TPM Vol. 32, No. S3, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

EVALUATING THE ROLE OF LOW-DOSE TERIPARATIDE IN INTERTROCHANTERIC FRACTURE FOLLOWING SURGICAL MANAGEMENT: A PROSPECTIVE STUDY

SAJITH S[1], SUBRAMANIAN A[1], ARUN KUMAR C[1], BALAJI M B[2], S.VIMAL[2], DR. N. C. JANANI VINODHINI[3],

[1]DEPARTMENT OF ORTHOPAEDICS, SAVEETHA MEDICAL COLLEGE & HOSPITAL, SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES, SAVEETHA UNIVERSITY, THANDALAM, KANCHIPURAM – 602105, TAMIL NADU, INDIA.

[2]DEPARTMENT OF BIOCHEMISTRY, SAVEETHA MEDICAL COLLEGE & HOSPITAL, SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES, SAVEETHA UNIVERSITY, THANDALAM, KANCHIPURAM – 602105, TAMIL NADU, INDIA.

[3]READER, DEPARTMENT OF PEDIATRIC DENTISTRY, SREE BALAJI DENTAL COLLEGE & HOSPITAL, CHENNAI, INDIA

Abstract

Background:
The most frequently encountered fractures in elderly is Intertrochanteric fractures which are associated with significant morbidity and mortality. Stable & unstable fractures can be managed with dynamic hip screw (DHS) fixation & proximal femoral nail (PFN). Despite surgical advancements, complications such as delayed union, non-union, implant failure, and suboptimal functional recovery remain concerns, especially in osteoporotic bone. Teriparatide, a recombinant human parathyroid hormone (PTH 1–34), has demonstrated potential in enhancing bone formation. This study is performed to evaluate the efficacy of low-dose teriparatide in enhancing fracture union, reducing complications, and improving functional outcomes in elderly patients with osteoporotic intertrochanteric fractures managed surgically.

Methods:
This prospective observational study was conducted at Saveetha Medical College and Hospital from January 2023 to January 2025. Fifty patients aged ≥50 years with osteoporotic intertrochanteric fractures treated with dynamic hip screw (DHS) or proximal femoral nail (PFN) were included. Patients were randomized into two groups: Group A (n=25) received low-dose teriparatide (20 µg subcutaneously on alternate days for 3 months) along with standard care, and Group B (n=25) received standard postoperative care alone. Patients were followed at 6, 12, and 24 weeks. Primary outcome was time to radiological union; secondary outcomes included Harris Hip Score (HHS), Visual Analog Scale (VAS) for pain, and complication rates.

Results:
Group A showed significantly faster fracture union (11.2 ± 1.5 weeks) compared to Group B (13.6 ± 2.1 weeks, $p < 0.001$). At 12 weeks, union was achieved in 84% of patients in Group A versus 60% in Group B ($p = 0.041$). HHS was significantly higher in Group A at both 12 and 24 weeks, while VAS pain scores were lower at 6 and 12 weeks. Group A also had fewer complications, with only one case of delayed union and no implant-related failures or reoperations, whereas Group B had four delayed unions, one implant cut-out, and one reoperation.

Conclusion:
Low-dose teriparatide administered postoperatively for three months significantly enhances early fracture healing, reduces pain, and improves functional recovery in surgically managed osteoporotic intertrochanteric fractures. It represents a clinically beneficial and cost-effective adjunct in the postoperative management of elderly patients.

Keywords:
Intertrochanteric fracture, Osteoporosis, Teriparatide, Fracture union, Elderly, Proximal femoral nail, Dynamic hip screw, Functional outcome, Harris Hip Score, VAS.

TPM Vol. 32, No. S3, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

INTRODUCTION

Intertrochanteric fractures are among the most frequently encountered osteoporotic fractures in the elderly population, commonly resulting from low-energy mechanisms such as simple falls [1]. These fractures are associated with substantial morbidity and mortality and can lead to prolonged immobilization, loss of independence, and a decline in quality of life [2]. The rising incidence of intertrochanteric fractures, as illustrated in Figure 1, is linked to age-related decline in bone mineral density, impaired balance, and the presence of comorbidities, making older adults particularly vulnerable [3]. Various classification systems exist for intertrochanteric fractures, with the AO/OTA classification (types 31-A1 to A3) and Evans classification being commonly used to guide treatment decisions [4].

While stable fractures can be managed effectively with dynamic hip screw (DHS) fixation, unstable patterns often require intramedullary devices such as the proximal femoral nail (PFN) to provide biomechanical stability [5]. Despite surgical advancements, complications such as delayed union, non-union, implant failure, and suboptimal functional recovery remain concerns, especially in osteoporotic bone [6]. Anabolic agents like teriparatide, a recombinant human parathyroid hormone (PTH 1–34), have shown promise in promoting bone formation and accelerating fracture healing [7].

Teriparatide enhances callus formation and improves microarchitecture by stimulating osteoblastic activity, thereby potentially overcoming the challenges of poor bone quality in elderly patients [8]. Studies have reported its efficacy in reducing time to union and improving outcomes in fractures of the distal radius, pelvis, and proximal femur [9,10]. However, there is limited literature evaluating the effectiveness of short-duration, low-dose teriparatide as an adjunct following surgical management of intertrochanteric fractures. This study aims to assess the role of low-dose teriparatide in promoting early union, reducing complications, and enhancing functional outcomes in surgically managed intertrochanteric fractures in elderly osteoporotic patients.

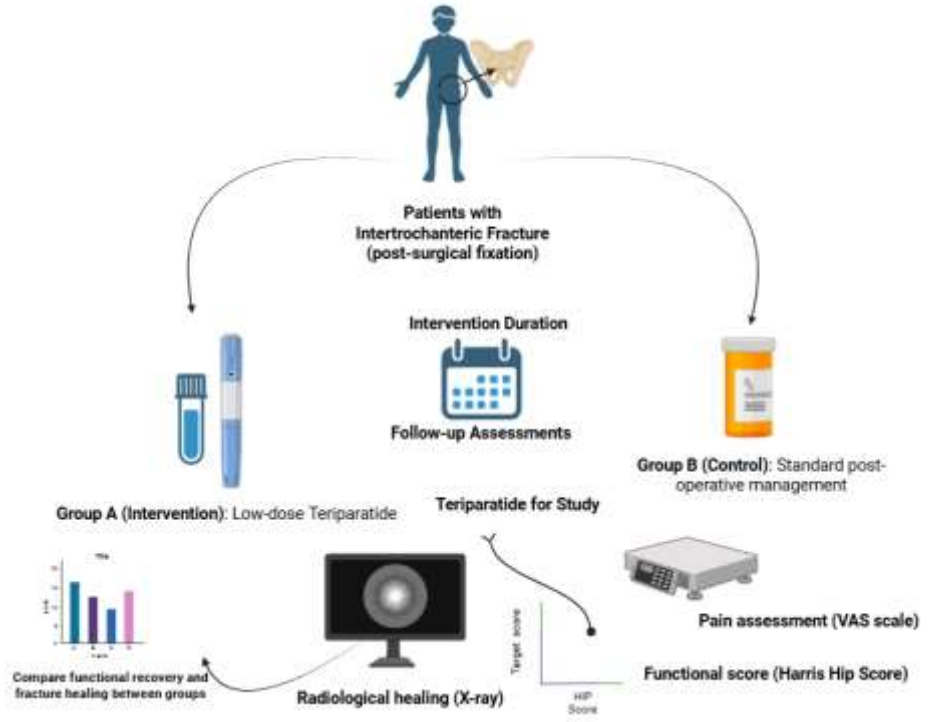


Figure 1. Study design showing post-surgical intertrochanteric fracture patients allocated to low-dose teriparatide or standard care, with follow-up to assess healing, pain, and function.

MATERIALS AND METHODS

Study Design:

This is a prospective, comparative observational study conducted at the Department of Orthopaedics, Saveetha Medical College and Hospital, Chennai, over a period of 2 years, from January 2023 to January 2025. The study is conducted after obtaining approval from the Institutional Ethics Committee of Saveetha Medical College and Hospital. All patients provided written informed consent prior to enrolment. The study is designed to evaluate the role of low-dose teriparatide in promoting fracture union following surgical fixation of intertrochanteric fractures.

Study Population:

A total of 50 patients diagnosed with intertrochanteric fractures and treated operatively were enrolled in the study and divided into two equal groups using a consecutive sampling technique from eligible admissions during the study period.

Group A (n = 25): Received low-dose teriparatide (20 µg subcutaneously on alternate days) for 3 months, starting within 48–72 hours postoperatively, along with standard care.

Group B (n = 25): Received standard postoperative care only, including calcium and vitamin D supplementation.

Inclusion Criteria:

1. Age ≥ 50 years
2. Radiologically confirmed intertrochanteric fracture (OTA/AO 31-A1, A2, or A3)
3. Treated surgically with dynamic hip screw (DHS) or proximal femoral nail (PFN)
4. Confirmed osteoporosis (T-score ≤ -2.5 on DEXA scan)
5. Medically stable and able to tolerate teriparatide
6. Willingness to provide informed consent and adhere to follow-up

Exclusion Criteria:

1. Pathological fractures other than osteoporosis (e.g., metastasis, infection)
2. Polytrauma or open fractures
3. History of malignancy, skeletal irradiation, or metabolic bone disorders
4. Known allergy or contraindication to PTH analogs
5. Severe renal impairment (CKD stage 4 or 5) or hypercalcemia
6. Concurrent treatment with bisphosphonates, denosumab, or systemic steroids
7. Cognitive impairment or inability to comply with treatment/follow-up

Surgical Procedure:

All patients underwent standard surgical fixation using DHS or PFN, based on fracture classification and surgeon preference. Perioperative management included antibiotics, thromboprophylaxis, and early mobilization as per institutional protocols.

Postoperative Management:

Group A: Received teriparatide 20 µg subcutaneously every day for 3 months, in addition to: Calcium (1000 mg/day) & Vitamin D3 (1000–2000 IU/day) with structured physiotherapy and early ambulation.

Group B: Received the same supportive care excluding teriparatide

Patients were evaluated with timely Follow-Up and Outcome measured at 6 weeks, 12 weeks & 24 weeks using radiological assessments [Standard AP and lateral X-rays at each follow-up, Fracture union defined as bridging callus in at least 3 out of 4 cortices] and Clinical assessments [Visual Analog Scale (VAS) for pain, Harris Hip Score (HHS)] for functional outcome.

Primary Outcome: Time to radiological union (in weeks)

Secondary Outcomes: Harris Hip Score at 6 months & VAS pain score at 6 and 12 weeks

Incidence of delayed union, non-union, or implant-related complications were assessed.

RESULTS

In this prospective study involving 50 patients with osteoporotic intertrochanteric fractures treated surgically, 25 patients in Group A received low-dose teriparatide for 3 months postoperatively, while 25 in Group B received standard postoperative care. The demographic and baseline clinical parameters such as age, gender, fracture type (AO/OTA classification), and type of implant used (DHS or PFN) were comparable between both groups. The mean time to radiological union was significantly shorter in Group A (11.2 ± 1.5 weeks) compared to Group B (13.6 ± 2.1 weeks), with a p-value of <0.001, indicating statistical significance. Radiological union by the 12th postoperative week was observed in 84% of patients in Group A versus only 60% in Group B (p = 0.041). Functional outcome as assessed by the Harris Hip Score (HHS) [Figure 1] showed a significantly higher mean in Group A at 12 weeks (63.4 ± 7.2 vs. 56.1 ± 8.3) and at 24 weeks (83.5 ± 5.8 vs. 76.4 ± 6.1), both with statistically significant differences. Pain evaluation using the Visual Analog Scale (VAS) showed that patients in Group A had lower pain scores at 6 weeks (3.4 ± 1.1 vs. 4.5 ± 1.3) and at 12 weeks (2.1 ± 0.9 vs. 3.4 ± 1.2), indicating better pain control in the teriparatide group. Clinical outcomes comparison of Group A & Group B is shown in Figure 1. Furthermore, complication rates were lower in Group A, with only one case of delayed union and no implant failures or reoperations, whereas Group B reported four cases of delayed union, one implant cut-out, and one patient requiring reoperation. These findings demonstrate that low-dose teriparatide therapy contributed to faster healing, improved function, reduced pain, and fewer complications in the postoperative period following surgical management of intertrochanteric fractures.

Table-1 Demographic and Baseline Characteristics

Parameter	Group A (Teriparatide)	Group B (Control)	P-value
Mean Age (years)	68.1 ± 6.4	67.6 ± 7.1	0.74 (NS)
Male:Female Ratio	10:15	11:14	0.78 (NS)
Mean T-score (DEXA)	–2.9 ± 0.3	–2.8 ± 0.4	0.42 (NS)
Fracture Type (AO 31-A2/A3)	17 A2 / 8 A3	16 A2 / 9 A3	NS
Implant Used (PFN/DHS)	18 PFN / 7 DHS	17 PFN / 8 DHS	NS

Table-2 Primary Outcome: Time to Radiological Union

Time to Union	Group A	Group B	P-value
Mean Time to Union (weeks)	**11.2 ± 1.5**	**13.6 ± 2.1**	**<0.001**
Union at 12 weeks (n, %)	21 (84%)	15 (60%)	**0.041**
Delayed Union (>16 weeks)	1	4	

Table-3 Secondary Outcomes

1.Functional Outcome – Harris Hip Score (HHS)

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	P-value
At 12 weeks	63.4 ± 7.2	56.1 ± 8.3	0.007
At 24 weeks	**83.5 ± 5.8**	**76.4 ± 6.1**	**0.003**

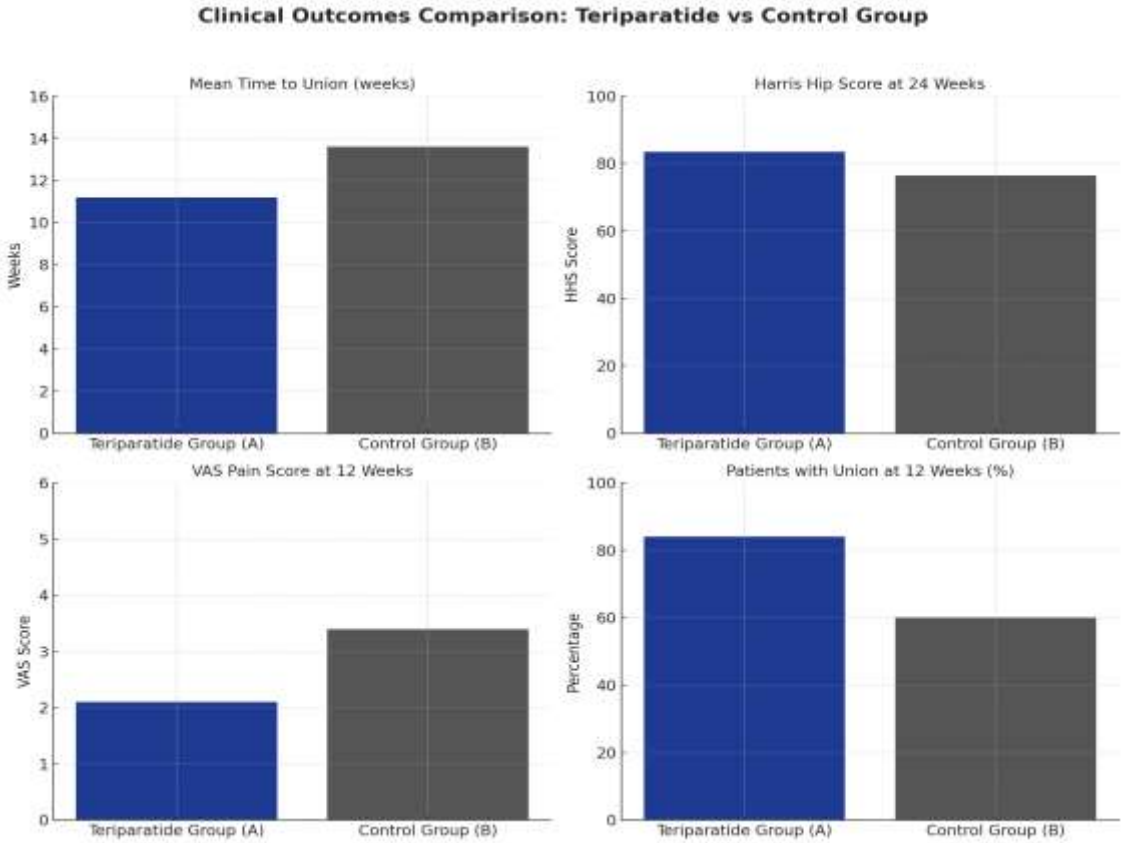
2.Pain – Visual Analog Scale (VAS)

Time Point	Group A (Mean ± SD)	Group B (Mean ± SD)	P-value
At 6 weeks	3.4 ± 1.1	4.5 ± 1.3	0.009
At 12 weeks	**2.1 ± 0.9**	**3.4 ± 1.2**	**0.003**

Table-4 Complications

Complications	Group A (n)	Group B (n)
Superficial Infection	1	1
Delayed Union	1	4
Implant Cut-out/Failure	0	1
Reoperation	0	1
Mortality within 6 months	0	0

Figure-1 bar diagram for the clinical outcomes comparison



DISCUSSION

Intertrochanteric fractures are among the most common fragility fractures seen in the elderly, primarily due to falls on osteoporotic bone. These fractures are related to significant complications and fatalities, potentially resulting in extended periods of immobility, and a deterioration in the quality of life. Surgical fixation remains the base of treatment, but challenges persist due to poor bone quality, delayed healing, implant-related complications, and high morbidity. Our study was undertaken to assess whether low-dose teriparatide, a recombinant form of parathyroid hormone (PTH 1–34), could accelerate bone healing, improve functional outcomes, and reduce complications when used as an adjunct following operative fixation in these patients.

The rationale for using teriparatide from its anabolic effect on bone metabolism, where it stimulates osteoblast activity, enhances callus formation, and increases bone remodelling and mineralization. Several experimental and clinical studies have demonstrated its potential in improving fracture healing in osteoporotic bone [11,12]. In most of these studies teriparatide have been used as daily dosing (20 µg/day). Hence, our study also explored the effect

of a low-dose, every day regimen for 3 months, hypothesizing that it may offer comparable benefits at lower cost and risk.

Our results showed a statistically significant reduction in the time to radiological union in the teriparatide group compared to the control group (11.2 ± 1.5 weeks vs. 13.6 ± 2.1 weeks, $p < 0.001$). This aligns with the findings of Aspenberg et al. (2010), who demonstrated that teriparatide accelerated distal radius fracture healing in postmenopausal women by approximately 2 weeks [13]. Similarly, Peichl et al. (2011) reported faster union and improved pain control in elderly women with pelvic fractures treated with teriparatide [14]. A randomized control trial by Kim et al. (2016) also showed significant improvement in hip fracture healing and early functional recovery when teriparatide was administered in the postoperative period [15].

In terms of functional outcomes, our study demonstrated significantly higher Harris Hip Scores at 12 and 24 weeks in the teriparatide group ($p < 0.01$), consistent with the findings of Bhandari et al. (2016), who noted better functional recovery in patients receiving teriparatide for lower limb fractures [16]. Pain scores were also lower at each follow-up, indicating improved early mobilization and reduced dependence on analgesics.

Our study also had fewer cases of delayed union and implant failure, echoing similar results from Huang et al. (2019), who found lower complication rates in the teriparatide group following hip fracture fixation [17].

One of the advantages of our study is the use of a low-dose, every day teriparatide regimen for 3 months, which is cost-effective and better tolerated in elderly patients and provide significant clinical benefit. Moreover, we focused specifically on intertrochanteric fractures, a subgroup where bone quality plays a critical role in outcomes, and where delayed union or implant cut-out can lead to devastating consequences.

Additionally, our study used real-world clinical data from a tertiary care centre in South India, adding to the limited body of literature from developing countries where fracture burden is rising and access to high-cost biologics is restricted. The prospective design, standardized surgical protocols, and consistent follow-up lend further strength to the study.

CASE ILLUSTRATIONS

Patient-1

FIGURE 2: PRE-OPERATIVE STANDARD RADIOGRAPH OF PELVIS WITH BILATERAL HIPS – AP VIEW

FIGURE 3: PRE-OPERATIVE STANDARD PLAIN RADIOGRAPH OF LEFT HIP –AP AND LATERAL VIEW SHOWING RIGHT SIDE INTERTROCHANTERIC FRACTURE

FIGURE 4: POST-OPERATIVE STANDARD PLAIN RADIOGRAPH OF RIGHT HIP AP/LATERAL VIEW

FIGGUE 5: 3 MONTH POST-OPERATIVE STANDARD PLAIN RADIOGRAPH OF PELVIS WITH BILATERAL HIPS –AP VIEW

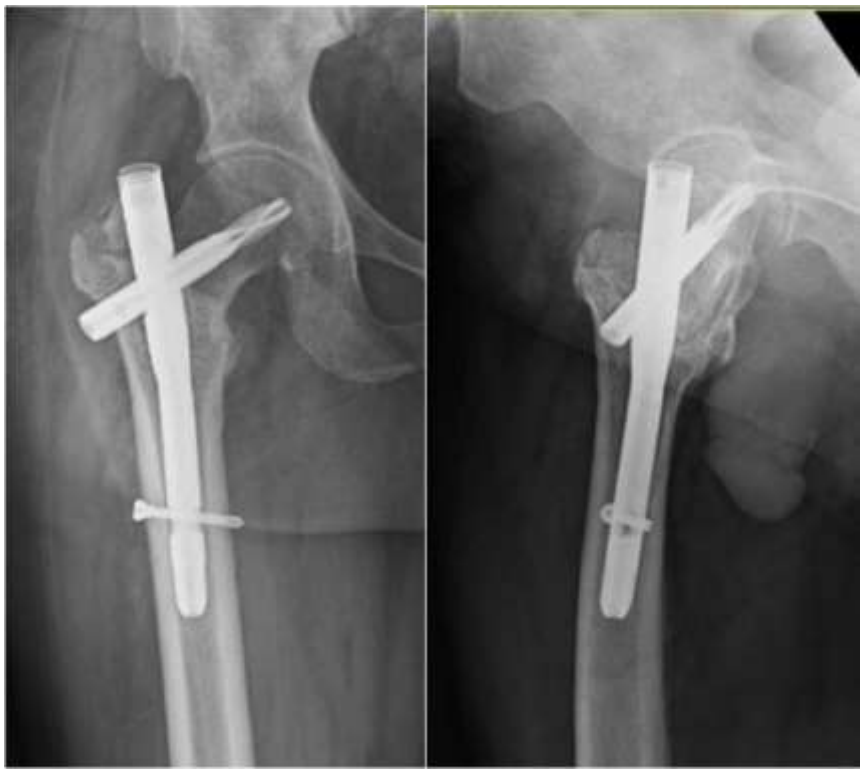


FIGURE 6: 3 MONTH POST-OPERATIVE STANDARD PLAIN RADIOGRAPH RIGHT HIP AP/LATERAL

FIGURE 7: 6 MONTH POST OP – STANDARD PLAIN RADIOGRAPH RIGHT HIP AP/LATERAL

A)  B) 

C) 

FIGURE 8: 6 MONTH UP FOLLOW UP- RANGE OF MOVEMENTS

Limitations

However, this study has limitations. The sample size is modest, and longer-term outcomes such as refracture rates or mortality were not assessed. Biochemical markers of bone turnover were not evaluated, which could have provided more insight into teriparatide's mechanism of action in this setting.

Conclusion

In conclusion, our findings support the use of low-dose teriparatide for 3 months as an effective adjuvant in enhancing fracture healing, reducing pain, and improving early functional outcomes in elderly patients with osteoporotic intertrochanteric fractures. This strategy may offer a cost-efficient and clinically beneficial approach in resource-limited settings and warrants further exploration through larger, multicentric randomized controlled trials.

REFERENCES:

1. Kannus P, Parkkari J, Sievänen H, Heinonen A, Vuori I, Järvinen M. Epidemiology of hip fractures. Bone. 1996;18(1 Suppl):57S-63S.
2. Haentjens P, Magaziner J, Colon-Emeric CS, et al. Meta-analysis: Excess mortality after hip fracture among older women and men. Ann Intern Med. 2010;152(6):380–390.
3. Johnell O, Kanis JA. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporos Int. 2006;17(12):1726–1733.
4. Marsh JL, et al. Fracture and dislocation classification compendium – 2007. J Orthop Trauma. 2007;21(10 Suppl):S1–S133.
5. Parker MJ, Handoll HH. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. Cochrane Database Syst Rev. 2008;(3):CD000093.
6. Subash Y. Valgus Osteotomy with DHS Fixation in the Management of Malunited Intertrochanteric Fractures in a Rural Population. *Malays Orthop J*. 2020 Nov;14(3):98-103.
7. Sundar, R. A., & Subash, Y. (2024). Fixation of intertrochanteric fractures with proximal femoral nail (PFN) versus dynamic hip screw (DHS) – A comparative study. South Eastern European Journal of Public Health, 680–684.
8. Lindsay R, Cosman F, Zhou H, et al. Teriparatide for osteoporosis: Importance of the modeling-based bone formation. Curr Med Res Opin. 2006;22(1):61–70.
9. Aspenberg P, Genant HK, Johansson T, et al. Teriparatide for acceleration of fracture repair in humans: A prospective, randomized, double-blind study of 102 postmenopausal women with distal radial fractures. J Bone Miner Res. 2010;25(2):404–414.
10. Narayanan, V. L., Karthik, A., & Sathish Babu, M. (2024). Study of short-term outcome of proximal femoral nailing and dynamic hip screw in cases of intertrochanteric fractures of femur. *International Journal of Life Sciences, Biotechnology and Pharma Research, 13*(11), 559–566.
11. Neer RM, et al. Effect of parathyroid hormone (1–34) on fractures and bone mineral density in postmenopausal women with osteoporosis. *N Engl J Med.* 2001;344(19):1434–1441.
12. Bukata SV. Systemic administration of PTH in fracture healing: what is the evidence? *Curr Osteoporos Rep*. 2011;9(3):153–160.
13. Aspenberg P, Genant HK, Johansson T, et al. Teriparatide for acceleration of fracture repair in humans: a prospective, randomized, double-blind study. *J Bone Miner Res.* 2010;25(2):404–414.
14. Peichl P, Holzer LA, Maier R, Holzer G. Parathyroid hormone 1–84 accelerates fracture healing in pubic bones of elderly osteoporotic women. *J Bone Joint Surg Am.* 2011;93(17):1583–1587.
15. Kim TY, Ha YC, Kang BJ, et al. Does early administration of teriparatide accelerate fracture healing in elderly patients with hip fractures? *J Bone Joint Surg Am.* 2016;98(9):767–772.
16. Bhandari M, Bajammal S, Guyatt G, et al. Effect of teriparatide on fracture healing: a systematic review and meta-analysis of randomized controlled trials. *Osteoporos Int.* 2016;27(9):3129–3138.
17. Huang TW, Wang CJ, Chen SK, et al. Effects of teriparatide on unstable pertrochanteric fractures treated with a dynamic hip screw. *J Orthop Surg Res.* 2019;14(1):1–8.