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Comparative Assessment Of Health-Related Quality Of Life In Osteoporosis Patients Treated With Teriparatide Versus Zoledronic Acid: A Prospective, Observational Study Using The OPAQ-SV Questionnaire

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Abstract

Background

Osteoporosis significantly impacts health-related quality of life (HRQOL), particularly in the elderly and postmenopausal women. While multiple pharmacologic options are available, their comparative impact on HRQOL remains under-investigated in Indian clinical settings.

Objective

To assess longitudinal changes in HRQOL using the Osteoporosis Assessment Questionnaire - Short Version (OPAQ-SV) among osteoporosis patients treated with Teriparatide or Zoledronic Acid in a tertiary care hospital.

Methods

An open-label, prospective, observational study was conducted over 52 weeks involving 80 osteoporosis patients. Participants were allocated to receive either Teriparatide (daily subcutaneous injection) or Zoledronic Acid (yearly intravenous infusion). HRQOL was measured using OPAQ-SV at baseline, 13, 26, and 52 weeks. Statistical analysis was performed using paired t-tests to assess intra-group changes.

Results

At baseline, the mean HRQOL score was 90.12 ± 17.45. Significant improvements were observed in both treatment arms at all timepoints ($p < 0.0001$). By week 52, Teriparatide-treated patients exhibited a greater increase in HRQOL (117.97 ± 17.58) compared to those treated with Zoledronic Acid (105.64 ± 16.37). The greatest improvements were noted in physical functioning and emotional status domains.

Conclusion

Both Teriparatide and Zoledronic Acid significantly improved HRQOL over time. However, Teriparatide demonstrated a more robust improvement, particularly in physical and emotional well-being. These findings support Teriparatide's preferential use in HRQOL-focused osteoporosis management strategies.

Keywords: *Osteoporosis, OPAQ-SV, HRQOL, Teriparatide, Zoledronic Acid, Quality of Life, Questionnaire Study*

INTRODUCTION

Osteoporosis is a systemic skeletal disorder[1] characterized by decreased bone mass and deterioration of bone microarchitecture, leading to increased fragility and susceptibility to fractures. Affecting over 200 million individuals worldwide[2], it has emerged as a global health concern, particularly among postmenopausal women and the elderly population. According to the International Osteoporosis Foundation (IOF), osteoporosis causes more than 8.9 million fractures annually[3], one every three seconds, highlighting its vast clinical and economic burden. In India alone, over 61 million[4] people are estimated to be affected, with a significant proportion comprising postmenopausal women and individuals over the age of 60[5].

The clinical implications of osteoporotic fractures particularly those involving the hip, vertebrae, and wrist are profound. These fractures are associated not only with increased morbidity and mortality but

also with significant reductions in mobility, independence, and overall quality of life. In fact, osteoporosis-related fractures account for more hospitalizations[6] than myocardial infarction, breast cancer, or stroke in elderly women in several developed countries. Despite the availability of therapeutic agents aimed at reducing fracture risk, the disease remains underdiagnosed and undertreated, especially in developing nations.

Health-Related Quality of Life (HRQOL) in osteoporosis has increasingly gained recognition as a critical endpoint in both clinical practice and research. It encapsulates the broader psychosocial and functional implications of osteoporosis beyond traditional clinical outcomes like Bone Mineral Density (BMD) or fracture incidence. One of the most widely validated tools to assess HRQOL in osteoporosis is the Osteoporosis Assessment Questionnaire Short Version (OPAQ-SV), a disease-specific, self-reported instrument that evaluates physical functioning, emotional status, and back pain. Studies have shown that OPAQ-SV is sensitive to both prevalent and incident fractures[11], and it accurately reflects changes in patients' perceived well-being over time.

Pharmacologic management of osteoporosis typically involves two major therapeutic classes: anti-resorptive agents like bisphosphonates (e.g., Zoledronic Acid) and anabolic agents like recombinant parathyroid hormone analogs (e.g., Teriparatide). Zoledronic Acid inhibits osteoclast-mediated bone resorption, while Teriparatide stimulates new bone formation by activating osteoblasts. Both drugs have been shown to reduce fracture risk and increase BMD; however, comparative data on their impact on HRQOL remain limited, especially in real-world clinical settings within the Indian subcontinent.

This study was thus undertaken to evaluate and compare the impact of Teriparatide and Zoledronic Acid on HRQOL in osteoporosis patients using the OPAQ-SV questionnaire. By assessing longitudinal changes over a 52-week treatment period, this study aims to provide valuable insights into patient-centered outcomes that are often underrepresented in clinical trials.

MATERIALS AND METHODS

Study Design

This was a prospective, observational, open-label study conducted at a tertiary care teaching hospital in South India from 2022 to 2025. The study aimed to evaluate and compare the effectiveness of two widely used osteoporosis treatments—Teriparatide and Zoledronic Acid—on Health-Related Quality of Life (HRQOL), as measured by the Osteoporosis Assessment Questionnaire Short Version (OPAQ-SV).

Ethical Considerations

The study was approved by the Institutional Ethics Committee of Sree Balaji Medical College and Hospital, Chennai. Written informed consent was obtained from all participants prior to enrollment, and confidentiality of patient data was strictly maintained.

Inclusion Criteria

- Adults aged ≥50 years with a diagnosis of primary osteoporosis, either postmenopausal or senile, confirmed by a T-score ≤ –2.5 on DEXA scan.
- Patients either treatment-naïve or on osteoporosis therapy willing to shift to Teriparatide or Zoledronic Acid.
- Ability to complete self-administered questionnaires.
- Willingness to adhere to a 52-week follow-up schedule.

Exclusion Criteria

- Secondary osteoporosis due to endocrine, renal, hepatic, or gastrointestinal causes.
- Prior treatment with both Teriparatide and Zoledronic Acid.
- Active malignancy or bone metastases.
- Severe psychiatric illness or cognitive impairment precluding questionnaire completion.
- History of hypersensitivity to either drug.

Sample Size and Recruitment

A total of 80 patients were enrolled and equally distributed into two treatment arms:

- **Teriparatide Group (n = 40):** Patients received 20 mcg of Teriparatide subcutaneously once daily.
- **Zoledronic Acid Group (n = 40):** Patients received a 5 mg intravenous infusion of Zoledronic Acid once at baseline.

Patients were selected through purposive sampling based on eligibility criteria and followed for one year.

Data Collection Tool: OPAQ-SV Questionnaire

The **Osteoporosis Assessment Questionnaire – Short Version (OPAQ-SV)** was used to measure HRQOL at four timepoints: baseline, 13 weeks, 26 weeks, and 52 weeks. The questionnaire, containing 34 items, was self-administered and comprised the following three domains:[8]

- **Physical Function (19 items)** – Includes walking, bending, transfers, and daily activity.
- **Emotional Status (11 items)** – Includes fear of falls, body image, and independence.
- **Back Pain (4 items)** – Focuses on frequency, intensity, and functional impact.

Responses were recorded on a 5-point Likert scale, and scores were normalized to a 0–100 scale, with higher scores indicating better HRQOL.

Outcome Measures

The **primary outcome** was change in overall HRQOL score from baseline to week 52 within and between the two groups.

Secondary outcomes included:

- Domain-specific improvements (physical function, emotional status, symptoms).
- Time-course trend analysis at week 13 and week 26.
- Statistical comparison between treatment arms.

Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables were presented as mean ± standard deviation. Paired t-tests were used to compare within-group HRQOL scores across timepoints, and independent t-tests were used for between-group comparisons. A p-value < 0.05 was considered statistically significant.

Missing questionnaire items were addressed using imputation strategies recommended in the OPAQ-SV scoring manual, where domain scores were calculated if at least 50% of the items in that domain were completed.

RESULTS

A total of 80 patients diagnosed with osteoporosis were enrolled in the study. The patients were divided equally into two groups: the Teriparatide group (n = 40) and the Zoledronic Acid group (n = 40). By the end of 52 weeks, 73 patients completed all scheduled follow-ups (Teriparatide: 37; Zoledronic Acid: 36), with a dropout rate of 8.75% due to non-compliance or loss to follow-up. The average age of the study population was 65.6 ± 7.2 years, with no significant difference between groups. The majority of patients were female (81.3%), reflecting the higher prevalence of osteoporosis in postmenopausal women. A substantial proportion (61.3%) had a prior history of osteoporotic fracture, most commonly involving the spine or wrist. The mean baseline T-score across all patients was –2.85 ± 0.45, confirming advanced osteoporosis.

Table 1: Baseline Demographic and Clinical Characteristics

Parameter	Teriparatide (n = 40)	Zoledronic Acid (n = 40)	Total (n = 80)
Mean Age (years)	65.2 ± 7.4	66.1 ± 6.9	65.6 ± 7.2
Female (%)	82.5% (n = 33)	80% (n = 32)	81.3% (n = 65)
Postmenopausal (%)	80%	77.5%	78.8%
BMI (kg/m²)	22.4 ± 3.1	22.1 ± 3.3	22.2 ± 3.2
History of Fracture (%)	62.5% (n = 25)	60% (n = 24)	61.3% (n = 49)
Baseline BMD (T-score)	–2.8 ± 0.4	–2.9 ± 0.5	–2.85 ± 0.45

HRQOL Scores Over Time

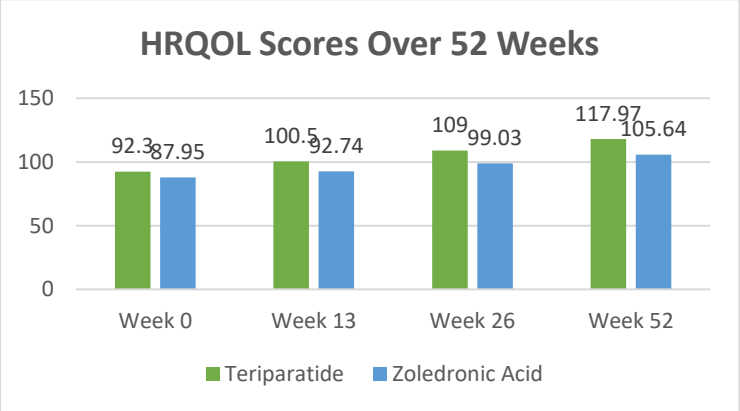
Health-related quality of life, assessed using the OPAQ-SV, improved significantly in both treatment groups from baseline to week 52. Mean HRQOL increased from 90.12 ± 17.45 at baseline to 111.89 ±

17.98 at week 52 across the entire cohort. The Teriparatide group exhibited greater improvements at all checkpoints compared to the Zoledronic Acid group. The most marked change occurred between week 26 and week 52 in the Teriparatide group, suggesting continued anabolic benefits.

Table 2: HRQOL Scores Over Time by Treatment Group

Timepoint	All Patients (n)	Mean ± SD	Teriparatide (n)	Mean ± SD	Zoledronic Acid (n)	Mean ± SD
Baseline	80	90.12 ± 17.45	40	92.30 ± 16.62	40	87.95 ± 18.20
Week 13	78	96.72 ± 17.63	40	100.50 ± 16.92	38	92.74 ± 17.71
Week 26	75	104.21 ± 17.69	39	109.00 ± 17.53	36	99.03 ± 16.57
Week 52	73	111.89 ± 17.98	37	117.97 ± 17.58	36	105.64 ± 16.37

Figure 1: HRQOL Scores Over 52 Weeks



DISCUSSION

This prospective observational study assessed longitudinal changes in health-related quality of life (HRQOL) among osteoporosis patients treated with either Teriparatide or Zoledronic Acid using the Osteoporosis Assessment Questionnaire – Short Version (OPAQ-SV)[8]. Our findings demonstrate that both therapies resulted in significant improvements in HRQOL over a 52-week period, with Teriparatide showing consistently greater benefits across all domains—physical function, emotional status, and symptoms—compared to Zoledronic Acid.

The improvement in mean HRQOL scores from 90.12 ± 17.45 at baseline to 111.89 ± 17.98 at week 52 across all patients is in alignment with existing literature[13] which emphasizes the strong correlation between pharmacologic treatment and improved patient-reported outcomes in osteoporosis. This underscores the utility of HRQOL as a valid and sensitive endpoint in clinical and real-world research settings. Importantly, the use of a disease-specific instrument like OPAQ-SV ensures the capture of nuanced changes in physical activity, emotional distress, and pain-related limitations that generic tools may overlook.

In this study, the Teriparatide group exhibited more pronounced and statistically significant HRQOL improvements at all three follow-up points. By week 52, the Teriparatide group's score had increased by 25.67 points, compared to a 17.69-point increase in the Zoledronic Acid group. These findings corroborate evidence from previous trials indicating that Teriparatide not only enhances bone mineral density[14] (BMD) and reduces vertebral fracture risk but also improves physical and psychological well-being more substantially than bisphosphonates.

The superiority of Teriparatide may be attributed to its anabolic mechanism of action, which actively stimulates osteoblast function and promotes new bone formation. Zoledronic Acid, while effective in

reducing bone resorption through osteoclast inhibition, may not elicit similarly rapid or extensive structural remodeling of the skeleton. These differences may influence not only bone density but also functional status, pain levels, and fear of fractures, all of which are key contributors to HRQOL in osteoporotic patients.

A notable aspect of our findings is the significant within-group improvement in emotional well-being, which may reflect reduced fear of falling, increased confidence in daily tasks, and a sense of physical stability. These changes were more evident in the Teriparatide group, as reported by improvements in domains such as body image, fear of fractures, and independence. Emotional health is often overlooked in osteoporosis management, yet it plays a critical role in long-term treatment adherence and lifestyle quality.

Our results also align with the US-based cross-sectional survey by Gold et al.[17], where the burden of fractures—especially spine and hip fractures—was found to dramatically lower HRQOL, emphasizing the need for treatments that offer both structural and functional benefit. The OPAQ-SV's robust psychometric properties and ease of administration make it a practical tool for longitudinal patient assessment in outpatient and inpatient settings.

Despite the strength of our findings, certain limitations warrant consideration. First, the open-label design introduces the possibility of reporting bias, although the use of standardized instruments mitigates this concern to some extent. Second, although the sample size was adequate for intra-group and inter-group comparisons, a larger, multicenter trial would enhance the generalizability of these results. Third, long-term sustainability of HRQOL gains beyond 52 weeks remains to be evaluated.

Nonetheless, this study contributes valuable evidence from an Indian clinical setting, where real-world data on osteoporosis management and HRQOL remain sparse. By demonstrating the differential impact of two widely used anti-osteoporotic agents, this study provides clinicians with actionable insights to tailor treatment not just for fracture prevention but also for functional and psychosocial recovery.

CONCLUSION

This prospective, observational study demonstrates that both Teriparatide and Zoledronic Acid significantly improve health-related quality of life (HRQOL) in patients with osteoporosis, as measured by the disease-specific OPAQ-SV questionnaire. Notably, Teriparatide was associated with greater and more sustained improvements across all HRQOL domains—physical function, emotional status, and symptoms—over a 52-week treatment period compared to Zoledronic Acid.

These findings reinforce the clinical value of Teriparatide, not only as an anabolic agent that promotes bone regeneration but also as a treatment that substantially enhances patient well-being, independence, and psychological resilience. While both agents effectively improved outcomes, the magnitude of improvement observed with Teriparatide suggests its potential as the preferred agent for patients prioritizing functional and emotional recovery in addition to fracture risk reduction.

Given the increasing prevalence of osteoporosis and its impact on quality of life in aging populations, future large-scale, multicenter studies are warranted to validate these findings and explore longer-term HRQOL trajectories. The integration of patient-reported outcomes into routine clinical practice will be essential for holistic osteoporosis management.

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