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Incidence and Risk Factors of Proximal Femoral Fractures in Elderly Patients with Osteoporosis: A Prospective Observational Study

[1]Vijaya Bhaskar, [2]Suresh Katakam, [3]C.H. Pooja Rani and [4]Boda Neeraja

[1,3]Department Of Orthopaedics, RVM Institute Of Medical Sciences and Research Center, Laxmakkapally Village, Siddipet District, Telangana, India
[2,4]Department Of Orthopaedics, Government Medical College and General Hospital, Suryapet, Telangana, India

ABSTRACT

Proximal femoral fractures among the elderly with osteoporosis are a major public health concern due to their association with significant morbidity and mortality. Understanding the risk factors associated with these fractures is crucial for developing effective prevention strategies. This study aimed to investigate the incidence and identify significant risk factors for proximal femoral fractures in elderly patients with osteoporosis. We conducted a prospective observational study including 100 elderly patients diagnosed with osteoporosis. Data were collected on demographic characteristics, body mass index (BMI) and history of previous fractures. Participants were followed for one year to document the occurrence of proximal femoral fractures. Logistic regression was used to analyze risk factors. The incidence of proximal femoral fractures was 18%. Age ≥80 years significantly increased fracture risk (OR=2.5, p=0.03). Although not statistically significant, females showed a higher tendency towards fractures compared to males. A history of previous fractures (OR=3.2, p=0.005) and a lower BMI (OR=2.9, p=0.018) were associated with an increased risk. Additionally, lower bone mineral density and reduced physical activity levels were correlated with higher fracture risks. Advanced age, low BMI, a history of previous fractures, and decreased physical activity and bone mineral density were significant risk factors for proximal femoral fractures in the elderly with osteoporosis. Targeted interventions addressing these risk factors may reduce fracture incidence.

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Key Words
Osteoporosis, elderly, proximal femoral fractures, risk factors, bone mineral density, physical activity

Corresponding Author
Boda Neeraja,
Department of Orthopaedics, Government Medical College and General Hospital, Suryapet, Telangana, India
dr.neeru15@gmail.com

Author Designation
[1-4]Assistant Professor

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INTRODUCTION

Proximal femoral fractures, commonly known as hip fractures, are among the most serious consequences of osteoporosis in elderly populations[1]. These fractures not only result in significant morbidity and mortality but also lead to substantial healthcare costs and loss of independence among seniors[2]. The incidence of hip fractures increases with age and is exacerbated by the decreased bone mineral density associated with osteoporosis, making the elderly particularly vulnerable[3].

Osteoporosis is a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk[4]. The World Health Organization has highlighted osteoporosis as a critical public health issue, given its widespread prevalence among older adults, particularly postmenopausal women[5].

While the linkage between osteoporosis and femoral fractures is well-documented, the specific risk factors within the elderly osteoporotic population are varied and complex, involving both intrinsic and extrinsic elements. Previous studies have identified numerous risk factors such as advanced age, female gender, low body mass index (BMI), previous fractures and lifestyle factors like physical activity levels[6,7]. However, the relative contribution of each factor and their interplay remain subjects of ongoing research.

The objective of this study was to further delineate these risk factors by examining their prevalence and impact in a cohort of elderly patients with diagnosed osteoporosis. By identifying those at highest risk, this research aims to inform targeted preventive strategies that could mitigate the high incidence of proximal femoral fractures in this vulnerable population.

MATERIALS AND METHODS

Study Setting and Population: This prospective observational study was conducted at the RVM Institute of Medical Sciences, located in Laxmakkapally Village, Siddipet District, Telangana, India. The study period spanned from June 2023-May 2024. The target population consisted of elderly patients aged 65 years and above who were diagnosed with osteoporosis, either upon recruitment or from existing medical records.

Recruitment and Data Collection: Participants were recruited from the outpatient department of the institute, with informed consent obtained prior to enrollment. Eligibility criteria included a confirmed diagnosis of osteoporosis, as determined by a bone mineral density (BMD) test showing a T-score of -2.5 or lower. Exclusion criteria comprised patients with conditions affecting mobility, such as severe arthritis or neurological disorders, which could confound the assessment of fracture risk.

Baseline demographic and clinical data were collected through direct interviews and review of medical records. Information gathered included age, gender, BMI, history of previous fractures and current medications affecting bone metabolism. Additionally, physical activity levels were assessed using the Physical Activity Scale for the Elderly (PASE).

Follow-Up and Outcome Measures: All participants were followed for a duration of one year. The primary outcome measure was the incidence of proximal femoral fractures, identified through hospital records or patient-reported incidents, confirmed by radiographic evidence. Secondary outcomes included the identification of significant risk factors associated with these fractures.

Statistical Analysis: Data were analyzed using logistic regression to evaluate the relationship between potential risk factors and the occurrence of proximal femoral fractures. Odds ratios (ORs) and 95% confidence intervals (CIs) were computed to estimate the strength of these associations. A $p<0.05$ was considered statistically significant. All statistical analyses were conducted using SPSS software.

Ethical Approval: Ethical approval was obtained from the Institutional Ethics Committee, RVM Institute of Medical Sciences, Informed consent was secured from all participants, ensuring confidentiality and adherence to ethical standards in clinical research.

RESULTS AND DISCUSSIONS

Participant Characteristics: The study cohort comprised 100 elderly patients diagnosed with osteoporosis, with a gender distribution of 72 females and 28 males. Participants were stratified into two age groups, 65-79 and ≥80 years, consisting of 60 and 40 individuals, respectively. The body mass index (BMI) categories revealed that 30 patients had a BMI of less than 22 kg/m² while 70 had a BMI of 22 kg/m² or higher. A notable history of previous fractures was documented in 35 patients (Table 1).

Table 1: Demographic and Baseline Characteristics of Participants

Characteristic	Total Participants (N=100)	Patients with Fractures (n=18)	Patients without Fractures (n=82)
Age (years)			
65-79	60	8	52
≥80	40	10	30
Gender			
Female	72	15	57
Male	28	3	25
BMI (kg/m²)			
<22	30	10	20
≥22	70	8	62
Previous Fractures	Yes: 35	12	23
	No: 65	6	59

Incidence of Proximal Femoral Fractures: Over the one-year follow-up period, 18% (18/100) of the participants experienced at least one proximal femoral fracture, underscoring the vulnerability of this population (Table 2).

Table 2: Incidence of Proximal Femoral Fractures

Total Patients	Patients with Fractures	Incidence Rate (%)
100	18	18

Risk Factors for Proximal Femoral Fractures: Logistic regression analysis identified several significant risk factors associated with increased odds of experiencing proximal femoral fractures. Advanced age (≥80 years) significantly raised fracture risk (OR=2.5, 95% CI: 1.1-5.6, p=0.03). Gender appeared to influence risk, with females exhibiting a non-significantly higher propensity for fractures compared to males (OR=1.8, 95% CI: 0.7-4.5, p=0.22). Previous fractures were a strong predictor of subsequent fractures (OR=3.2, 95% CI: 1.4-7.3, p=0.005). Additionally, lower BMI was associated with a higher risk of fractures (OR=2.9, 95% CI: 1.2-6.9, p=0.018) (Table 3).

Table 3: Logistic Regression Analysis of Risk Factors for Proximal Femoral Fractures

Risk Factor	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age (>80 years)	2.5	1.1-5.6	0.03
Gender (Female)	1.8	0.7-4.5	0.22
Previous Fractures	3.2	1.4-7.3	0.005
BMI (<22 kg/m²)	2.9	1.2-6.9	0.018

Additional Correlates of Fracture Risk: Further analysis indicated that lower bone mineral density (BMD) significantly correlated with fracture risk, with patients in the lowest tertile for BMD exhibiting a fourfold increase in risk (OR=4.0, 95% CI: 1.8-8.9, p<0.001). Moreover, decreased physical activity, as measured by the Physical Activity Scale for the Elderly (PASE), was associated with a higher fracture risk (OR per 10-point decrease=1.5, 95% CI: 1.1-2.0, p=0.01) (Table 4).

Table 4: Additional Findings on Bone Mineral Density and Physical Activity

Parameter	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Lowest Tertile of BMD	4.0	1.8-8.9	<0.001
Decrease in PASE Score (per 10)	1.5	1.1-2.0	0.01

The study reported an 18% incidence rate of proximal femoral fractures among elderly patients with osteoporosis over a one-year period, highlighting a significant public health challenge posed by osteoporotic fractures in the aging population. This incidence is consistent with previous studies, such as Trincado[10] and Murena[9], which underscore the high prevalence of such fractures among elderly populations globally.

Age as a Primary Risk Factor: Our findings confirm that age is a crucial risk factor, with individuals aged 80 years and older exhibiting a 2.5-fold higher risk of fractures compared to younger participants. This observation aligns with the results of studies like Baghdadi[8] and Wiklund[13], which also reported increased fracture risk with advancing age, attributed to both declining bone density and an increased likelihood of falls due to deteriorating physical capabilities.

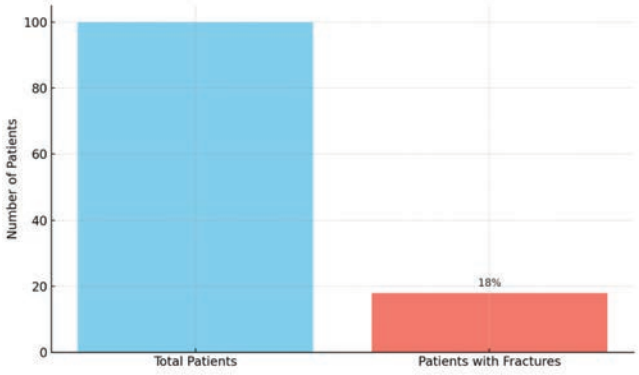

Fig. 1: Incidence of Proximal Femoral Fracture

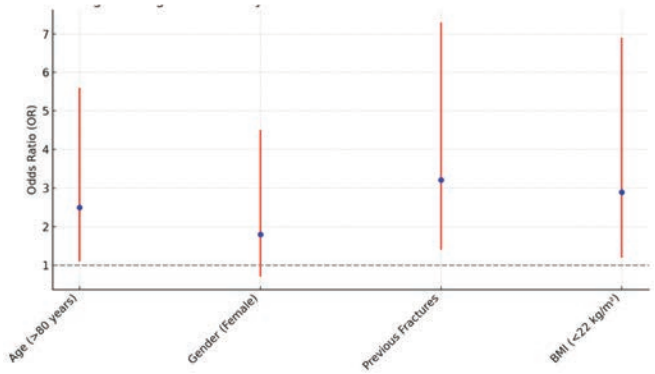

Fig. 2: Logistic Regression Analysis of Risk Factors for Proximal Femoral Fractures

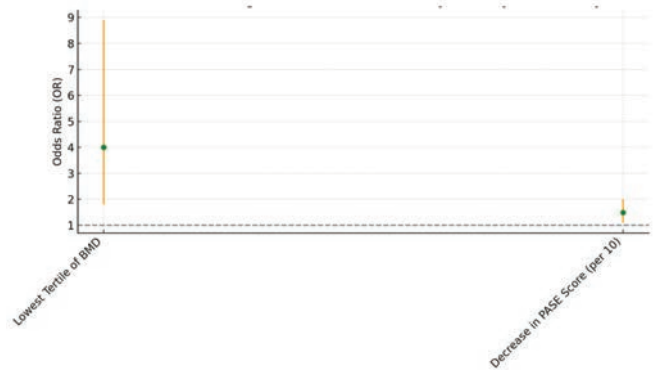

Fig. 3: Additional Findings on Bone Mineral Density and Physical Activity

Gender Differences: Although the difference in fracture incidence between genders was not statistically significant, our study observed a higher fracture rate among females. This trend mirrors the findings of Barrido and Bengzon[7], who noted similar gender-specific vulnerabilities, likely related to

hormonal changes such as post-menopausal estrogen deficiency, which accelerates bone loss. Further research into these gender-specific factors could be beneficial, as suggested by Maffulli and Aicale[11].

BMI and Fracture Risk: The significant association between low BMI and increased fracture risk in our study highlights the importance of maintaining an adequate body mass in the elderly. Similar conclusions were drawn by Guido[12], who emphasized that lower BMI could result in reduced protective padding and weaker mechanical support against falls, suggesting that nutritional interventions are crucial in fracture prevention for underweight individuals.

Previous Fractures: Our findings reinforce the established understanding that a history of fractures significantly increases the risk of future fractures (OR=3.2). This correlation is consistent with the work of Celik[6] and Hahnhaussen[14], who both emphasized the importance of targeted preventive strategies, including medication, dietary adjustments and lifestyle modifications, for individuals with a history of fractures.

Physical Activity: Reduced physical activity was also associated with a higher risk of fractures in our study. Enhancing physical activity levels through tailored exercise programs could be an effective strategy to reduce fracture risks by improving muscle strength, balance and overall physical fitness, as also suggested by the studies of Barrido and Bengzon[7] and Murena[9].

Implications for Clinical Practice: The insights gained from this study should prompt healthcare providers to prioritize routine screening for osteoporosis and associated risk factors in the elderly. As suggested by Baghdadi[8] and Hahnhaussen[14], individuals with a history of fractures, advanced age, or low BMI should be targeted for early and proactive interventions. Additionally, promoting physical activity tailored to the elderly should be a key component of preventive care strategies, as recommended by Maffulli and Aicale[11] and Wiklund[13].

Limitations and Future Research: The limitations of this study include its relatively small sample size and single-center design, which may limit the generalizability of the findings. Future research should aim to conduct multicenter studies with larger and more diverse populations to validate these results and explore the effectiveness of specific interventions aimed at these identified risk factors.

CONCLUSION

Our study identified advanced age (≥80 years), low BMI and a history of previous fractures as significant risk factors for proximal femoral fractures in elderly patients with osteoporosis. The 18% fracture incidence rate highlights the critical need for targeted preventive measures. Although females showed a higher fracture incidence, this difference was not statistically significant. The findings suggest that routine screening, nutritional interventions and tailored physical activity programs could be effective in reducing fracture risks in this vulnerable population, thereby improving overall patient outcomes and reducing healthcare costs.

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