

Incidence of Second Osteoporotic Fracture Following Proximal Femoral Fracture in Elderly Patients – A Prospective Observational Study**Malay Kumar Mandal¹, Abhijit Sen², Shumayou Dutta³, Swagatam Jash⁴, Partha Sarathi Ray⁵**¹Associate Professor, Department of Orthopedics, KPC Medical College & Hospital, Kolkata, West Bengal, India²Assistant Professor, Department of Orthopedics, KPC Medical College & Hospital, Kolkata, West Bengal, India³Assistant Professor, Department of Orthopedics, KPC Medical College & Hospital, Kolkata, West Bengal, India⁴Senior Resident, Department of Orthopedics, KPC Medical College & Hospital, Kolkata, West Bengal, India⁵Junior Resident, Department of Orthopedics, KPC Medical College & Hospital, Kolkata, West Bengal, India

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Conflict of interest: Nil

Abstract

Background: Proximal femoral fractures are among the most serious consequences of osteoporosis in the elderly, often leading to prolonged morbidity and elevated mortality. A pressing, yet often underemphasized concern is the development of subsequent osteoporotic fractures following an initial proximal femoral injury. These secondary fractures not only worsen functional outcomes but also impose a significant socioeconomic burden. This study aimed to determine the incidence and identify risk factors associated with second osteoporotic fractures in elderly patients following a primary proximal femoral fracture.

Methods: A prospective observational study was carried out over a 24-month period, enrolling 250 patients aged 60 years and above who were admitted with osteoporotic proximal femoral fractures. Participants were monitored at regular intervals (3, 6, 12, 18, and 24 months) to detect new low-energy fractures. Baseline and follow-up data included demographic details, fracture classification, treatment modality, medical comorbidities, and adherence to prescribed anti-osteoporotic therapy. Multivariate analysis was used to evaluate associations between these variables and the occurrence of secondary fractures.

Results: During the two-year follow-up, 21 patients (8.4%) sustained a subsequent osteoporotic fracture. The majority of these events occurred within the first 12 months post-injury, with the contralateral hip and distal radius being the most frequently affected sites. Risk factors significantly associated with the occurrence of second fractures included advancing age, female sex, existing comorbidities, and suboptimal adherence to osteoporosis medications. Despite clinical recommendations, medication compliance remained poor throughout the cohort.

Conclusion: Elderly individuals who sustain a proximal femoral fracture face a considerable risk of experiencing a second osteoporotic fracture, particularly within the first year. These findings underscore the urgent need for improved secondary prevention strategies, including comprehensive osteoporosis management, enhanced patient education, and systematic long-term follow-up to reduce re-fracture rates and improve functional outcomes in this vulnerable population.

Keywords: Osteoporosis, Osteoporotic Fracture, Second Osteoporotic Fracture, Proximal Femoral Fractures.

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Introduction

Osteoporosis is a progressive skeletal disorder characterized by reduced bone mass and micro architectural deterioration, resulting in increased bone fragility and a heightened risk of fractures [1, 2]. The condition remains underdiagnosed and undertreated globally, despite its substantial

contribution to disability and healthcare burden in ageing populations. The most clinically significant outcomes of osteoporosis are fragility fractures, especially of the spine and hip, which are associated with increased morbidity, loss of independence, and premature mortality. The

lifetime risk of osteoporotic fractures at the hip, spine, or forearm is estimated at nearly 40% in women and 13% in men over the age of 50 [3, 4]. Among these, proximal femoral fractures pose the greatest public health concern due to their serious consequences.

Approximately 20% of older adults who sustain a hip fracture die within one year, and nearly half never regain their previous functional status. In India, where population ageing is accelerating, the burden of osteoporosis is substantial, with estimates suggesting that more than 50 million individuals are affected. Nutritional deficiencies, lack of awareness, limited access to diagnostic tools, and underutilization of treatment further exacerbate the problem.

Of particular concern is the markedly elevated risk of subsequent fractures following an initial osteoporotic event—a phenomenon known as the “imminent fracture risk” [5]. Evidence suggests that the risk of a second fracture increases by 2- to 4-fold following a primary fragility fracture and is highest within the first two years. Despite this, secondary prevention remains inadequate. Studies across various populations, including in Asia, have consistently reported low rates of osteoporosis evaluation and treatment after an initial fracture.

In the Indian context, where healthcare systems face resource constraints and public awareness about osteoporosis is limited, understanding the pattern and predictors of second fractures is critical. Proximal femoral fractures often represent the sentinel event for osteoporosis diagnosis and provide a valuable opportunity for early intervention. However, literature on the incidence and clinical course of second osteoporotic fractures in Indian patients remains scarce.

The current study aims to investigate the incidence of second osteoporotic fractures following proximal femoral fractures in elderly patients treated at a tertiary care teaching hospital in eastern India. By addressing this evidence gap, the study seeks to inform strategies for post-fracture care and highlight the importance of fracture liaison services in preventing the recurrence of fragility fractures in high-risk populations.

Material and Method

Study Design and Setting: A prospective, observational study was conducted at the Department of Orthopaedics, KPC Medical College and Hospital, Kolkata, West Bengal, India, over a 12-month period from November 1, 2023, to October 30, 2024.

The study aimed to evaluate the incidence of second osteoporotic fractures in elderly individuals with a history of proximal femoral fracture.

Study Population: The study included male and female patients aged ≥ 50 years who had previously sustained a proximal femoral fracture and subsequently presented with a second osteoporotic fracture involving the vertebral body, proximal femur, proximal humerus or distal radius. Patients were recruited from both inpatient and outpatient orthopaedic services.

Inclusion and Exclusion Criteria

Inclusion Criteria: Consenting patients aged 50 years and above were included in this study, who had history of osteoporotic proximal femoral fracture, now presenting with fracture of:

- Vertebral body
- Proximal femur
- Proximal humerus
- Distal end of radius

Exclusion Criteria:

- Patients refused to give informed consent and to participate in the study
- Poly-trauma patients
- Pathological fracture
- Dropouts

Sample Size: Based on an estimated incidence of 9.5% for second fractures post-hip fracture from prior studies by Bogoch E et al. [8] a minimum sample size of 229 was calculated using Cochran's formula at a 99% confidence level and 5% margin of error.

Sample size (n) calculation (Cochran's formula):

$$n = p(1 - p) z^2 / e^2$$

n = sample size

p = the population proportion ($p = 0.095$)

e = acceptable sampling error 5 % ($e = 0.05$)

z = z value at reliability level or significance level. (Reliability level 99% or significance level 0.01; $z = 2.58$)

$$p = 0.095$$

$$(1 - p) = 0.905$$

$$\text{So, } n = [(2.58)^2 \times 0.095 \times 0.905 / (0.05)^2] = 228.91$$

A total of 250 patients were ultimately enrolled using a total enumeration sampling method.

Data Collection and Variables

A pre-tested, semi-structured questionnaire was used to collect data through patient interviews, medical records, and clinical evaluations. Variables included demographic details (age, sex), lifestyle factors (smoking, alcohol use), comorbidities, details of the first and second fractures (site, type, management), time to second fracture, duration of

medication or supplementation, and hospital stay duration.

Ethical Considerations: The study protocol was approved by the Institutional Ethics Committee of KPC Medical College and Hospital.

Informed written consent was obtained from all participants or their legal guardians in their preferred language. Confidentiality was maintained throughout.

Statistical Analysis: Data were analyzed using SPSS version 20. Descriptive statistics were presented as means $\pm$ standard deviation for continuous variables and proportions for categorical variables. Differences between groups were analyzed using the Chi-square test for categorical variables and Student's t-test for continuous variables. A p-value <0.05 was considered statistically significant.

Result

Demographic and Clinical Characteristics: A total of 250 patients were included in the study. The mean age was 61.90 ± 4.27 years.

Table 1: Distribution of study subjects according to age (n=250)

Age groups (years)	Number	Percentage
50-59	90	36.0
60-69	148	59.2
≥ 70	12	4.8

The majority were between 60 and 69 years of age (59.2%), followed by 36.0% in the 50–59 age group, and 4.8% aged 70 years or above. Females comprised 60% of the study population, indicating a higher burden among postmenopausal women. Tobacco use was reported in 23.6% of participants, while 12.8% reported alcohol consumption.

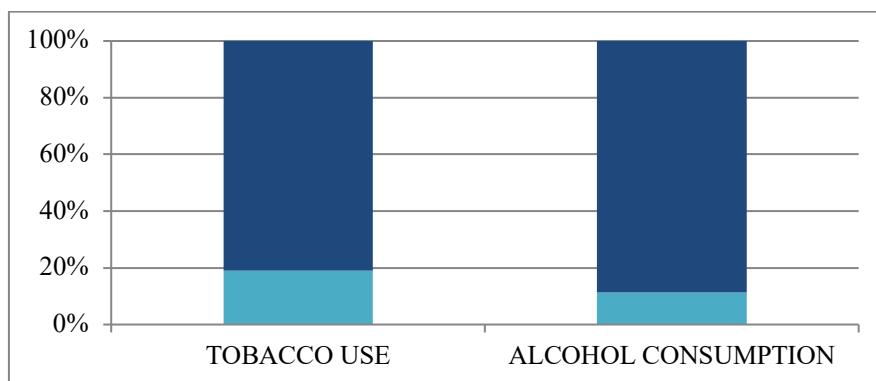


Figure 1: Percentage Distribution showing addiction in the study population

Hypertension (25.6%) and type 2 diabetes mellitus (28.4%) were the most common comorbidities, often coexisting with chronic obstructive pulmonary disease (COPD) in 10% of patients.

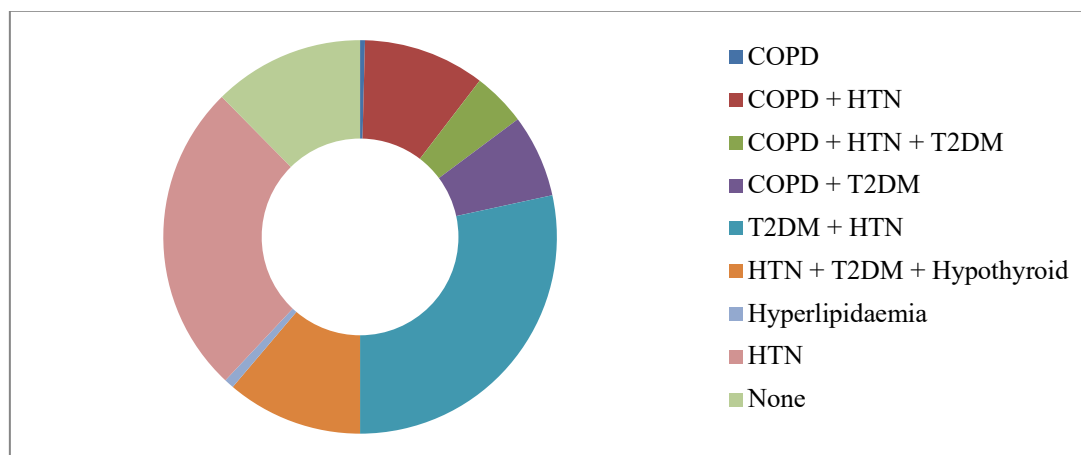


Figure 2: Distribution according to existing co-morbidities

Incidence and Timing of Second Fracture: A total of 21 patients (8.4%) sustained a second osteoporotic fracture after the index proximal femoral fracture. The mean time to the second fracture was 2.76 ± 1.3 years.

Table 2: Distribution of study subjects according to duration of second fracture following first proximal femoral fracture (n=21)

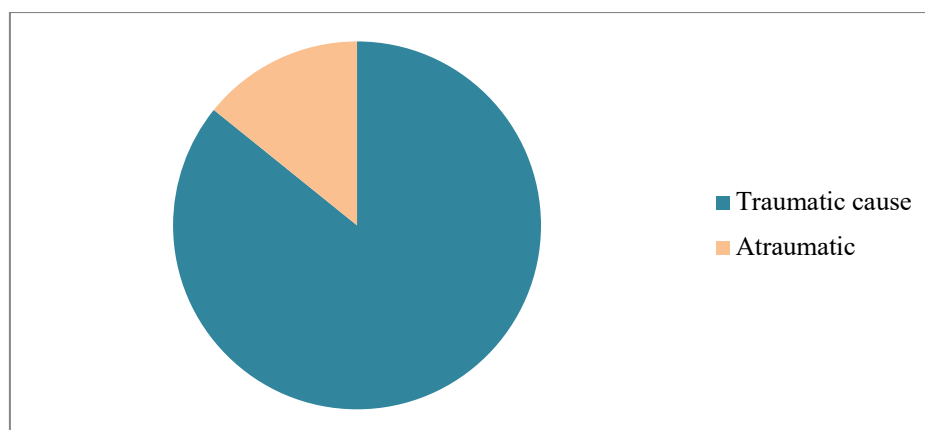
Duration to second fracture (years)	Number	Percentage
1	5	23.8
2	4	19.1
3	5	23.8
4	5	23.8
5	2	9.5

Type and Laterality of Second Fracture: The most common site of second fracture was again the intertrochanteric region of the femur (66.7%), followed by vertebral fractures (23.8%) and contralateral proximal femoral fractures (9.5%). This was consistent with patterns observed in osteoporotic hip fractures in the elderly [9].

Table 3: Distribution of study subjects according to type of second fracture following first proximal femoral fracture (n=21)

Type of second fracture	Number	Percentage
Distal Radius	5	23.8
Inter-trochanteric Femur	7	33.3
L1 Vertebra Compression	1	4.8
L2 Vertebra Compression	2	9.5
L3 Vertebra Compression	2	9.5
Neck of Femur	1	4.8
Proximal Humerus	3	14.3

Initial fractures were slightly more common on the right side (53.6%) compared to the left (46.4%). A similar pattern was observed in second fractures as well. The fracture were caused due to fall in majority of the cases (85.8%; n = 18). Only 3 cases had no history of any trauma (14.2%; n = 3).

**Figure 3: Mode of injury leading to the second fracture (n = 21)**

Risk Factors

Statistically significant associations were found between second fracture incidence and the following variables:

- Age ≥ 65 years ($p < 0.05$)
- Female gender ($p < 0.05$)
- Presence of ≥ 1 comorbidity ($p = 0.001$)
- Shorter duration (< 6 months) of osteoporosis medication/supplement use ($p = 0.001$)

Hospitalization: The average duration of hospitalization for second fractures was 4.28 ± 1.1 days. Although brief, this does not reflect the overall rehabilitation time, which may be prolonged due to functional decline and the need for supportive care in this population.

Discussion

This prospective observational study evaluated the incidence and associated factors of second osteoporotic fractures in elderly patients with a prior history of proximal femoral fracture. The findings indicate that approximately 8.4% of individuals experienced a subsequent fragility fracture, with a mean interval of 2.76 years between the first and second events. This is consistent with international literatures, reporting a 6–13% risk of second fracture within 1–3 years post-index fracture, often referred to as the period of “imminent fracture risk” [10].

The predominance of second fractures occurring at the intertrochanteric region, followed by vertebral

sites, aligns with established epidemiological trends, where hip and spine remain the most frequent sites of osteoporotic injury in older adults [11]. Notably, a significant proportion of second fractures occurred in the contralateral hip, which has been previously described as a common pattern due to bilateral osteopenia and frailty in this age group [12].

The study also reinforces the multifactorial nature of osteoporotic fracture risk. Increasing age, female gender, and presence of comorbidities—especially diabetes and hypertension—were significantly associated with the occurrence of a second fracture. These factors are well-recognized in fracture risk models such as FRAX®, and their continued validation in diverse populations like India highlights the global relevance of these predictors [13]. One of the most important findings is the association between inadequate duration of osteoporosis-specific medication use and higher second fracture risk. Patients who received calcium, vitamin D or anti-resorptive therapy for less than six months had a significantly greater likelihood of sustaining another fragility fracture. This underlines the challenge of treatment adherence and continuity in post-fracture care, particularly in developing healthcare systems with limited fracture liaison services (FLS) [14]. Early initiation and sustained use of pharmacotherapy are critical components of secondary fracture prevention, as also emphasized by international guidelines [15].

The study's strengths lie in its prospective design, standardized data collection, and focus on an underreported Indian population. However, there are limitations. First, the follow-up period may not capture long-term fracture events beyond the average 2–3 year window. Second, bone mineral density (BMD) measurements were not uniformly available, which limited the ability to correlate fracture risk with densitometric severity. Third, the lack of functional outcome assessment post-second fracture restricts the understanding of its full impact on quality of life. Nonetheless, the study fills a critical knowledge gap by documenting the incidence of secondary fragility fractures in an Indian cohort and identifies actionable risk factors that can inform local strategies for fracture prevention and rehabilitation.

Conclusion

Elderly patients with a history of proximal femoral fracture are at considerable risk of sustaining a second osteoporotic fracture, particularly within the first three years of the initial event. Intertrochanteric fractures remain the most common site, and factors such as advanced age, female sex, multimorbidity, and inadequate

osteoporosis treatment significantly contribute to this risk.

These findings underscore the urgent need for structured secondary prevention programs, including patient education, early pharmacological intervention, and improved follow-up systems. Implementation of coordinated care models such as fracture liaison services (FLS) could bridge this gap, especially in low- and middle-income countries like India.

Future research should include long-term, multicentric studies with functional outcomes and BMD monitoring to better characterize the trajectory of post-fracture bone health and to evaluate the real-world effectiveness of preventive strategies.

The authors declare no competing financial interests. The authors Dr. Swagatam Jash, Dr. Malay Kumar Mandal, Dr. Shumayou Dutta and Dr. Partha Sarathi Ray declare that they had no conflict of interest with respect to the present study.

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