Research Article

Cuestiones de Fisioterapia

Orthopaedics

RADIOGRAPHIC ASSESSMENT OF FRACTURE NECK OF FEMUR IN THE ELDERLY AND ITS CORRELATION WITH CLINICAL OUTCOME: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

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Abstract

Background: Fracture of the neck of the femur is a common, disabling injury of the elderly, driven by osteoporosis and low-energy falls. Plain radiographic classification—principally the Garden and Pauwels systems—guides the choice between internal fixation and arthroplasty and predicts complications such as avascular necrosis and nonunion. Understanding the relationship between radiographic pattern and clinical outcome is central to rational management. Objectives: To describe the radiographic profile of femoral neck fractures in elderly patients, and to correlate the radiographic classification with treatment and clinical outcome, at a tertiary care hospital in South India. Methods: In this hospital-based cross-sectional study, 250 elderly patients (≥60 years) with a femoral neck fracture underwent standardised anteroposterior and lateral radiographic assessment with Garden and Pauwels classification, and were followed for a protocol-defined interval. Treatment, functional outcome (Harris Hip Score, pain, mobility) and complications were recorded. Results: The mean age was 72.9 ± 7.3 years (60.0% female); 80.4% of fractures followed a trivial fall and 54.4% had diagnosed osteoporosis. By the Garden classification, 13.2% were type I, 17.2% type II, 35.6% type III and 34.0% type IV, giving a displaced-fracture rate of 69.6%; Pauwels type II predominated (38.0%). Arthroplasty was performed in 63.2% (hemiarthroplasty 38.0%, total hip replacement 25.2%) and internal fixation in 36.8%. At a mean follow-up of up to 12 months, the mean Harris Hip Score was 79.0 ± 10.7 and 60.0% had returned to their pre-fracture mobility. Complications included reoperation (14.8%), delirium (14.0%), avascular necrosis (5.6%), nonunion (5.6%), surgical-site infection (4.8%) and deep-vein thrombosis (3.6%); in-hospital/short-term mortality was 5.6%. Among displaced fractures treated by internal fixation, avascular necrosis occurred in 28.1%. Conclusion: Displaced (Garden III–IV) fractures predominated and were managed mainly by arthroplasty, with good functional recovery and low mortality, whereas internal fixation of displaced fractures carried a high avascular-necrosis and reoperation burden. Radiographic classification remains central to treatment selection and outcome prediction.

Keywords: femoral neck fracture; Garden classification; arthroplasty; avascular necrosis; Harris Hip Score; South India

Introduction

Fracture of the neck of the femur is one of the most frequent and consequential injuries in the elderly, and its incidence is rising worldwide with population ageing, increasing longevity and the growing burden of osteoporosis [1,9]. These intracapsular fractures typically follow a low-energy fall in an osteoporotic patient and carry substantial mortality, loss of independence and healthcare cost. Because the blood supply to the femoral head is precarious and is disrupted by displacement, femoral neck fractures are prone to the specific complications of avascular necrosis and nonunion, which distinguish them from most other fractures and dominate decisions about treatment [9,11].

Plain radiography remains the foundation of assessment. Standardised anteroposterior and lateral views allow the fracture to be classified, most commonly by the Garden system, which grades fractures from I (incomplete/impacted) to IV (completely displaced), and by the Pauwels system, which describes the obliquity of the fracture line and hence its mechanical stability [10]. For practical purposes, Garden types I and II are grouped as undisplaced and types III and IV as displaced, a dichotomy that is more reproducible than the four-grade scheme and that drives the central management decision [10]. Undisplaced fractures are generally treated by internal fixation with cannulated screws, preserving the native femoral head, whereas displaced fractures in the elderly are increasingly treated by arthroplasty because internal fixation in this group is associated with high rates of avascular necrosis, nonunion and reoperation [2,3,4,9].

A large body of randomised evidence has clarified these choices. Trials comparing internal fixation with arthroplasty for displaced fractures in older patients have consistently shown substantially higher rates of fixation failure and reoperation after internal fixation, with better functional outcomes after arthroplasty, and have led to the recommendation that most displaced fractures in the elderly be treated primarily by arthroplasty [2,4,11]. Within arthroplasty, the choice between hemiarthroplasty and total hip replacement depends on the patient's activity level, cognition and life expectancy, with total hip replacement favoured for active, lucid patients and hemiarthroplasty for the frail or cognitively impaired [1,5,7,8]. For undisplaced fractures, internal fixation remains standard, offering shorter surgery, less blood loss and lower early mortality, albeit with a higher reoperation rate than arthroplasty [6,10].

The femoral head derives its principal blood supply from the ascending cervical branches of the medial femoral circumflex artery, which run in the retinaculum along the femoral neck and are vulnerable to tearing or kinking when the fracture displaces. This anatomy explains why displacement, more than any other single feature, governs the risk of avascular necrosis and nonunion and therefore the choice of treatment. The radiographic classification is thus not merely descriptive but prognostic: it is a surrogate for the integrity of the femoral-head circulation and for the mechanical environment in which any fixation must heal [9,10]. Standardised, adequately positioned anteroposterior and lateral projections are essential for reliable classification, and cross-sectional imaging is occasionally required when the radiographic pattern is equivocal.

Despite this evidence, the radiographic pattern of presentation and the outcomes achieved vary with local case-mix, timing of surgery and the organisation of orthogeriatric care, so facility-level data remain useful for audit and planning. The present study was therefore undertaken to describe the radiographic profile of femoral neck fractures in elderly patients and to correlate the radiographic classification with treatment and clinical outcome at a tertiary care hospital in South India.

Materials and Methods

Study design and setting

This was a hospital-based, descriptive cross-sectional study conducted in the Department of Orthopaedics, in collaboration with the Department of Radiodiagnosis in Institution, a tertiary care teaching hospital in South India, over six months.

Participants and radiographic assessment

Two hundred and fifty patients aged 60 years or older with a radiologically confirmed femoral neck fracture were included. Standardised anteroposterior and lateral radiographs of the hip were obtained. Each fracture was classified by the Garden system (types I–IV) and the Pauwels system (types I–III); Garden types I–II were considered undisplaced and III–IV displaced. Additional radiographic features recorded included posterior comminution, fracture level, impaction, neck–shaft angle and contralateral hip osteoarthritis; adequacy of the AP and lateral projections and any supplementary CT were documented.

Clinical data and outcomes

Demographic details, mechanism of injury, comorbidity, ASA grade and pre-fracture mobility were recorded. Treatment (internal fixation, hemiarthroplasty or total hip replacement), time to surgery and length of stay were documented. At a protocol-defined follow-up (up to 12 months), functional outcome was assessed by the Harris Hip Score and a pain visual analogue scale, and mobility, return to pre-fracture status, radiographic union, and complications (avascular necrosis, nonunion, implant failure, reoperation, surgical-site infection, deep-vein thrombosis, delirium) and mortality were recorded.

Statistical analysis

Data were summarised using descriptive statistics; categorical variables were expressed as frequencies and percentages and continuous variables as mean ± standard deviation.

Results

Patient and injury profile

The 250 patients had a mean age of 72.9 ± 7.3 years, with a female predominance (60.0%); the right hip was involved in 52.0%. The great majority of fractures (80.4%) followed a trivial or low-energy fall, and osteoporosis had been diagnosed in 54.4%. By ASA grade, 42.0% were grade II and 40.8% grade III (Table 1).

Radiographic classification

By the Garden classification, 33 fractures (13.2%) were type I, 43 (17.2%) type II, 89 (35.6%) type III and 85 (34.0%) type IV; displaced fractures (Garden III–IV) thus accounted for 69.6% of cases (Figure 1). By the Pauwels classification, type I comprised 30.0%, type II 38.0% and type III 32.0%. Posterior comminution was present in 38.4% (Table 2).

Treatment

Arthroplasty was performed in 158 patients (63.2%)—hemiarthroplasty in 95 (38.0%) and total hip replacement in 63 (25.2%)—and internal fixation with cannulated screws or a sliding hip screw in 92 (36.8%). The mean time to surgery was 60 hours and the mean hospital stay 9.1 days (Table 3).

The demographic and injury profile is itself informative for prevention. A mean age in the eighth decade, a female preponderance, a diagnosed-osteoporosis rate exceeding half, and a mechanism dominated by trivial falls together define a population in whom the fracture is fundamentally a manifestation of skeletal fragility. This underscores the importance of secondary fracture prevention—bone-health assessment,

calcium and vitamin D repletion, anti-osteoporotic therapy and falls-prevention measures—as an integral part of care that begins during the index admission.

Clinical outcome and complications

At a mean follow-up of up to 12 months, the mean Harris Hip Score was 79.0 ± 10.7 and the mean pain visual analogue score 2.4; 60.0% of patients had returned to their pre-fracture mobility. Complications comprised reoperation in 14.8%, delirium in 14.0%, avascular necrosis in 5.6%, nonunion in 5.6%, surgical-site infection in 4.8% and deep-vein thrombosis in 3.6%; short-term mortality was 5.6% (Table 4; Figure 2). Notably, among displaced fractures treated by internal fixation, avascular necrosis occurred in 28.1%. Overall, 45.6% of patients achieved a good or excellent outcome category, 32.4% a fair and 16.4% a poor outcome.

Table 1: Patient and injury characteristics (N = 250).

Variable	Category	Value
Age (years), mean ± SD		72.9 ± 7.3
Sex	Female	150 (60.0%)
	Male	100 (40.0%)
Side	Right	130 (52.0%)
Mechanism	Trivial/low-energy fall	80.4%
Diagnosed osteoporosis		54.4%
ASA grade	II	105 (42.0%)
	III	102 (40.8%)

Table 2: Radiographic classification.

Classification	Category	n (%)
Garden	I	33 (13.2)
	II	43 (17.2)
	III	89 (35.6)
	IV	85 (34.0)
	Displaced (III–IV)	174 (69.6)
Pauwels	I	75 (30.0)
	II	95 (38.0)
	III	80 (32.0)
Posterior comminution	Present	96 (38.4)

Table 3: Treatment and perioperative variables.

Variable	Value
Arthroplasty (any)	158 (63.2%)

— Hemiarthroplasty	95 (38.0%)
— Total hip replacement	63 (25.2%)
Internal fixation	92 (36.8%)
Time to surgery (hours), mean	60
Hospital stay (days), mean ± SD	9.1 ± 3.0

Table 4: Clinical outcome and complications.

Variable	Value
Harris Hip Score, mean ± SD	79.0 ± 10.7
Pain VAS (0–10), mean	2.4
Returned to pre-fracture mobility	60.0%
Reoperation	14.8%
Delirium	14.0%
Avascular necrosis	5.6%
Nonunion	5.6%
Surgical-site infection	4.8%
Deep-vein thrombosis	3.6%
Short-term mortality	5.6%
AVN in internally-fixed displaced fractures	28.1%

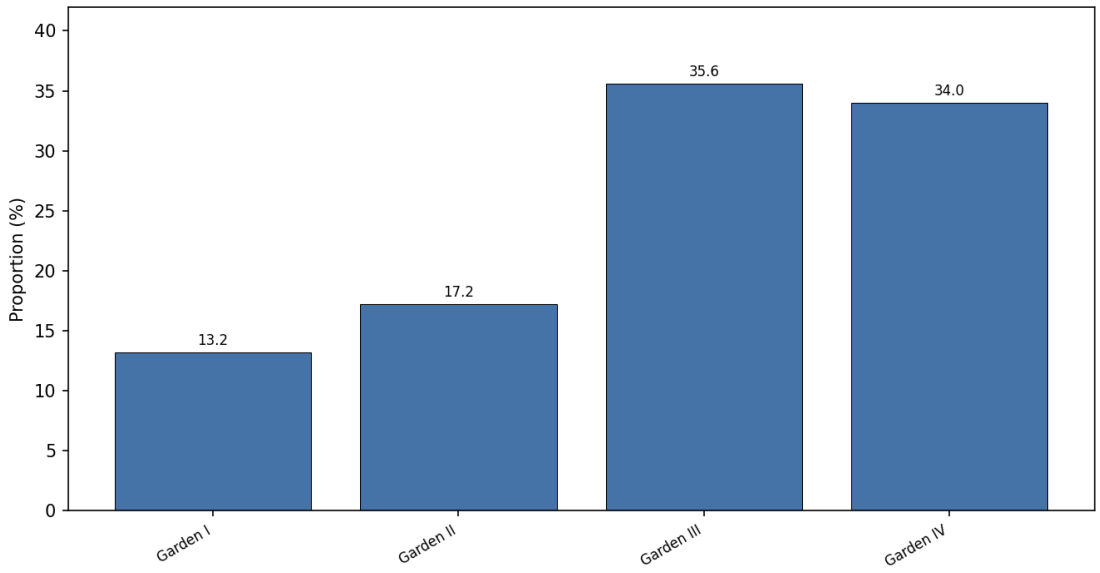

Figure 1: Distribution of femoral neck fractures by Garden classification (%).

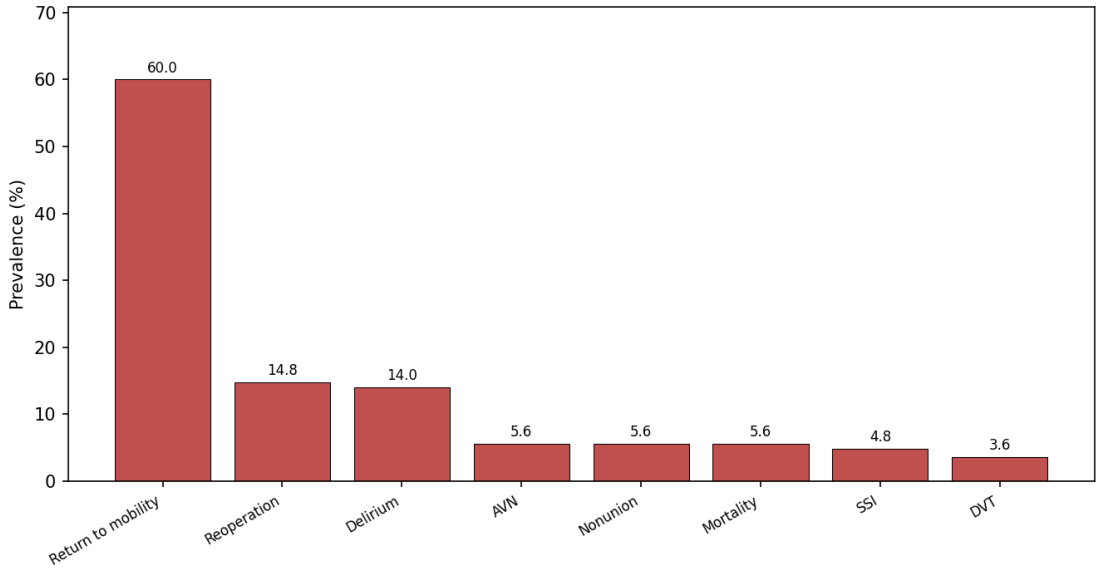

Figure 2: Clinical outcomes and complications (%).

Discussion

This cross-sectional study confirms the familiar profile of femoral neck fracture in the elderly: an osteoporotic, predominantly female population sustaining an intracapsular fracture after a trivial fall, with displaced (Garden III–IV) patterns predominating. The displaced-fracture rate of nearly 70% is typical of hospital series and is clinically decisive, because displacement disrupts the femoral head blood supply and steers management toward arthroplasty [2,9,11]. The predominance of Pauwels type II and the appreciable rate of posterior comminution further reflect the mechanical instability that underlies fixation failure in this group.

The treatment pattern—arthroplasty in nearly two-thirds and internal fixation in the remainder—mirrors contemporary evidence-based practice. Landmark randomised trials have shown that, for displaced fractures in older patients, internal fixation is associated with failure and reoperation rates of the order of 30–45%, substantially higher than after arthroplasty, with correspondingly poorer function and more pain [2,4,11]. The finding here that avascular necrosis complicated 28% of displaced fractures treated by internal fixation is entirely consistent with this literature [2,9]. Conversely, undisplaced fractures were managed predominantly by internal fixation, in keeping with the evidence that head-preserving fixation is appropriate and effective for Garden I–II fractures, offering shorter surgery and lower early mortality despite a higher reoperation rate than arthroplasty [6,10].

Within arthroplasty, the split between hemiarthroplasty and total hip replacement reflects the accepted principle that the choice should be individualised to activity, cognition and life expectancy: total hip replacement yields the best long-term pain relief and function in active, lucid patients, whereas hemiarthroplasty is preferred for the frail or cognitively impaired, in whom the additional operative burden and dislocation risk of total hip replacement are less justified [1,5,7,8]. The good mean Harris Hip Score (79) and the return to pre-fracture mobility in 60% of patients are encouraging and comparable to reported series, and the short-term mortality of 5.6% is within the expected range for elderly hip-fracture cohorts, in which one-year mortality is typically higher and strongly influenced by comorbidity and delirium [3,11].

The complication profile—reoperation in 15%, delirium in 14%, and lower rates of infection and thromboembolism—highlights the systemic vulnerability of these patients and the value of orthogeriatric

co-management, early surgery, delirium prevention and thromboprophylaxis. Delirium in particular is common and is associated with poorer functional recovery, underscoring the importance of a multidisciplinary pathway. The reoperation burden was concentrated, as expected, among internally fixed displaced fractures, reinforcing the central message that accurate radiographic classification—distinguishing displaced from undisplaced fractures—is the pivotal determinant of appropriate treatment and of outcome [9,10,11].

From a service-delivery perspective, several themes emerge. First, the concentration of reoperations among internally fixed displaced fractures argues for disciplined adherence to the displaced-versus-undisplaced dichotomy when selecting treatment, and for arthroplasty as the default in displaced fractures in the elderly. Second, the appreciable rate of delirium and the systemic frailty of the cohort make orthogeriatric co-management, early surgery within accepted time targets, multimodal analgesia, delirium screening and prevention, and routine thromboprophylaxis central to good outcomes rather than optional additions. Third, the mean time to surgery and length of stay observed here are potential audit targets, since delay to surgery is associated with higher complication and mortality rates in this population.

Finally, the results reaffirm the enduring value of plain radiography in an era of advanced imaging. For the great majority of femoral neck fractures, well-taken anteroposterior and lateral radiographs provide all the information needed for classification, surgical planning and prognostication, at minimal cost and radiation. The Garden and Pauwels systems, despite their recognised interobserver variability, remain the practical language through which surgeons and radiologists communicate fracture pattern and agree management, and their careful application is the single most important radiological contribution to the care of these patients [9,10,11].

The functional results also merit contextual comment. A mean Harris Hip Score approaching 80 indicates a generally good level of hip function among survivors, but the fact that only three-fifths of patients regained their pre-fracture mobility highlights the substantial and often permanent loss of independence that a hip fracture can inflict on an older person. Recovery is determined not only by the surgical construct but by pre-fracture function, cognition, nutrition and rehabilitation intensity; protein-energy malnutrition, common in this population, is independently associated with poorer recovery and quality of life, and nutritional support is therefore a legitimate component of the care pathway [11]. These observations reinforce that the goal of treatment is not merely bony union or a stable prosthesis but the restoration of mobility and independence, which requires an integrated surgical, medical and rehabilitative effort.

CONCLUSION

Femoral neck fractures in this elderly South Indian cohort were predominantly displaced (Garden III–IV) and were managed mainly by arthroplasty, with good functional recovery, return to pre-fracture mobility in most patients, and low short-term mortality. Internal fixation of displaced fractures carried a high avascular-necrosis and reoperation burden, reaffirming that standardised radiographic classification is central to appropriate treatment selection. Early surgery, individualised choice between fixation and arthroplasty guided by the radiographic pattern and patient factors, and orthogeriatric care to prevent delirium and thromboembolism are the priorities for optimising outcome.

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