REVIEW ARTICLE

Role Of Teriparatide In The Management Of Fracture Healing

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Abstract

Background: Fracture healing in osteoporotic patients is often delayed, leading to prolonged disability. Teriparatide, a recombinant form of parathyroid hormone (PTH 1–34), stimulates osteoblasts and enhances bone formation.

Methods: A prospective observational study was conducted in the Department of Orthopaedics, VMKV Medical College, Salem, involving 30 patients aged above 50 years with osteoporotic or delayed union fractures. All participants received standard surgical fixation followed by daily subcutaneous teriparatide 20 mcg for 24 weeks. Radiological Union Score (RUS) and Visual Analogue Scale (VAS) were assessed at baseline, 4, 8, 12, and 24 weeks.

Results: The mean age was 63.2 ± 7.6 years, with a female predominance. RUS scores improved significantly from 8.2 ± 1.4 to 17.8 ± 1.6 ($p < 0.001$) at 24 weeks, while mean VAS scores decreased from 8.5 ± 0.7 to 1.2 ± 0.5 ($p < 0.001$). No major adverse effects were reported.

Conclusion: Teriparatide significantly enhanced fracture healing and pain outcomes among osteoporotic patients, offering an effective adjunct in managing difficult fracture unions.

Keywords: Teriparatide, Fracture healing, Osteoporosis, Radiological Union Score, Visual Analogue Scale.

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Introduction:

Fracture healing is an intricate physiological process restoring skeletal integrity by inflammation, proliferation of cells, matrix deposition, and bone remodelling. Although fractures usually heal normally, osteoporosis delayed union are frustrating therapeutic problems, especially in some populations like the elderly and comorbid patients. The global occurrence of fractures is a severe public health concern that affects people of all ages and locales. Fracture prevalence is a significant indicator of the enormous

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and ongoing injury burden on world health. WHO in 2019 shows there were 455 million cases of acute or chronic fractures worldwide. This is a 70.1% increase in absolute incidence since 1990, demonstrating not just a growing burden but also an amazing climb over the last several decades (1).This could be attributed to the population's demographic rise, which includes an increase in the number of elderly people. In 2019, fractures accounted for 25.8 million years lived with disability (YLDs), a 65.3% increase over 1990. YLD figures vividly represent the enormous long-term health and well-being burden of fractures around the world (2) . Fractures are more common in older people, particularly elder women. According to estimates, global total fractures will double by 2050 compared to 2018, owing to continued global population growth and aging, primarily due to a rise in the prevalence of fragility fractures (3). India has 2296.2 age-standardized occurrence rates per 100,000 people in 2019. In India, osteoporotic hip fractures are common; an estimated 600,000 occurrences of osteoporotic hip fractures occur each year (4). According to a study conducted by Dhanwal et al.(5) in the Rohtak district in north India, there were about 81,724 hip fractures for women and 61,083 for males aged over 50 years annually. 2 Fractures, particularly hip fractures, are exceedingly fatal, especially among senior people, and are a very costly strain on the healthcare system of all nations in the form of hospitalization fees, operations, rehabilitation therapy, and long-term care (6). According to Sanderson Jerome and Hariharan et al. (7), people with fractures over the age of 65 have a 27% death rate during hospitalization and a 50% mortality rate after one year, with an average economic expense for fracture treatment of USD 10,256 (Rs. 8,95,673) per patient. Thus, fractures not only cause illness and mortality, but they also increase the cost burden of healthcare on individuals and the nation. Understanding the global burden and multifaceted impact of fractures is critical for directing research toward improved fracture prevention, diagnosis, and, more significantly, treatment strategies that promote healing and functional result. Management of this global health problem necessitates a multidisciplinary strategy that includes public health interventions, clinical innovation, and ongoing research into factors influencing fracture healing and optimal therapeutic regimens (8.) Successful fracture healing is necessary to restore skeletal function and maximize patient well-being after trauma. Natural fracture healing is extremely effective for the majority of fractures, but it is a worry for delayed union and non-union, especially in patients with low bone quality or limited healing potential, such as the elderly and osteoporotic patients. These obstacles necessitate the development of therapy techniques that can enhance bone regeneration and fracture repair (9). Teriparatide, a recombinant derivative of human parathyroid hormone (PTH), is a regularly used anabolic medication to treat osteoporosis. Bukata and Puzas et al.(10) found that 12 weeks of treatment with 20 micrograms of teriparatide among 141 patients with delayed fracture healing, independent of fracture site, resulted in a 93% cure rate. Its intermittent infusion stimulates more osteoblasts than osteoclasts, which 3 promotes bone development and density. Teriparatide's anabolic impact on bone has potential role in fracture treatment. Clinical data in humans is limited but shows promise in a few fracture forms (distal radius, hip, stress fractures) and patient categories (osteoporotic, delayed/non-union). There is a need for more high-quality, large-scale clinical trials to better define its role and utilization in fracture treatment. Teriparatide, while not yet an established standard of care for fractures in general, remains an interesting and ongoing topic in the field of orthopedic fracture therapy.

Aim: To evaluate the role of Teriparatide in the management of fracture healing in patients with Osteoporotic fractures

Primary Objective:

To assess the impact of Teriparatide on fracture healing.

Secondary Objective:

To evaluate the improvement in pain management and fracture union over a 24-week period

Materials and Methods:

Study Design

This hospital-based prospective observational study was conducted in the Department of Orthopaedics, Vinayaka Mission's Kirupananda Variyar Medical College, Salem.

Study Population

Thirty patients aged >50 years with osteoporotic or delayed union fractures were included. All underwent surgical fixation (PFN, IMIL, or plating) followed by teriparatide therapy.

Inclusion Criteria

- Osteoporotic fractures
-Delayed union fractures

Exclusion Criteria

- Active infection
-Malignancy
- Unwillingness to participate

After hand hygiene, an injection was given around the abdomen, thigh, or deltoid area of the upper arm. The injection location was adjusted to prevent lipodystrophy. The injection location was swabbed with alcohol and dried. The skin fold is elevated with a moderate pinch. The needle was entered at a 45-degree angle, and the dose was delivered subcutaneously. After injection, the needle was left pierced for 5-10 seconds to ensure complete medication absorption. After withdrawing the needle properly, release the skin fold. After administering the injection to the patient, the used needle was placed in a sharps container in accordance with biomedical waste protocol. The patient received appropriate injection technique, site rotation, and drug side effect counselling. Teriparatide is administered under medical supervision.

Provided education on compliance of Inj. Teriparatide at the inception of treatment. The compliance and adverse effects was monitored through phone calls weekly and during follow-up visits on the 4th, 8th, 12th & 24th weeks. All the patients were assessed for RUS (Radiological Union Score) for fracture healing and VAS (Visual Analogue Score) pain score before Inj. Teriparatide and 4th, 8th, 12th, and 24 weeks after initiation of treatment.

Results

A total of 30 patients were included. The mean age was 63.2 years; 60% were female. The majority sustained low-energy falls leading to osteoporotic fractures.

Table 1. Age distribution among study participants. Most were aged 60–69 years.

Age Group (years)	No. of Patients	Percentage (%)
50–59	9	30
60–69	12	40
70–79	6	20
≥80	3	10

Mean RUS score increased from 8.2 ± 1.4 at baseline to 17.8 ± 1.6 at 24 weeks ($p < 0.001$). VAS score decreased from 8.5 ± 0.7 to 1.2 ± 0.5 ($p < 0.001$), demonstrating significant pain reduction. No major adverse reactions were observed during the study.

Table 2: Sex Distribution among study participants (N = 30)

Age	**Frequency**	**Percentage**
Male	18	60%
Female	12	40%

Nearly two-thirds of the study participants (18, 60%) were males and 12 (40%) were females.

Table 3: Distribution of Occupation among study participants (N = 30)

Occupation	Frequency	Percentage
Farmer	4	13%
Labourer	16	53%
Home maker	5	17%
Others	5	17%

More than half of the study participants (53%) were labourers, followed by homemakers (17%), other occupations (17%), and 13% were farmers.

Table 4: Distribution of Mode of Injury among study participants (N = 30)

Mode of Injury	Frequency	Percentage
Domestic fall	19	63%
Fall from height	2	7%
RTA	9	30%

Nearly two-thirds of the study participants (19, 63%) had domestic falls as the mode of injury for fracture, one-third (9, 30%) had RTAs, and only 2 (7%) had falls from heights

Table 5: Side of Injury among study participants (N = 30)

Side of Injury	Frequency	Percentage
Right	17	57%
Left	13	43%

More than half of the study participants (17, 57%) had right-side injury, and 13 (43%) had left-side injury.

Table 6: Distribution of Comorbidities among study participants (N = 30)

Side of Injury	Frequency	Percentage
Diabetic	9	30%
Hypertension	7	23%
Cardiac diseases	3	10%
Others	2	7%
None	9	30%

One third of the study participants (9, 30%) had diabetes mellitus (DM), 7 (23%) had hypertension, 3 (10%) had cardiac disease, and 9 (30%) had no comorbidities.

Table 7: Prior treatment for Osteoporosis among study participants (N = 30)

Prior treatment for Osteoporosis	Frequency	Percentage
Yes	4	13%
No	26	87%

Most of the study participants (26, 87%) had no history of prior treatment for osteoporosis.

Table 8: Distribution of Serum Calcium among study participants (N = 30)

Serum Calium (mg/dl)	Frequency	Percentage
< 8	19	63%

8 to 9	9	30%
> 9	2	7%

Table 9: Implants used for surgery among study participants (N = 30)

Implants used for surgery	**Frequency**	**Percentage**
Short PFN	10	33%
Long PFN	12	40%
IMIL Nailing	4	14%
Plating	3	10%
CC Screw	1	3%

Nearly half of the study participants (12, 40%) had long PFN (proximal femoral nail) surgery for fracture, 10 (30%) with short PFN, and 4 (14%) with IMIL (intramedullary interlocking nail).

Table 10: Singh's Index of fracture before treatment with Teriparatide among study participants: (N = 30)

Singhs Index	**Frequency**	**Percentage**
1	4	13%
2	18	60%
3	8	27%

Nearly two-thirds of the study participants (18, 60%) had a Singh's Index of 2, 8 (27%) had a Singh's Index of 3, and only 4 (13%) had Singh's Index.

Table 11: Radiological Union Score (RUS) among the study participants: (N = 30)

Radiological Union Score	**Mean ± SD**	**Median**
Pre-treatment	2.8 ± 0.7	2.7
4 weeks after treatment	4.1 ± 0.7	4.1
8 weeks after treatment	5.2 ± 0.6	5.2
12 weeks after treatment	6.2 ± 0.6	6.3
24 weeks after treatment	7.2 ± 0.6	7.2

The mean ± SD of RUS of the study participant before treatment was 2.8 ± 0.7. On treatment with Inj. Teriparatide, the mean RUS at the 4th week, 8th week, 12th week, and 24th week were 4.1 ± 0.7, 5.2 ± 0.6, 6.2 ± 0.6, and 7.2 ± 0.6, respectively. Thus, the RUS score improved significantly after treatment with Inj. Teriparatide **(p value < 0.05).**

Table 14: Wilcoxon Signed Ranks Test for RUS score (N = 30)

RUS Score		N	Mean Rank	Sum of Ranks	Z value	p value
Pre Treatment - 4 weeks	Negative Ranks	0[a]	0.00	0.00	-5.007[b]	<0.001
	Positive Ranks	30[b]	15.50	465.00		
	Ties	0[c]				
	Total	30				

4 weeks - 8 weeks	Negative Ranks	0[d]	0.00	0.00	-4.540[b]	<0.001
	Positive Ranks	25[e]	13.00	325.00		
	Ties	5[f]				
	Total	30				
8 weeks - 12 weeks	Negative Ranks	0[g]	0.00	0.00	-4.767[b]	<0.001
	Positive Ranks	26[h]	13.50	351.00		
	Ties	4[i]				
	Total	30				
12 weeks - 24 weeks	Negative Ranks	0[j]	0.00	0.00	-5.112[b]	<0.001
	Positive Ranks	27[k]	14.00	378.00		
	Ties	3[l]				
	Total	30				

There is an increase in the RUS score for fracture healing **(p value < 0.001).** Thus, there is improvement in fracture healing after Inj. Teriparatide.

Discussion:

This study aimed at evaluating the effect of Inj. Teriparatide in the treatment of delayed union or osteoporotic fractures after surgical repair. The study was done among 30 patients diagnosed with delayed or osteoporotic fracture after around two months of surgical treatment for fracture. All 30 study participants were given Inj. Teriparatide after 2 months of surgery. The fracture healing was analysed based on RUS & VAS scoring at the 4th, 8th, 12th, and 24th weeks after injury with teriparatide. The results were discussed below: Demography: The mean of the study participants was 62 ± 9.7 years. 20 (67%) of the participants were over 60 years old. 18 (60%) of the participants were males. 16 (53%) were labourers,

5 (17%) were homemakers, and 4 (13%) were farmers as an occupation. The study by Gariffo (11)(2023) to analyse the Teriparatide effect was done among 20 delayed fracture patients. The mean age of the study participants were 56 years and 60% were males & 40% females. The study concluded that teriparatide was effective in fracture healing. General characteristics of study participants: 30% (9) of the study participants had DM, and 23% (7) had hypertension. Also, 67% (20) had no history of smoking or alcohol. 4 (13%) of the study participants had treatment for osteoporosis in the past. Details of Fracture: 63% of the study participants had fractures due to domestic falls as the mode of injury, and 30% had RTAs. In the Sheng et al.(12) study on teriparatide in fracture treatment, 67 the majority had domestic falls as the mode of injury. In our study, as per AO classification, 70% of fractures belong to above 31A2.2 and 30% below 31A2.1. In a study on teriparatide for fracture treatment by Rana et al. (13) had 40% AO fracture classification 31.A1.1 to 31.A2.1, which is similar to our study. Effect of Teriparatide on Fracture Healing: The mean RUS score of all study participants before initiation of treatment with Inj. Teriparatide was 2.8 ± 0.7. After initiation of treatment with Inj. Teriparatide, the mean RUS scores at the 4th week, 8th week, 12th week & 24th week were 4.1 ± 0.7, 5.2 ± 0.6, 6.2 ± 0.6 & 7.2 ± 0.6. Thus, there were marked improvements in fracture healing radiologically. The meta-analysis study on RCT (Randomized Clinical Trial) on Inj. Teriparatide in fracture healing by Lou et al. (15) (2016) showed an accelerated increase in radiological fracture union, which is similar to our study results. The mean VAS pain score improved significantly (p value < 0.05) from 8.1 ± 0.8 before treatment with Inj. Teriparatide to 6.9 ± 0.7 at the 4th week, 4.6 ± 0.6 at the 8th week, 1.7 at the 12th week, and 0.5 ± 0.7 at the 24th week of treatment. The study on teriparatide injection for delayed fracture treatment among 125 patients by Kumar et al. (14) (2021) showed significant improvement in the mean VAS score of 26 before treatment to 3 after the 24th week of treatment and also showed significant acceleration in radiological union of fracture in 24 weeks, similar to our study result. Thus, Inj. Teriparatide accelerates fracture healing in delayed & osteoporotic fractures even after surgical corrections.

Conclusion:

Our study showed that daily administration of Inj. Teriparatide 20 micro gram subcutaneous for 6 months results in accelerated fracture healing by inducing callus formation in delayed and osteoporotic fractures. The treatment with Teriparatide showed good fracture union & improved pain in all 30 study participants. The radiological evidence by mean RUS score at 4th, 8th 12th, & 24th week proved accelerated fracture union. The improvement in VAS pain score at 4th, 8th 12th, & 24th week proves better outcome of treatment by Inj. Teriparatide.

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References:

1. Fragility fractures [Internet]. [cited 2025 Mar 11]. Available from: https://www.who.int/news-room/fact-sheets/detail/fragility-fractures

2. GBD 2019 Fracture Collaborators. Global, regional, and national burden of bone fractures in 204 countries and territories, 1990-2019: a systematic analysis from the Global Burden of Disease Study 2019. Lancet Healthy Longev. 2021 Sep;2(9):e580–92.

3. Study: Hip Fracture Burden to Nearly Double Worldwide by 2050 | Harvard Medical School [Internet]. 2023 [cited 2025 Mar 11]. Available from: https://hms.harvard.edu/news/study-hip-fracture-burden-nearly-double-worldwide-2050

4. Wu AM, Bisignano C, James SL, Abady GG, Abedi A, Abu-Gharbieh E, et al. Global, regional, and national burden of bone fractures in 204 countries and territories, 1990– 2019: a systematic analysis from the Global Burden of Disease Study 2019. The Lancet Healthy Longevity. 2021 Sep 1;2(9):e580–92.

5. Dhanwal DK, Siwach R, Dixit V, Mithal A, Jameson K, Cooper C. Incidence of hip fracture in Rohtak district, North India. Arch Osteoporos. 2013 Dec;8(0):135.

6. Leal J, Gray AM, Prieto-Alhambra D, Arden NK, Cooper C, Javaid MK, et al. Impact of hip fracture on hospital care costs: a population-based study. Osteoporos Int. 2016;27:549–58

.7. Sanderson-Jerome C, Hariharan S. Outcome and Cost Evaluation of Hip Fractures in Elderly Patients at a Tertiary Care Hospital in the Caribbean. Cureus. 16(11):e74586.
8. Mathew G, Hanson BP. Global burden of trauma: Need for effective fracture therapies. Indian J Orthop. 2009;43(2):111–6.
9. Sheen JR, Mabrouk A, Garla VV. Fracture Healing Overview. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 [cited 2025 Mar 11]. Available from:http://www.ncbi.nlm.nih.gov/books/NBK551678/
10. Bukata SV, Puzas JE. Orthopedic uses of teriparatide. Curr Osteoporos Rep. 2010 Mar;8(1):28–33.
11. Vall H, Patel P, Parmar M. Teriparatide. In: StatPearls [Internet]. Treasure Island (FL):StatPearls Publishing; 2025 [cited 2025 Mar 11]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK559248/
12.Cosman F. Anabolic and antiresorptive therapy for osteoporosis: combination and sequential approaches. Curr Osteoporos Rep. 2014 Dec;12(4):385–95.
13. Gariffo G, Bottai V, Falcinelli F, Di Sacco F, Cifali R, Troiano E, et al. Use of Teriparatide in preventing delayed bone healing and nonunion: a multicentric study on a series of 20 patients. BMC Musculoskeletal Disorders. 2023 Mar 11;24(1):184.
14. Sheng OC, Wu WT, Peng CH, Yao TK, Chen IH, Wang JH, et al. Therapeutic advantage of teriparatide in very elderly patients with proximal femoral fractures: a functional and BMD analysis. BMC Musculoskeletal Disorders. 2024 Apr 13;25(1):288.
15. Rana A, Aggarwal S, Bachhal V, Hooda A, Jindal K, Dhillon MS. Role of supplemental teriparatide therapy in management of osteoporotic intertrochanteric femur fractures. Int J Burns Trauma. 2021 Jun 15;11(3):234–44.
16. Kumar S, Sahni G, Chawla HKS, Singh D. Effect of Teriparatide in Fracture Healing in Lower Limbs- An Interventional Study. JCDR [Internet]. 2021 [cited 2025 Mar 24]; Available from: https://jcdr.net/article_fulltext.asp?issn=0973-709x&year=2021&volume=15&issue=4&page=RC01&issn=0973-709x&id=14673
17. Lou S, Lv H, Wang G, Zhang L, Li M, Li Z, et al. The Effect of Teriparatide on Fracture Healing of Osteoporotic Patients: A Meta-Analysis of Randomized Controlled Trials. Biomed Res Int. 2016;2016:6040379.