



“ROLE OF TERIPARATIDE IN FUNCTIONAL AND RADIOLOGICAL OUTCOME IN PATIENTS WITH INTERTROCHANTERIC FRACTURE FEMUR TREATED WITH PROXIMAL FEMORAL NAIL (PFN)”

Orthopaedics

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ABSTRACT

Background: Intertrochanteric fractures are common in elderly osteoporotic patients and often lead to prolonged healing and increased morbidity. Proximal Femoral Nail (PFN) is commonly used for fracture fixation, but challenges like delayed healing persist. Teriparatide, an anabolic agent, has shown potential to enhance bone healing and improve functional outcomes in such fractures. **Aims & Objectives:** This study aimed to evaluate the impact of teriparatide on the functional and radiological outcomes of intertrochanteric femur fractures treated with PFN. The primary objectives were to assess the time to radiological union, functional recovery, pain management, and serum osteocalcin and calcium levels. **Methods:** A prospective cohort study was conducted from February 2023 to June 2024 at Subharti Medical College, Meerut. Patients with intertrochanteric femur fractures treated with PFN were divided into two groups: one receiving Calcium + Vitamin D and the other receiving Calcium + Vitamin D + Teriparatide. Radiological union, functional scores (Palmer and Parker), serum calcium, osteocalcin, and VAS pain scores were recorded at 1, 2, and 3 months. **Results:** The teriparatide group showed a significantly faster radiological union (11.8 weeks vs. 13.6 weeks) and greater improvements in Palmer and Parker scores. Serum osteocalcin levels were higher in the teriparatide group, reflecting enhanced bone formation, while serum calcium levels remained stable in both groups. Pain reduction was more pronounced in the teriparatide group. **Conclusions:** Teriparatide accelerates fracture healing, improves functional outcomes, and enhances bone formation, making it a valuable adjunct therapy for intertrochanteric fractures. These findings are consistent with existing literature, supporting teriparatide's potential in fracture management.

KEYWORDS

Intertrochanteric fracture; Teriparatide; Proximal Femoral Nail; Radiological union; Bone healing

INTRODUCTION

Intertrochanteric fractures of the femur are a prevalent concern, particularly among elderly osteoporotic patients.¹ These fractures occur between the greater and lesser trochanters, extending into the femoral shaft, and often lead to significant morbidity. With an expected doubling of incidence by 2040, effective management of these fractures is paramount.² Historically, nonoperative approaches were favored, but they were fraught with complications.

Modern orthopedic surgery now leans heavily towards operative interventions, with proximal femoral nails (PFN) being a leading choice for intramedullary fixation.³ PFN is preferred, especially in unstable fractures, due to its biomechanical superiority over extramedullary devices like dynamic hip screws (DHS).⁴ Despite its advantages, PFN is not without complications, such as screw cut-out and varus collapse, which emphasize the need for continuous refinement in surgical techniques and implants.⁵

In the evolving field of fracture management, attention has shifted towards enhancing biological healing in addition to mechanical fixation.⁶ Teriparatide, a recombinant form of human parathyroid hormone, has gained attention for its potential to accelerate fracture healing.

Initially approved for osteoporosis treatment, teriparatide stimulates bone formation and improves bone strength.⁷ Recent studies have explored its role in hastening fracture union, improving callus volume, and enhancing bone mineralization.⁸ Encouraging results from both animal and human trials suggest that teriparatide could be a promising adjunct in managing complex fractures, such as intertrochanteric femur fractures.⁹

This study aims to evaluate the functional and radiological outcomes of intertrochanteric femur fractures treated with PFN, with a specific focus on the impact of teriparatide. By investigating its potential to accelerate healing and improve postoperative outcomes, this study seeks to provide a comprehensive understanding of whether teriparatide can enhance recovery and reduce complications in this patient population.

MATERIALS AND METHODS

This prospective cohort study was conducted from February 2023 to June 2024 at the Department of Orthopedics, Subharti Medical College, Meerut.

The study included patients over the age of 18 years, of both sexes, with intertrochanteric fractures treated with a proximal femoral nail (PFN). Patients with bilateral spontaneous fractures, pathological fractures (other than osteoporosis-related), those unfit for surgery, patients undergoing chemotherapy or radiotherapy, and those on antiresorptive drugs were excluded from the study.

All data were collected from patient records and the hospital's electronic data capturing system (VIPHA). Demographic characteristics, fracture type, time to union, serum calcium, osteocalcin levels, Palmer and Parker scoring, Visual Analog Scale (VAS) for pain, and complications (both early and late) were documented. Patients were randomly assigned to one of two groups using the chit method:

Group A received calcium and vitamin D supplementation, while Group B received daily subcutaneous injections of 20 micrograms of teriparatide for three months along with calcium and vitamin D supplementation.

Radiographic evaluation was performed preoperatively with an anteroposterior (AP) and lateral view of the affected hip, and fractures were classified according to the Boyd and Griffin classification. Closed reduction and internal fixation with PFN-A were carried out for all patients. Postoperative outcomes, including time to union and complications, were recorded. Statistical analysis was performed using a Student T-Test, with a p-value of <0.05 considered statistically significant.

After surgery, patients were monitored for pain and stability, with regular checks of distal pulses and mobility. X-rays were taken, and quadriceps exercises started. From day 1, both groups received calcium and vitamin D3, with Group B also receiving teriparatide from day 2. Osteocalcin, calcium levels, and functional outcomes (VAS, Palmer and Parker scores) were assessed at 1, 2, and 3 months, and annually. X-rays were used to track fracture healing.

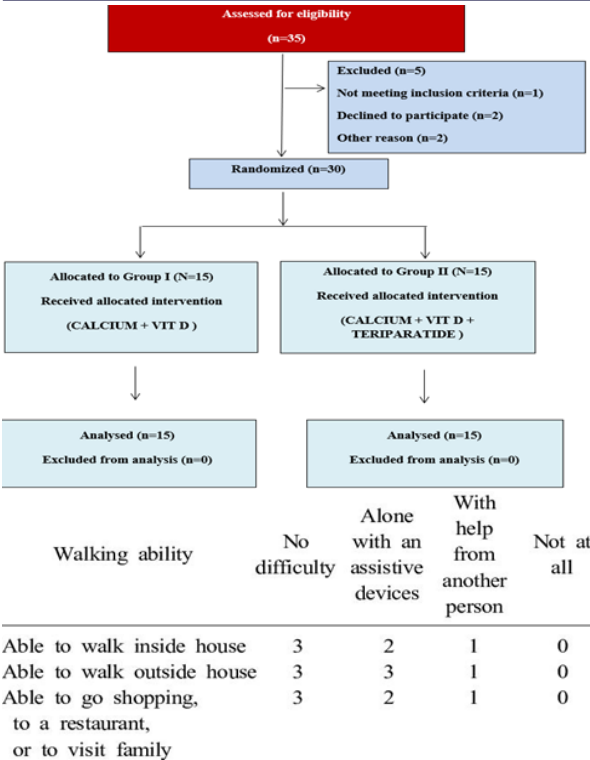


Figure - Palmer And Parker Scoring

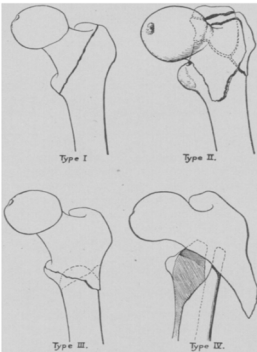


Figure - Boyd And Griffin Classification



Figure - Instruments Used In Proximal Femur Nailing



Figure - Spinal Anesthesia Positioning And Painting



Figure - Drapping



Figure- Incision And Superficial Layer Dissection And Palpation Of Greater Trochanter



Figure - Placing Bone Awl Over Entry Point Under C Arm Guidance

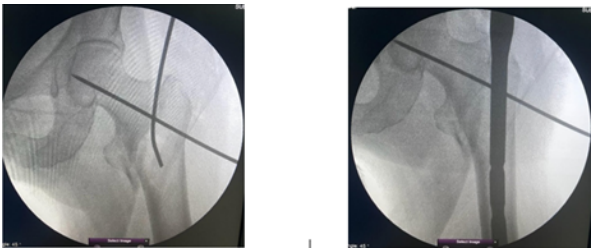


Figure - Passing Guide Wire And After Reaming Nail Is Loaded Over Zig And Passed Through The Reamed Intramedullary Cavity

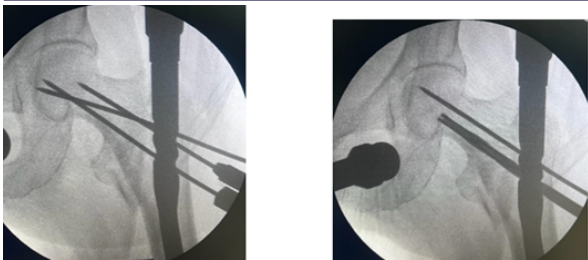


Figure - Guide Wire Is Passed Through The Drill Sleeve And Reaming Is Done.

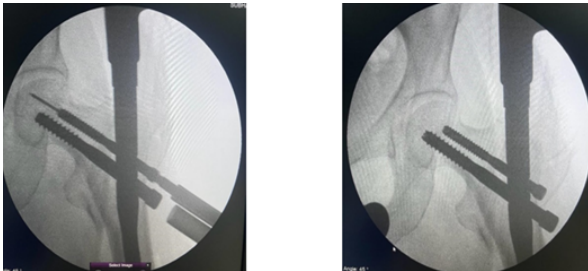


Figure - Lag Screw And Derotation Screw In Place

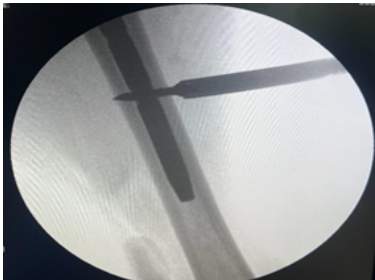


Figure - Dynamic Screw Is Placed With Static Screw

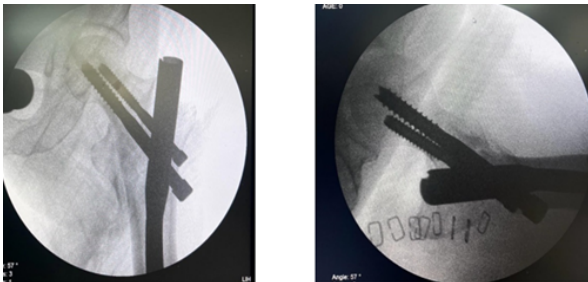


Figure - Reduction Checked In Ap And Lateral View

RESULTS

Table 1 Distribution Of Study Population According To Age, Gender Between Both Groups

Age Range	CALCIUM + VIT D	CALCIUM + VIT D + TERIPARATIDE
<20	0	0
20-30	1	0
30-40	0	1
40-50	1	1
50-60	1	4
60-70	2	2
70-80	7	5
>80	3	2
GENDER		
MALE	6	7
FEMALE	9	8

This table compares the age and gender distribution between two treatment groups: "Calcium + Vit D" and "Calcium + Vit D + Teriparatide." The majority of patients are aged between 70-80 years, and there is a relatively balanced gender distribution across both groups. The data highlights the variations in age and gender between the two interventions.

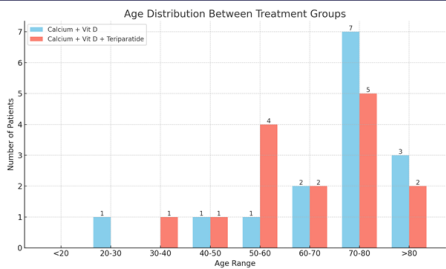


Table 2 Distribution Of Study Population By Side And Type Between Treatment Groups

Side/Type	Calcium + Vit D	Calcium + Vit D + Teriparatide
Left	10	10
Right	5	5
Type 1	4	5
Type 2	6	7
Type 3	1	0
Type 4	4	3

This table presents the distribution of patients based on the side of fracture (left or right) and fracture type (Type 1 to Type 4) in both treatment groups: "Calcium + Vit D" and "Calcium + Vit D + Teriparatide." The data shows a balanced distribution of fractures on both sides, with Type 2 being the most common fracture type in both groups.

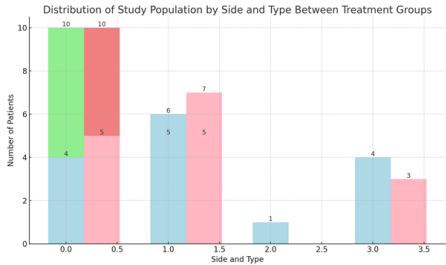
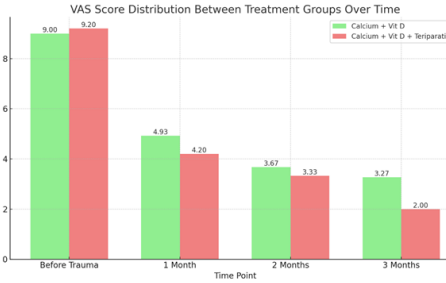


Table 3 Functional, Calcium Levels, S. Osteocalcin, And Vas Score Distribution Between Treatment Groups

Time Point	Calcium + Vit D (Functional)	Calcium + Vit D + Teriparatide (Functional)	Calcium + Vit D + Teriparatide (Calcium Levels)	Calcium + Vit D + Teriparatide (Calcium Levels)	S. Osteocalcin (Calcium + Vit D)	S. Osteocalcin (Calcium + Vit D + Teriparatide)	VAS Scores (Calcium + Vit D)	VAS Scores (Calcium + Vit D + Teriparatide)
Before Trauma	8.07 ± 0.88	8.47 ± 0.83	8.48 ± 0.72	8.52 ± 0.69	173.8 ± 65.83	192.87 ± 85.72	9.00 ± 0.76	9.20 ± 0.77
1 Month	0.93 ± 0.80	1.87 ± 0.83	8.73 ± 0.67	8.55 ± 0.58	226.0 ± 108.17	343.47 ± 335.78	4.93 ± 1.10	4.20 ± 1.21
2 Months	1.67 ± 0.72	3.07 ± 0.88	8.83 ± 0.51	8.91 ± 0.48	243.93 ± 114.91	720.47 ± 751.38	3.67 ± 0.72	3.33 ± 0.82
3 Months	2.67 ± 0.72	3.93 ± 0.96	8.81 ± 0.58	8.81 ± 0.50	264.33 ± 156.61	513.13 ± 508.05	3.27 ± 0.59	2.00 ± 0.65



This table summarizes the distribution of functional scores, calcium levels, serum osteocalcin, and VAS scores at different time points for both "Calcium + Vit D" and "Calcium + Vit D + Teriparatide" groups. The data reflects variations in recovery and response to treatment across both groups, with notable differences in VAS scores and serum osteocalcin levels over time.

Illustrative Cases

Case I – Santosh, a 58-year-old female, diagnosed with a Boyd and Griffin Type 2 intertrochanteric fracture of the left femur, underwent CRIF with PFN on 28-04-2023 and was discharged on 06-05-2023. She was treated with Calcium, Vitamin D, and Teriparatide.

Parameters	Pre op	1 month	2 month	3 months
Palmer and parker scoring	9	5	4	2
S. Calcium	8.4	9.4	9.4	9.4
S.osteocalcin	200	218	284	604
Vpas	9	1	2	4

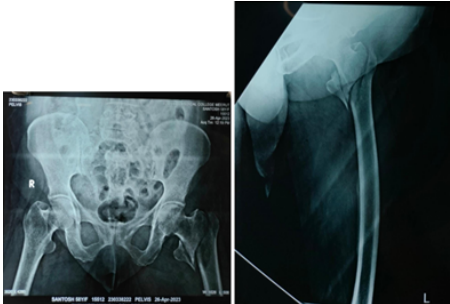


Figure – Pre-op Xray

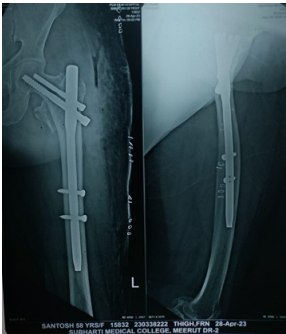


Figure -immediate Post- Op X-rays



Figure - 1 Months Follow Up Clinical Picture And Xray

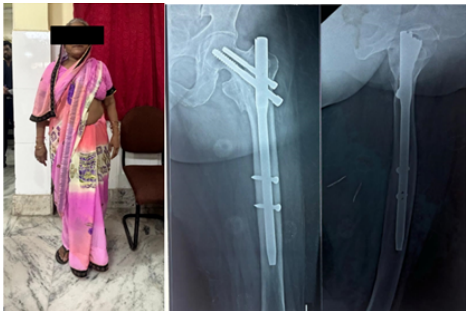


Figure - 6 Months Follow Up Clinical Picture And Xray

Case II - MO Arif, a 53-year-old male shopkeeper, was diagnosed with a Boyd and Griffin Type 1 intertrochanteric fracture of the left femur and underwent CRIF with PFN on 10-04-2024. He was discharged on 27-04-2024 and treated with Calcium, Vitamin D, and Teriparatide.

Parameters	Pre op	1 month	2 months	3 months
Palmer and parker scoring	9	4	5	2
S. Calcium	9.1	8.9	9	9
S.osteocalcin	75	150	397	450
Vpas	9	2	4	5

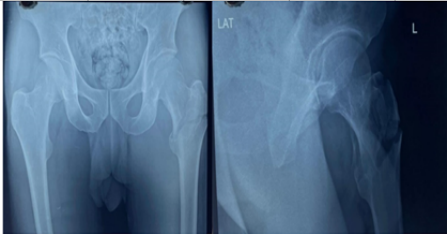


Figure - Pre-operative X-ray

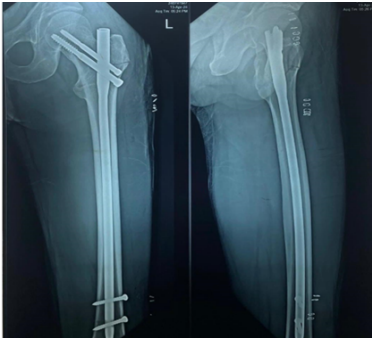


Figure - Post-operative X-ray

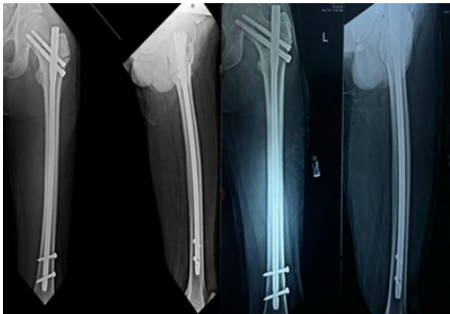


Figure - 1 And 3 Month Follow Up Xray



Figure - 3 Months Follow Up Clinical Picture

Case III - Dayawati, an 84-year-old female housewife, was diagnosed with a Boyd and Griffin Type 2 intertrochanteric fracture of the left femur and underwent CRIF with PFN on 09-03-2024. She was discharged on 27-03-2024 and treated with Calcium, Vitamin D, and Teriparatide.

Parameters	Pre op	1 month	2 months	3 months
Palmer and parker scoring	7	2	3	4
S. Calcium	8.4	8.8	9.1	9.2
S.osteocalcin	75	85	662	500
Vpas	8	5	3	1

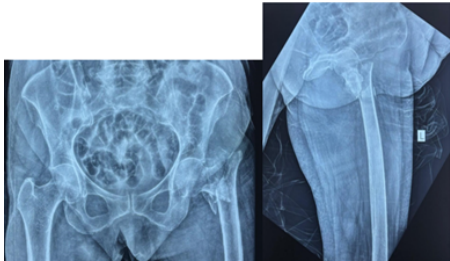


Figure - Pre Op Xray

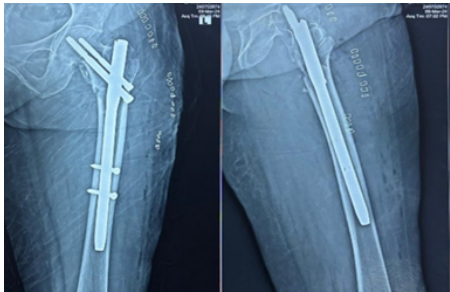


Figure – Post Op Xray

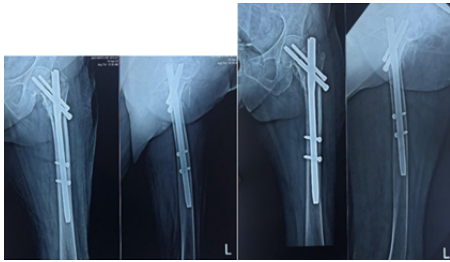


Figure – 1 Months And 2 Months Follow Up X-ray

Case IV - Jal Singh, a 95-year-old male farmer with a history of hypertension, was diagnosed with a Boyd and Griffin Type 4 intertrochanteric fracture of the left femur and underwent CRIF with PFN on 16-12-2023. He was discharged on 30-12-2023 and treated with Calcium and Vitamin D.

Parameters	Pre op	1 month	2 months	3 months
Palmer and parker scoring	7	2	3	3
S. Calcium	7.6	9.9	8.9	8.5
S.osteocalcin	247	179	435	231
Vpas	9	3	3	4



Figure – Pre Op Xray



Figure – Post Op Xray



Figure - 3 Months Follow Up Xray

DISCUSSION

This study explored the role of Teriparatide in treating intertrochanteric fractures, showing significant improvements in both healing time and functional outcomes. In the current study, the time to radiological union was reduced by nearly two weeks in the Teriparatide group compared to the control group (11.8 weeks vs. 13.6 weeks), while functional recovery scores (Palmer and Parker) also showed more pronounced improvements over time. Other studies such as Huang et al.¹⁰ (2016) found that Teriparatide significantly reduced fracture union time in an older population, while Chesser et al.¹¹ (2016) reported faster union in elderly patients treated with Teriparatide. Kim et al.¹² (2019) and Bhandari et al.¹³ (2016) also highlighted faster healing and improved clinical outcomes with Teriparatide. Andreassen et al.¹⁴ (1999) demonstrated enhanced callus formation and mechanical strength in animal models, reinforcing the anabolic effects seen in humans. Serum calcium levels remained stable across both groups, consistent with findings from Huang et al.¹⁰ (2015) and Bhandari et al.¹³ (2016). Serum osteocalcin levels, a marker of bone formation, were significantly higher in the Teriparatide group by the second month, mirroring results from Glover et al.¹⁵ (2015) and Harman et al.¹⁶ (2015). These results, in line with existing literature, underscore the potential of Teriparatide as an effective treatment for intertrochanteric fractures, particularly in accelerating healing and improving functional recovery.

CONCLUSION

The integration of teriparatide into the treatment of intertrochanteric fractures has demonstrated significant benefits in accelerating fracture healing, as evidenced by a shorter time to radiological union, improved functional outcomes, and effective pain management. Patients in the teriparatide group experienced better Palmer and Parker scores, higher serum osteocalcin levels indicating enhanced bone formation, and

stable calcium levels, showcasing the safety of the treatment. Additionally, the findings of this study align with existing literature, supporting teriparatide's efficacy in treating complex fractures and enhancing recovery across genders and fracture types. This comprehensive evaluation highlights teriparatide as a valuable adjunct therapy for osteoporotic fractures, suggesting its potential to improve patient outcomes and quality of life, while future research should focus on optimizing dosing regimens and understanding long-term impacts.

Conflict of Interest: The authors declare no conflicts of interest.

Funding: No funding was received.

Consent: Written consent from participants has been obtained and preserved.

Ethical Approval: Ethical approval was obtained and documented as per institutional guidelines.

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