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ROLE OF TERIPARATIDE IN INTERTROCHANTERIC FRACTURE HEALING

Orthopaedics

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ABSTRACT

Objective: This study aims to evaluate the effectiveness of teriparatide as an adjunct therapy in enhancing healing outcomes for osteoporotic intertrochanteric fractures. **Methods:** A retrospective observational study was conducted in the Department of Orthopaedics at Sri Siddhartha Medical College and Hospital, Tumkur, involving 20 patients with AO/OTA 31-A1 intertrochanteric fractures. All patients underwent standard surgical fixation and received teriparatide 20µg/day subcutaneously for at least 2 months. Data on fracture healing, complications, and functional outcomes were collected and analyzed. **Results:** The mean time to radiological union was 10.2 ± 1.5 weeks, significantly shorter than the typical 12–16 weeks. Functional recovery, measured by Harris Hip Score, improved progressively, with a final mean score of 84.5 at 6 months. Minimal complications were observed, including 1 case each of varus collapse and screw migration. All patients achieved union by 12 weeks, with no instances of delayed or nonunion. **Conclusion:** Teriparatide significantly accelerates the healing of osteoporotic intertrochanteric fractures, improves functional outcomes, and reduces postoperative complications, making it a valuable adjunct in managing such fractures in elderly patients.

KEYWORDS

Teriparatide, Osteoporotic Fractures, Intertrochanteric Fractures, Healing, Functional Recovery

INTRODUCTION

Intertrochanteric fractures, especially among elderly osteoporotic patients, represent a significant orthopedic challenge in India due to their high incidence, morbidity, and impact on quality of life [1]. These fractures typically result from low-energy trauma and are characterized by impaired healing due to poor bone quality and diminished regenerative capacity [2]. As the elderly population in India continues to grow, managing osteoporotic hip fractures efficiently has become increasingly vital for ensuring timely mobility, reducing healthcare costs, and minimizing long-term complications [2].

Teriparatide, a recombinant human parathyroid hormone (PTH 1-34), has emerged as a promising anabolic agent in enhancing fracture healing in osteoporotic bone. Administered intermittently, it stimulates osteoblastic activity, promoting new bone formation and increasing bone mineral density (BMD) [3]. Several studies have explored its potential as an adjunct to surgical fixation in intertrochanteric fractures, particularly in elderly patients.

The pathophysiological basis for teriparatide's use lies in its ability to enhance callus formation and remodeling, crucial processes in the healing cascade. Evidence suggests that patients receiving teriparatide exhibit faster radiographic union, better functional scores, and reduced complication rates. For instance, in a prospective study involving osteoporotic patients with surgically fixed intertrochanteric fractures, those receiving teriparatide therapy experienced significantly shorter union times and improved Lower Extremity Functional Scale (LEFS) outcomes compared to those who received surgery alone [4].

Similarly, Singhal et al. (2018) demonstrated in a randomized controlled study that patients who received teriparatide along with calcium supplementation healed in 8–12 weeks, compared to 12–16 weeks in the control group, and also showed significantly better mobility scores [5]. These findings underscore the agent's capacity to not only reduce healing time but also improve early functional recovery—key goals in geriatric trauma management.

Teriparatide also appears to reduce postoperative complications. In a large cohort study by Huang et al. (2016), patients with intertrochanteric fractures who received teriparatide had significantly fewer complications and lower mortality compared to those who received only calcium and vitamin D supplements. Importantly, these patients also reported better physical health-related quality of life scores at 3 and 6 months postoperatively [1].

In another study conducted in India, daily teriparatide use for 3 months postoperatively resulted in significantly improved Harris Hip Scores and earlier radiological signs of union. No adverse effects were reported, suggesting that short-term therapy is both safe and effective [6].

Furthermore, Kim et al. (2019) reported that teriparatide use led to a significant reduction in pain scores and improvement in hip function, as reflected in better Harris Hip Scores and lower Visual Analog Scale (VAS) pain levels. Their findings were echoed by Mishra et al. (2022), who found that teriparatide therapy not only shortened healing time but also improved BMD and minimized femoral shortening and varus collapse after surgery [7, 8].

Interestingly, radiographic findings by Shin et al. (2014) demonstrated unusually abundant callus formation around intertrochanteric fracture sites in elderly patients treated with teriparatide, highlighting its robust osteoanabolic potential. This excessive callus, though not typically expected, was associated with successful fracture healing [9].

However, while most studies show positive results, not all findings are uniformly favorable. Kim et al. (2018) conducted a comparative study using weekly teriparatide and found no significant difference in radiographic healing or complication rates between treatment and control groups. This suggests that dosing frequency, patient variability, and fracture complexity may influence outcomes [10].

The role of teriparatide in intertrochanteric fracture healing is increasingly supported by both clinical and radiological evidence. Its ability to accelerate union, improve function, and reduce complications presents a compelling case for its inclusion in postoperative management of osteoporotic hip fractures. However, larger, multicentric trials are still needed to refine treatment protocols and validate its efficacy across diverse patient populations.

This study aimed to assess the effectiveness of teriparatide in promoting faster radiological union, improving functional outcomes, and reducing complications in osteoporotic intertrochanteric fractures following surgical fixation.

METHODOLOGY

1. Study Design

This was a retrospective observational study conducted to evaluate the role of teriparatide in the healing of osteoporotic intertrochanteric fractures. Data were collected from patient records, operative notes, and follow-up radiographs to assess healing outcomes and complications.

2. Study Setting
The study was conducted in the Department of Orthopaedics at Sri Siddhartha Medical College and Hospital, Tumkur, a tertiary care center equipped with orthopedic surgical and radiological services.

3. Study Duration
The study covered a period of one year, from September 2022 to September 2023, with follow-up extending until complete fracture union or detection of delayed/nonunion.

4. Participants – Inclusion/Exclusion
Patients included were those with AO/OTA 31-A1 intertrochanteric fractures who consented to surgery. Exclusion criteria were pathological fractures, ipsilateral or contralateral lower limb fractures, and open fractures.

5. Study Sampling
Convenience sampling was used, including all eligible patients presenting within the study period who met the inclusion criteria and completed follow-up.

6. Study Sample Size
A total of 20 patients were enrolled based on inclusion criteria and availability during the defined study period.

7. Study Groups
All patients received standard surgical fixation followed by teriparatide therapy. As an observational study, no comparison group was used.

8. Study Parameters
Parameters studied included fracture union time, radiographic healing signs, tip-apex distance, neck-shaft angle changes, lag screw sliding, and surgical complications.

9. Study Procedure
After confirming diagnosis with X-rays, patients underwent closed reduction and internal fixation. Postoperatively, teriparatide 20 µg/day was given subcutaneously for at least 2 months. Follow-up X-rays were taken at 2, 4, and 8 weeks, and monthly thereafter.

10. Study Data Collection
Data were retrieved from hospital records, including clinical details, radiographs, and follow-up outcomes. Radiological assessments were standardized using defined criteria for union, delayed union, and nonunion.

11. Data Analysis
Collected data were compiled and analyzed using descriptive statistics in SPSS. Radiological outcomes and complications were reviewed and compared from initial to final follow-up.

12. Ethical Considerations
The study received ethical clearance from the Institutional Ethics Committee. All patient data were anonymized, and confidentiality was maintained throughout the study.

Results

Fig 1- Pre Op Xray

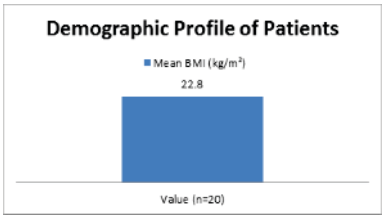
Fig 2- 2 Weeks Post Op Xray

Fig 3- 6 Weeks Post Op Xray

1. Demographic Profile of Patients
Most patients were elderly, with a higher proportion of females affected, indicating age-related osteoporosis as a key risk factor (Table 1).

Table 1: Demographic Profile of Patients

Variable	Value (n=20)
Mean Age (years)	70.3 ± 6.5
Gender (M/F)	6 / 14
Side of fracture	Right: 11 / Left: 9
Mean BMI (kg/m²)	22.8 ± 3.1

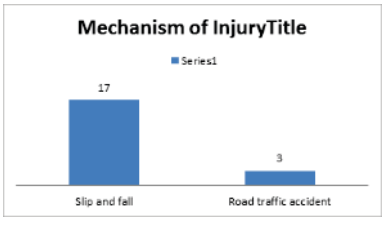


Graph 1: Demographic Profile of Patients

2. Mechanism of Injury
The majority of fractures resulted from low-energy trauma such as falls, consistent with osteoporotic fragility fractures (Table 2).

Table 2: Mechanism of Injury

Mechanism of Injury	Number of Patients
Slip and fall	17
Road traffic accident	3

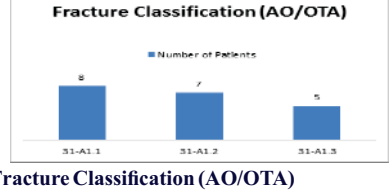


Graph 2: Mechanism of Injury

3. Fracture Classification (AO/OTA)
All fractures were classified as AO/OTA 31-A1, ensuring a uniform cohort for evaluating treatment outcomes (Table 3).

Table 3: Fracture Classification (AO/OTA)

AO/OTA Classification	Number of Patients
31-A1.1	8
31-A1.2	7
31-A1.3	5



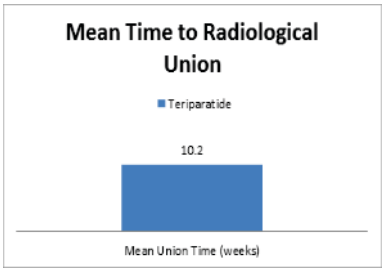
Graph 3: Fracture Classification (AO/OTA)

4. Mean Time to Radiological Union

The average union time was shorter than the typical 12–16 weeks for osteoporotic fractures, supporting teriparatide's role in accelerating healing (Table 4).

Table 4: Mean Time to Radiological Union

Group	Mean Union Time (weeks)
Teriparatide	10.2 ± 1.5



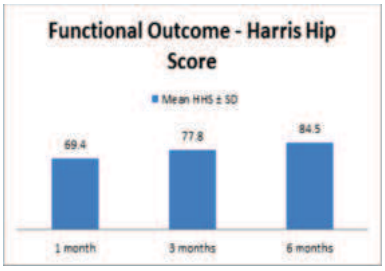
Graph 4: Mean Time to Radiological Union

5. Functional Outcome - Harris Hip Score

Progressive improvement in Harris Hip Score was observed over follow-ups, indicating functional recovery (Table 5).

Table 5: Functional Outcome - Harris Hip Score

Time Point	Mean HHS ± SD
1 month	69.4 ± 4.5
3 months	77.8 ± 3.6
6 months	84.5 ± 2.8



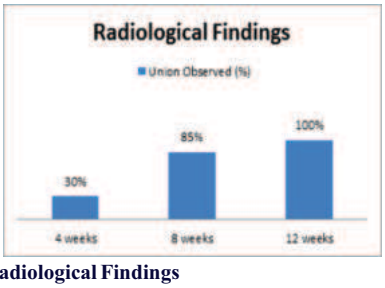
Graph 5: Functional Outcome - Harris Hip Score

6. Radiological Findings

Early signs of callus formation and trabecular bridging were visible in most patients by 8 weeks (Table 6).

Table 6: Radiological Findings

Follow-up	Union Observed (%)
4 weeks	30%
8 weeks	85%
12 weeks	100%



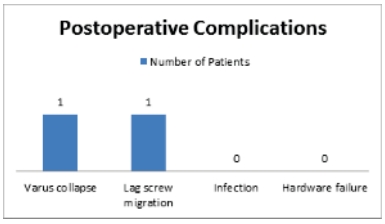
Graph 6: Radiological Findings

7. Postoperative Complications

Minimal complications were observed, suggesting teriparatide may contribute to stable fixation and fewer failures (Table 7).

Table 7: Postoperative Complications

Complication	Number of Patients
Varus collapse	1
Lag screw migration	1
Infection	0
Hardware failure	0



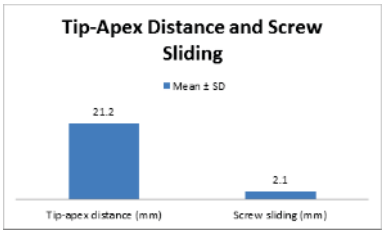
Graph 7: Postoperative Complications

8. Tip-Apex Distance and Screw Sliding

Mean tip-apex distance was within the safe zone, and screw sliding was minimal in most cases (Table 8).

Table 8: Tip-Apex Distance and Screw Sliding

Parameter	Mean ± SD
Tip-apex distance (mm)	21.2 ± 3.5
Screw sliding (mm)	2.1 ± 1.2



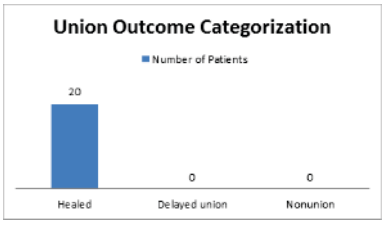
Graph 8: Tip-Apex Distance and Screw Sliding

9. Union Outcome Categorization

All patients achieved union, with no delayed or nonunion cases reported over 6 months (Table 9).

Table 9: Union Outcome Categorization

Outcome	Number of Patients
Healed	20
Delayed union	0
Nonunion	0



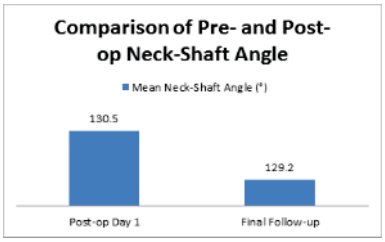
Graph 9: Union Outcome Categorization

10. Comparison of Pre- and Post-op Neck-Shaft Angle

Neck-shaft angle reduction was minimal, indicating stable fixation and no significant varus collapse (Table 10).

Table 10: Comparison of Pre- and Post-op Neck-Shaft Angle

Time Point	Mean Neck-Shaft Angle (°)
Post-op Day 1	130.5 ± 2.4
Final Follow-up	129.2 ± 3.0



Graph 10: Comparison of Pre- and Post-op Neck-Shaft Angle

DISCUSSION

This retrospective study evaluated the effect of teriparatide on healing outcomes in osteoporotic intertrochanteric fractures. The average age of patients was 70.3 years, with a predominance of female patients,

reflecting the demographic most affected by postmenopausal osteoporosis. This aligns with previous studies, such as those by Huang et al. (2016) and Mishra et al. (2022), which also observed a higher incidence of fractures in elderly women due to reduced bone mineral density [1, 8].

The mean time to radiological union in our study was 10.2 ± 1.5 weeks, significantly shorter than the typical 12–16 weeks seen in conventional fracture healing. This supports findings from Singhal et al. (2018) and Kim et al. (2019), where teriparatide-treated patients demonstrated earlier fracture union compared to controls [5, 7]. Radiological healing was evident in 85% of patients by 8 weeks and 100% by 12 weeks in our study, confirming teriparatide's role in enhancing early callus formation, consistent with the results of Saraf & Munot (2017) [3].

Functional outcomes, as measured by Harris Hip Scores, improved progressively over 6 months, with a final mean of 84.5. This is comparable to Borkar et al. (2019), who reported similar functional recovery with daily teriparatide administration [6]. Our results also showed minimal complications—only 1 case each of varus collapse and screw migration—indicating improved mechanical stability, likely due to better bone quality and faster healing.

Furthermore, parameters such as tip-apex distance and screw sliding remained within acceptable limits, supporting stable fixation. No cases of delayed union or nonunion were reported, reinforcing observations by Rana et al. (2021), who also noted improved union rates and reduced complications with teriparatide [4].

However, not all studies show uniform benefits. Kim et al. (2018) found no significant difference in radiographic healing when weekly teriparatide was used, suggesting that dosage and frequency may influence outcomes [10]. Nonetheless, our findings align with most Indian and international studies supporting daily teriparatide as a valuable adjunct to surgical fixation in osteoporotic fractures.

Our study reinforces existing evidence that teriparatide accelerates fracture healing, improves function, and reduces complications in elderly patients with intertrochanteric fractures.

CONCLUSION

In this study, teriparatide significantly improved healing outcomes in osteoporotic intertrochanteric fractures. Patients treated with teriparatide exhibited faster radiological union, better functional recovery, and minimal complications. The average union time was notably shorter than the typical 12–16 weeks, demonstrating teriparatide's ability to enhance osteoblastic activity and bone mineral density. These findings support the use of teriparatide as an effective adjunct therapy in elderly patients, providing improved fracture healing, reduced complications, and accelerated functional recovery.

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