

Original Research Article

FRAGILITY FRACTURES OF THE PROXIMAL HUMERUS: A HOSPITAL-BASED EPIDEMIOLOGICAL ANALYSIS OF DEMOGRAPHIC AND INJURY CHARACTERISTICS

Nithin B R¹, Akhil Jose², Sanjay K³

¹Assistant Professor, Department of Orthopaedics, KMCT Medical College, Mukkam, Kozhikode, Kerala, India.

²Senior Resident, Department of Orthopaedics, KMCT Medical College, Mukkam, Kozhikode, Kerala, India.

³Senior Resident, Department of Orthopaedics, KMCT Medical College, Mukkam, Kozhikode, Kerala, India.

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Corresponding Author:

Dr. Nithin B R,
Assistant Professor, Department of
Orthopaedics, KMCT Medical College,
Mukkam, Kozhikode, Kerala, India.
Email: nithinbalachandran1@gmail.com

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ABSTRACT

Background: Proximal humerus fractures (PHFs) are among the most common fragility fractures in older adults and represent a growing public-health concern in ageing populations. While their surgical management is extensively studied, the demographic and injury-mechanism profile of patients presenting to tertiary centres in South India is less well characterised. This study describes the age, sex, mechanism-of-injury and fracture-pattern characteristics of patients presenting with PHFs.

Materials and Methods: This hospital-based observational study analysed 50 skeletally mature patients presenting with radiologically confirmed PHFs to a tertiary care medical college in North Kerala over an 18-month period (September 2019 to March 2021). Demographic variables, mechanism of injury, side affected and fracture pattern (Neer classification) were recorded on a pre-tested proforma. Associations were tested using the chi-square test and one-way analysis of variance, with $p < 0.05$ considered significant.

Results: The mean age was 65.8 ± 13.9 years; 78% of patients were aged 56 years or older. Women predominated (76%; male-to-female ratio 1:3.2). Low-energy self-falls accounted for 82% of injuries, rising to 86.8% among women, whereas high-energy trauma was proportionately more frequent in men (33.3% vs 13.2%). Neer three-part fractures were most common (58%), followed by four-part (28%) and two-part (14%) fractures. Four-part fractures occurred in the oldest patients (mean 72.5 years). Left and right sides were affected equally.

Conclusion: PHFs in this setting occurred predominantly in older women following ground-level falls, a pattern consistent with underlying bone fragility. These findings support integrating fall-prevention counselling and osteoporosis screening into the routine care of older adults presenting with PHFs, and highlight the need for community-level preventive strategies.

Keywords: Shoulder Fractures; Osteoporotic Fractures; Accidental Falls; Aged; Epidemiology.

INTRODUCTION

Fractures of the proximal humerus are the third most common fragility fracture in older adults, after those of the hip and the distal radius, and account for a substantial share of the osteoporosis-related fracture burden worldwide.^[1,2] They account for approximately 5–6% of all adult fractures, and their incidence rises steeply with age, so that as

populations age they are increasingly regarded as a public-health problem rather than a purely surgical one.^[3,4]

The typical proximal humerus fracture (PHF) in an older adult results from a low-energy fall from standing height onto an outstretched hand or the side of the shoulder. This mechanism, combined with a marked female preponderance and a strong association with advancing age, places PHFs firmly

within the spectrum of fragility fractures that signal underlying osteoporosis.^[4,5] Osteoporosis is highly prevalent in India, affecting an estimated 40–50% of postmenopausal women, yet it remains substantially underdiagnosed and undertreated.^[6,7] A first fragility fracture is a well-recognised predictor of future fractures, including hip fracture, but the sentinel value of a PHF is frequently overlooked, and many patients are treated for the fracture without any assessment of bone health or falls risk.^[8]

Most published literature on PHFs concentrates on the comparative effectiveness of operative versus non-operative treatment and on surgical technique.^[9,10] The descriptive epidemiology of these injuries in Indian tertiary-care settings, and in Kerala in particular, has received comparatively little attention, despite Kerala having one of the highest proportions of older adults of any Indian state. Understanding who sustains these fractures, and how, is a prerequisite for designing context-appropriate prevention.

This study therefore aimed to describe the demographic profile, mechanism of injury, side affected and fracture pattern of patients presenting with PHFs to a tertiary care centre in North Kerala, and to examine the associations between these characteristics, with a view to informing fall-prevention and bone-health strategies for older adults.

MATERIALS AND METHODS

Study design and setting

This was a hospital-based observational study conducted in the Department of Orthopaedics of a tertiary care teaching hospital in North Kerala, India, over an 18-month period from September 2019 to March 2021. The study was reported in accordance with the STROBE statement for observational studies. The present analysis focuses on the demographic and injury characteristics of the cohort; treatment-related functional outcomes are reported separately.

Participants

Consecutive skeletally mature patients (aged 18 years or older) presenting to the orthopaedics department and casualty with a radiologically confirmed PHF, classified according to the Neer system as two-, three- or four-part fractures, were screened for eligibility. Patients with severely comminuted fractures, segmental fractures, pathological fractures from primary or metastatic tumours, associated axillary

nerve palsy, pre-existing shoulder or rotator-cuff pathology, glenohumeral arthritis, polytrauma, chronic debilitating systemic illness, or unfitness for the planned intervention were excluded, as were those unwilling to provide informed consent and those presenting more than two weeks after injury. Fifty patients met the criteria and were enrolled.

Data collection and variables

Details of all participating patients were recorded on a predesigned, pre-tested proforma. Diagnosis was based on clinical and radiological evaluation. The variables analysed for this study were age, sex, mechanism of injury (categorised as low-energy self-fall or high-energy trauma, the latter including road-traffic accidents), side affected (right or left), and Neer fracture pattern (two-, three- or four-part). Age was analysed both as a continuous variable and in decade-based bands.

Statistical analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 20.0. Quantitative variables were expressed as mean $\pm$ standard deviation and qualitative variables as frequencies and percentages. The Shapiro–Wilk test was used to assess normality. The chi-square test, with Yates' continuity correction for 2×2 tables, was used to examine associations between categorical variables, and the independent-samples t-test and one-way analysis of variance (ANOVA) were used for comparisons involving continuous variables. A probability value of $p < 0.05$ was considered statistically significant.

Ethical considerations

The study was approved by the Institutional Scientific and Ethics Committee before commencement. Written informed consent was obtained from every participant after the purpose and methods of the study had been explained.

RESULTS

Age and sex distribution

Fifty patients were analysed. The mean age of the cohort was 65.8 ± 13.9 years. Older adults formed the bulk of the sample: 78% of patients were aged 56 years or older, and 48% were older than 65 years (Table 1, Figure 1). Women accounted for 38 patients (76%) and men for 12 (24%), a male-to-female ratio of approximately 1:3.2 (Table 2, Figure 2). The mean age was similar in women (66.1 ± 14.3 years) and men (64.8 ± 12.8 years; $p = 0.78$).

Table 1: Age distribution of patients with proximal humerus fracture (N = 50)

Age band (years)	n	%
34–45	4	8.0
46–55	7	14.0
56–65	15	30.0
66–75	8	16.0
>75	16	32.0
Total	50	100.0

Majority of patients had GBM (63.3%); 50% had ECOG PS 2 at enrolment.

Table 2: Distribution by sex (N = 50)

Sex	n	%
Female	38	76.0
Male	12	24.0
Total	50	100.0

Table 3: Mechanism of injury, overall and by sex

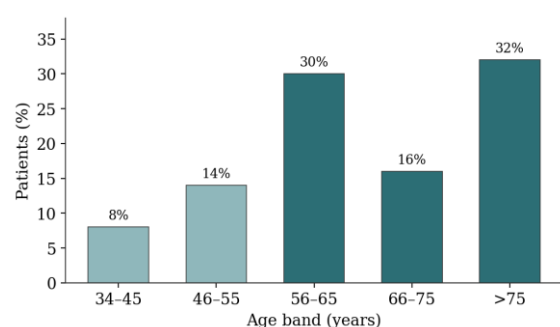
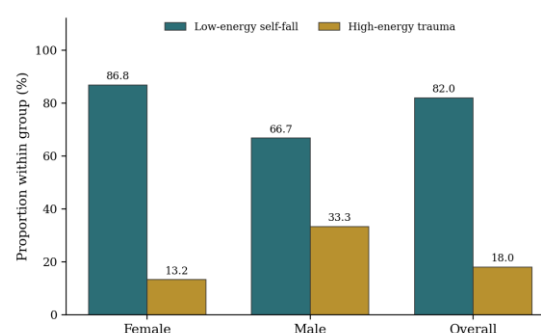
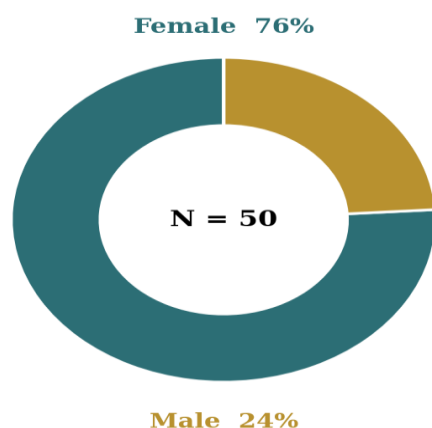
Mechanism	Overall n (%)	Female n (%)	Male n (%)
Low-energy self-fall	41 (82.0)	33 (86.8)	8 (66.7)
High-energy trauma	9 (18.0)	5 (13.2)	3 (33.3)

Chi-square test for association between sex and mechanism: $p = 0.24$ (not significant).

Table 4: Neer fracture pattern and mean age

Neer pattern	n	%	Mean age $\pm$ SD (years)
Two-part	7	14.0	65.8 ± 12.9
Three-part	29	58.0	62.6 ± 14.7
Four-part	14	28.0	72.5 ± 10.5

One-way ANOVA for age across fracture patterns: $p = 0.08$ (not significant).

**Figure 1: Age distribution of patients with proximal humerus fracture (N = 50)****Figure 3: Mechanism of injury by sex and overall, shown as the proportion within each group****Figure 2: Distribution of patients by sex (N = 50)**

Mechanism of injury

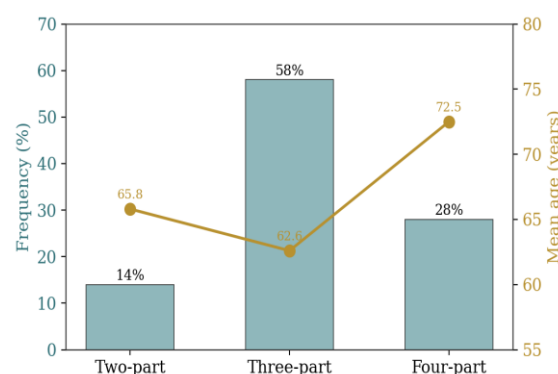
Low-energy self-falls were the dominant mechanism, accounting for 41 of 50 injuries (82%), while high-energy trauma, including road-traffic accidents, accounted for the remaining 9 (18%) (Table 3, Figure 3). The mechanism differed by sex: among women, 33 of 38 injuries (86.8%) followed a self-fall, compared with 8 of 12 (66.7%) among men, in whom high-energy trauma was proportionately more frequent (33.3% vs 13.2%). This difference did not reach statistical significance ($p = 0.24$), likely reflecting the small number of male patients.

Side affected

The right and left sides were affected equally, each accounting for 25 patients (50%).

Fracture pattern and its relationship with age

Neer three-part fractures were the most common pattern, seen in 29 patients (58%), followed by four-part fractures in 14 (28%) and two-part fractures in 7 (14%) (Table 4, Figure 4). Fracture severity tended to increase with age: the mean age of patients with four-part fractures was 72.5 ± 10.5 years, compared with 62.6 ± 14.7 years for three-part and 65.8 ± 12.9 years for two-part fractures. This trend approached but did not reach statistical significance ($p = 0.08$).

**Figure 4: Neer fracture pattern (bars, left axis) and mean patient age for each pattern (line, right axis)**

DISCUSSION

In this hospital-based series, proximal humerus fractures occurred overwhelmingly in older women and followed low-energy falls in the great majority of cases — a demographic and mechanistic signature that is characteristic of fragility fractures. Three-quarters of patients were women, nearly four-fifths were aged 56 years or older, and 82% of injuries resulted from a simple fall from standing height. Taken together, these features indicate that the typical PHF seen at this centre is an osteoporosis-related event rather than a consequence of major trauma.

These observations align closely with contemporary international series. The mean age of 65.8 years and female predominance of 76% are consistent with recent epidemiological reports, in which the majority of patients are women and most are older than 60 years, and the 82% low-energy mechanism mirrors the predominance of ground-level falls described in those cohorts.^[4,11,12] The concordance between a South Indian tertiary-care sample and predominantly Western data reinforces the view that the fragility-fracture phenotype of the proximal humerus is broadly consistent across settings.

The predominance of three-part fractures (58%) in the present series contrasts with several cohorts in which two-part fractures predominate.^[11,12] This difference is most plausibly explained by referral and selection effects at a tertiary centre, where more complex fractures are concentrated, together with the study's exclusion of the most severely comminuted injuries. The tendency for four-part fractures to occur in the oldest patients (mean 72.5 years) is nonetheless consistent with the expectation that bone quality declines with age, although imaging studies have linked lower proximal-humeral bone density to the occurrence of fracture rather than to its complexity.^[13]

The sex difference in mechanism — with high-energy trauma proportionately more common in men and falls dominant in women — reflects both the higher prevalence of osteoporosis in older women and differing patterns of activity and exposure between the sexes.^[4,6] Although this association was not statistically significant here, its direction is consistent with the broader literature, and the lack of significance is attributable to the small number of male patients.

The public-health implications are the central message of these findings. A proximal humerus fracture sustained in a low-energy fall should be regarded as a sentinel event that flags both underlying bone fragility and a heightened risk of future falls and fractures.^[8] The orthopaedic encounter is an opportunity, frequently missed, to initiate falls-risk assessment, osteoporosis evaluation and, where indicated, bone-protective treatment (Figure 5). Fracture-liaison services — coordinated, multidisciplinary programmes that systematically

identify fragility-fracture patients and close the post-fracture care gap — have been shown to increase bone-density testing and treatment initiation and to reduce the risk of subsequent fractures and mortality.^[14,15] Given Kerala's demographic profile, with a large and growing older population, embedding fall-prevention counselling and a structured fracture-liaison approach into the care of these patients could yield substantial reductions in the downstream burden of fragility fractures.

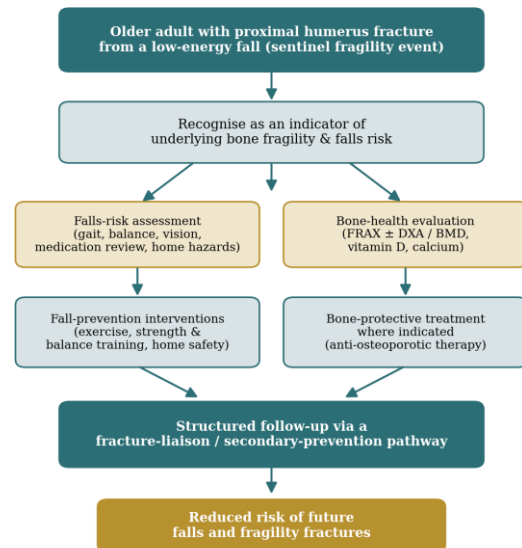


Figure 5: Proposed public-health pathway framing a low-energy proximal humerus fracture as a sentinel fragility event warranting falls-risk assessment, bone-health evaluation and structured secondary prevention.

Limitations

Several limitations should be acknowledged. The sample was drawn from patients presenting for treatment at a single tertiary centre and was assembled for a treatment-comparison study with specific exclusion criteria; it therefore describes the injury pattern among treated patients and cannot be used to estimate community incidence. The modest sample size ($N = 50$), and in particular the small number of male patients, limited the statistical power to detect associations, and bone mineral density was not measured, so the inference of underlying osteoporosis rests on the demographic and mechanistic profile rather than on direct densitometric confirmation. Larger, multi-centre and ideally population-based studies incorporating bone-density assessment would strengthen and extend these observations.

CONCLUSION

Proximal humerus fractures at this North Kerala tertiary centre occurred predominantly in older women following low-energy falls, a profile that is characteristic of osteoporotic fragility fractures. These findings support treating such fractures as sentinel events that warrant fall-prevention

counselling and osteoporosis screening as part of routine care, and they underline the value of community-level preventive strategies directed at older adults.

Declarations

Ethical approval: Obtained from the Institutional Scientific and Ethics Committee prior to commencement of the study.

Informed consent: Written informed consent was obtained from all participants.

Conflicts of interest: The authors declare that they have no conflicts of interest.

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Author contributions: Dr. Nithin B R conceived and designed the study, supervised data collection, interpreted the results, drafted the manuscript and critically revised it for important intellectual content. Dr. Akhil Jose contributed to data acquisition, compiled the dataset, performed the statistical analysis and helped draft the Results section. Dr. Sanjay K contributed to data acquisition, conducted the literature review, helped interpret the findings and critically revised the manuscript. All authors read and approved the final version of the manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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