–74	19	25.33
	75–84	20	26.67
	85–94	1	1.33
Gender	Male	26	34.67
	Female	49	65.33

Table 1 observes that the majority of patients belonged to the 55–64 years age group, with a mean age of 65.67±10.63 years. Females predominated (65.33%), reflecting the higher prevalence of osteoporosis among elderly women.

Table 2: Mode of Injury and Fracture Type

Variable	Category	No.	%
Mode of Injury	Fall due to slip	56	74.67
	RTA	16	21.33
	Others	3	4.00
Fracture Type	Type 1	8	10.67
	Type 2	18	24.00
	Type 3	18	24.00
	Type 4	31	41.33

Table 2 illustrates that falls due to slips were the predominant cause of injury. Type 4 fractures were most common, indicating a higher prevalence of unstable fracture patterns in the study group.

Table 3: Perioperative Parameters

Parameter	Mean ± SD	Range
Time between trauma & surgery (days)	4.21 ± 2.21	1–10
Duration of surgery (min)	69.01 ± 13.74	50–130
Blood loss (ml)	167.33 ± 66.52	100–300
Hospital stays (days)	11.04 ± 4.47	5–20
Tip Apex Distance (mm)	24.69 ± 3.16	20–32

Table 3 demonstrates efficient operative management with moderate surgical duration, minimal blood loss, acceptable hospital stay, and satisfactory tip-apex distance (<25 mm).

Table 4: Functional Outcome – Harris Hip Score

Follow-up	Mean ± SD	p-value
6 weeks	38.47 ± 13.14	—
12 weeks	61.70 ± 19.10	<0.001
18 weeks	83.44 ± 12.24	<0.001
24 weeks	94.06 ± 4.71	<0.001
36 weeks	98.18 ± 4.27	<0.001
48 weeks	98.68 ± 1.84	<0.001

Table 4 highlights a statistically significant progressive improvement in functional outcome, reaching near-normal hip function by 48 weeks.

Table 5: Jensen Social Function & Parker Mobility Scores

Follow-up	Jensen Score (Mean±SD)	Parker Score (Mean±SD)
6 weeks	3.21 ± 0.50	1.68 ± 0.50
12 weeks	2.30 ± 0.49	3.33 ± 0.63
18 weeks	1.26 ± 0.44	5.49 ± 0.65
24 weeks	1.06 ± 0.29	7.99 ± 1.24
36 weeks	1.13 ± 0.46	8.85 ± 0.40
48 weeks	1.03 ± 0.17	8.74 ± 0.75

Table 5 indicates progressive social and mobility recovery, with near-complete independence by final follow-up.

Table 6: Pain and Radiological Union

Time	Severe Pain (%)	No Pain (%)	Union (%)
Baseline	62.7	0	—
6 weeks	54.1	0	36.1
12 weeks	0	0	97.2
24 weeks	0	57.3	97.1
48 weeks	0	77.2	100

Table 6 shows significant pain reduction and progressive radiological union, with complete union in all patients remaining at final follow-up.

Table 7: Complications and Final Outcome

Parameter	No.	%
No complications	35	50
Limp	13	18.5
Trochanteric pain	7	10
Implant failure	2	2.8
Non-union	2	2.8
Final Outcome (n=70)		
Good	41	58.5
Average	25	35.7
Poor	4	5.7

Table 7 summarizes that half of the patients had no complications. Implant failure and non-union rates were low (2.8% each). The majority (58.5%) achieved good functional outcomes at 48 weeks.

Discussion

Intertrochanteric fractures are among the most common hip fractures in elderly patients, typically resulting from low-energy trauma in osteoporotic bones. With increasing life expectancy and rising prevalence of osteoporosis, their incidence continues to increase. The primary goal of management in elderly patients is early mobilization and restoration to pre-fracture functional status with minimal morbidity and mortality. Surgical intervention remains the treatment of choice.

In the present study, 75 patients were enrolled with a mean age of 65.67±10.63 years. The mean age was slightly lower compared to other studies, as patients above 45 years were included. Bajpai et al.,[9] reported mean ages of 69.1 and 71.2 years in their study groups, while Kasha et al.,[10] reported a mean age of 69.4 years. Kumar et al.,[11] included patients aged 31–90 years with a mean age of 61 years.

Females constituted 65.33% of the study population. Similar female predominance has been reported by Bajpai et al.,[9] Kasha et al.,[10] and Sadic et al.,[12] which can be attributed to a higher incidence of osteoporosis in post-menopausal women.

Falls due to slips were the most common mechanism of injury (74.67%), consistent with the findings of Kasha et al.,[10] and Kumar et al. [11] The majority of patients had unstable fractures, with Type 4 fractures being most common (41.33%). A similar predominance of unstable fractures in elderly patients has been reported in previous studies.[11] The declining Singh's index with increasing fracture severity further supports the association between osteoporosis and unstable fracture patterns.

Mean operative time (69.01±13.74 minutes) and mean blood loss (167.33±66.52 ml) in the present study were comparatively lower than those reported by Bajpai et al.,[9] and Sadic et al. [12] These findings reflect the minimally invasive nature and biomechanical advantage of cephalomedullary nails with helical blade fixation. The mean tip-apex distance was 24.69±3.16 mm, comparable to Sadic et al.,[12] and within acceptable limits to prevent cut-out.

Functional outcomes showed significant improvement. The mean Harris Hip Score improved from 38.47 at 6 weeks to 98.68 at 48 weeks. Similar improvements were reported by Bajpai et al.,[9] and Kumar et al.,[11] Jensen Social Function and Parker Mobility scores also showed progressive improvement, indicating near-complete functional recovery. Park et al.,[13] reported improvement in social and mobility scores, although in an older population. De Landevoisin et al.,[14] reported relatively lower mobility scores, possibly due to higher mean age in their study population.

Implant failure rate in the present study was 2.7%, comparable to findings by Yu et al.,[15] non-union rate was 2.7%, similar to Sadic et al. [12] while several other studies did not report non-union. [10,11,14] The mortality rate was 4%, which is lower compared to studies involving older populations [14] and comparable to Yu et al. [15]

Limping (18.5%) and trochanteric pain (10%) were the most common complications, similar to findings reported by Park et al.,[13] Gavaskar et al.,[16] reported satisfactory outcomes in 65% of cases, while Kumar et al.,[11] and Monreal et al.,[17] also reported good to excellent outcomes in the majority of patients. Sadic et al. [12] reported good reduction outcomes in 61.4% of cases.

At 48 weeks, 58.5% of patients in the present study had good outcomes, 35.7% had average outcomes, and only 5.7% had poor outcomes, consistent with global literature. [11,12,16,17]

Thus, the findings of the present study demonstrate that cephalomedullary nail with helical blade fixation provides stable fixation, low complication rates, satisfactory union, and excellent functional outcomes in elderly patients with intertrochanteric fractures. However, inclusion of patients above 45 years may have influenced outcomes; therefore, further studies in strictly elderly populations (>60 years) with longer follow-up are recommended.

Conclusion

Based on the observations of the present study, cephalo-medullary nail with helical blade fixation in intertrochanteric fractures of the femur in elderly patients demonstrated significant clinical and radiological improvement. There was a progressive and statistically significant reduction in pain from the early postoperative period, with the majority of patients being pain-free by 48 weeks. Radiological union was achieved in most cases by 12 weeks, and complete union was observed in all patients remaining in follow-up at 36 and 48 weeks, with only two cases of non-union and two implant failures. Half of the patients did not experience any complications, and the complications observed were mostly minor, with limping being the most common. Overall, the procedure provided stable fixation, satisfactory union rates, minimal serious complications, and excellent functional outcomes. Therefore, cephalo-medullary nail with helical blade fixation can be recommended as an effective treatment modality for intertrochanteric fractures in elderly patients; however, further studies with larger sample sizes and longer follow-up durations are suggested to strengthen these findings.

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