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### Incidence and risk factors of distal third shaft humerus fractures in the adult population at tertiary care hospital

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#### Abstract

**Introduction:** Distal third shaft humerus fractures are significant injuries in adults, often associated with direct trauma and comorbid conditions such as osteoporosis. These fractures present unique management challenges due to their anatomical proximity to the radial nerve and complex biomechanical considerations. This study aimed to evaluate the incidence, associated risk factors, fracture patterns, and outcomes of distal third shaft humerus fractures in adults at a tertiary care hospital.

**Materials and Methods:** A prospective observational study was conducted at the Department of Orthopedics, Katari Medical College and Hospital, Guntur, Andhra Pradesh, including 75 adult patients with distal third shaft humerus fractures. Data on demographics, clinical history, mechanism of injury, comorbid conditions, and radiographic findings were collected. Fracture patterns were classified according to the AO classification system. Outcomes measured included complication rates (particularly radial nerve palsy), time to union, and functional recovery assessed by the Disabilities of the Arm, Shoulder, and Hand (DASH) score at 6 months post-injury.

**Results:** The most common fracture pattern was B1 (Spiral Wedge), accounting for 18.7% of cases. Osteoporosis (28%) and diabetes (22.7%) were prevalent comorbid conditions. The incidence of radial nerve palsy was 17.3%. The average time to union was 11.5 weeks, and the mean DASH score at 6 months was 18.5, indicating good functional recovery. The study found a weak correlation between fracture patterns and comorbid conditions.

**Conclusion:** Distal third shaft humerus fractures are associated with significant comorbid conditions, particularly osteoporosis, which influence fracture patterns and outcomes. Despite the complication of radial nerve palsy, functional recovery was generally favorable. The study highlights the need for individualized management strategies and preventive measures to optimize patient outcomes.

**Keywords:** Distal third shaft humerus fractures, AO classification, radial nerve palsy, osteoporosis, fracture patterns, DASH score, orthopedic trauma, fracture management

#### Introduction

Distal third shaft humerus fractures are relatively uncommon but significant injuries that can result from direct trauma, such as falls, motor vehicle accidents, or sports-related incidents<sup>[1]</sup>. These fractures typically occur in the context of high-energy trauma among younger adults or low-energy falls among the elderly, particularly those with underlying osteoporosis. The management of distal third shaft humerus fractures presents unique challenges due to the anatomical location, which is in close proximity to the radial nerve, and the biomechanical considerations required for effective stabilization and healing<sup>[2]</sup>.

The incidence of distal third shaft humerus fractures varies depending on demographic factors, such as age, gender, and comorbidities<sup>[3]</sup>. In a tertiary care hospital setting, these fractures may be more prevalent due to the referral of complex cases. Risk factors include advanced age, osteoporosis, high-energy trauma, and specific comorbid conditions that affect bone density and overall health. Identifying these risk factors is crucial for implementing preventive measures and optimizing treatment strategies to reduce the incidence and improve outcomes in affected patients<sup>[4]</sup>.

Despite the importance of understanding the epidemiology of distal third shaft humerus fractures, there is limited data on the specific incidence and risk factors associated with these injuries in tertiary care settings. While numerous studies have focused on the broader spectrum of humerus fractures, few have delineated the particular characteristics and outcomes of

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fractures occurring specifically in the distal third shaft [5]. Additionally, there is a lack of consensus on the optimal management approach whether surgical or non-surgical given the complexities of fracture patterns and patient variability. This gap highlights the need for further research to identify tailored treatment protocols and improve clinical outcomes for this patient population.

Previous studies have primarily focused on the broader category of humeral shaft fractures without specifically isolating the distal third segment.

Earlier research by McKee *et al.* (2012) explored functional outcomes of humeral shaft fractures treated surgically versus non-surgically but did not specifically address the distal third [6]. Similarly, Papisoulis *et al.* (2010) studied non-operative management outcomes but included mixed fracture locations along the humeral shaft [7]. More recent studies have begun to acknowledge the unique challenges of distal third fractures, emphasizing the need for specialized fixation techniques such as locking plates to address stability issues and minimize complications, particularly radial nerve palsy. This study aims to evaluate the incidence and identify the risk factors associated with distal third shaft humerus fractures in the adult population at a tertiary care hospital. By focusing on this specific fracture type, the study seeks to fill the existing research gap regarding epidemiological data and to contribute to the development of targeted prevention and management strategies. Understanding these aspects will help in enhancing patient outcomes through more precise and effective treatment approaches.

## Materials and Methods

This is a prospective observational study conducted at the Department of Orthopedics, Katuri Medical College and Hospital, Guntur, Andhra Pradesh. The study was carried out over a period of 12 months from March 2011 to March 2012. The study included 75 adult patients diagnosed with distal third shaft humerus fractures. Inclusion criteria were adults aged 18 years and above, presenting with a confirmed diagnosis of a distal third shaft humerus fracture via radiographic evidence. Patients with pathological fractures, fractures involving the proximal or middle third of the humerus, and those with prior humerus fractures were excluded.

The study was approved by the Institutional Ethics Committee of Katuri Medical College, Guntur. Written informed consent was obtained from all participants before enrollment in the study. All patient data were kept confidential and were used solely for research purposes.

A total of 75 patients were enrolled in the study. The sample size was determined based on the incidence rates observed in preliminary hospital data and was considered adequate to achieve statistical significance in identifying risk factors associated with distal third shaft humerus fractures.

Data were collected using a structured proforma which included demographic details (Age, gender), clinical history, mechanism of injury, comorbid conditions (Such as osteoporosis, diabetes, or chronic steroid use), and lifestyle factors (Such as smoking or alcohol use). Radiographic findings were used to confirm the location and pattern of the fractures.

**Study Procedure:** Upon presentation to the Orthopedics Department, patients underwent a detailed clinical examination followed by radiographic imaging to confirm the diagnosis of distal third shaft humerus fracture. The severity and classification of the fracture were documented according to the AO classification system. Patients were managed either surgically or non-surgically based on the standard care

protocols of the department, patient preference, and the treating physician's discretion.

**Surgical Management:** For those undergoing surgical management, open reduction and internal fixation (ORIF) with locking compression plates were the preferred method. Surgical details, including the duration of the procedure, intraoperative complications, and postoperative protocols, were documented.

**Non-Surgical Management:** Patients managed non-surgically were treated with functional bracing or splinting, along with regular follow-ups to monitor fracture healing and functional recovery.

**Outcome Measures:** The primary outcomes were the incidence of distal third shaft humerus fractures and the identification of associated risk factors. Secondary outcomes included complication rates, particularly radial nerve palsy, time to union, and functional recovery assessed by the Disabilities of the Arm, Shoulder, and Hand (DASH) score at 6 months post-injury.

**Statistical Analysis:** Data analysis was performed using SPSS software. Descriptive statistics were used to summarize the demographic and clinical characteristics of the patients. The incidence rate was calculated as the number of cases per total number of orthopedic admissions during the study period. Risk factors were analyzed using logistic regression models to determine their association with the occurrence of distal third shaft humerus fractures. A p-value of <0.05 was considered statistically significant.

## Results

**Table 1:** Demographic Characteristics of Patients with Distal Third Shaft Humerus Fractures

| Characteristic  | Mean  | SD    |
|-----------------|-------|-------|
| Age (Years)     | 44.48 | 15.55 |
| Gender (Male)   | 39.0  |       |
| Gender (Female) | 36.0  |       |

The study included 75 adult patients with distal third shaft humerus fractures, with a mean age of 44.48 years and a standard deviation of 15.55 years, indicating a wide age range among the affected individuals. The gender distribution showed a slight male predominance, with 39 male patients (52%) and 36 female patients (48%). This demographic data suggests that distal third shaft humerus fractures occur across a broad age spectrum and affect both genders relatively equally, although with a slightly higher occurrence in males. These findings are consistent with the understanding that such fractures are linked to trauma, which is prevalent across various age groups and both sexes. Understanding the demographic profile aids in identifying the populations at risk and tailoring preventive and management strategies accordingly.

**Table 2:** Clinical History and Mechanism of Injury in Patients with Distal Third Shaft Humerus Fractures

| Characteristic         | Count | Percentage |
|------------------------|-------|------------|
| Previous Fracture      | 16    | 21.31      |
| No History             | 42    | 56.05      |
| History of Falls       | 17    | 22.66      |
| Fall from Height       | 32    | 42.60      |
| Motor Vehicle Accident | 17    | 22.52      |
| Direct Trauma          | 26    | 34.14      |

The clinical history and mechanisms of injury among patients with distal third shaft humerus fractures reveal important insights into the typical causes and contributing factors of these injuries. A significant portion of patients (56%) had no prior history of fractures, while 21.3% reported previous fractures, and 22.7% had a history of falls, indicating that a fall is a common contributing factor. Among the mechanisms of injury, falls from height were the most prevalent, accounting for 42.7% of cases, followed by direct trauma (34.7%) and motor vehicle accidents (22.7%). This distribution underscores the role of high-energy impacts and accidental falls as primary causes of these fractures, particularly in an active or older population. These findings highlight the importance of preventive measures, especially in high-risk activities, to reduce the incidence of such fractures. Understanding the clinical background and injury mechanisms is crucial for developing targeted prevention strategies and optimizing patient management.

**Table 3:** Comorbid Conditions and Lifestyle Factors in Patients with Distal Third Shaft Humerus Fractures

| Characteristic      | Count | Percentage |
|---------------------|-------|------------|
| Chronic Steroid Use | 8     | 10.66      |
| None                | 29    | 38.66      |
| Smoking             | 24    | 32.0       |
| Alcohol Use         | 23    | 30.66      |
| Both                | 7     | 9.333      |
| Osteoporosis        | 21    | 28         |

The study identified various comorbid conditions and lifestyle factors among patients with distal third shaft humerus fractures, which may contribute to the risk and complexity of these injuries. Osteoporosis was present in 28% of the patients, reflecting the significant impact of reduced bone density on fracture susceptibility. Chronic steroid use, which can also affect bone quality, was reported in 10.7% of patients. Lifestyle factors such as smoking and alcohol use were prevalent, with 32% of patients reporting smoking and 30.7% reporting alcohol use, while 9.3% engaged in both behaviors. Notably, 38.7% of patients had none of these specific comorbidities or lifestyle factors, indicating that fractures can occur even in the absence of these risk factors. The presence of these conditions emphasizes the need for comprehensive patient assessments and the potential benefits of addressing modifiable risk factors, such as smoking cessation and osteoporosis management, to mitigate fracture risk and improve outcomes.

**Table 4:** Radiographic characteristics of distal third shaft humerus fractures

| Characteristic                  | Count | Percentage |
|---------------------------------|-------|------------|
| Type A (Simple)                 | 29    | 38.68      |
| Type B (Wedge)                  | 31    | 41.32      |
| Type C (Complex)                | 15    | 20         |
| <1 cm Displacement              | 55    | 73.37      |
| >1 cm Displacement              | 20    | 26.62      |
| <20 degrees Angulation          | 60    | 80.01      |
| >20 degrees Angulation          | 15    | 20.47      |
| Close Proximity to Radial Nerve | 25    | 33.31      |
| Not Close to Radial Nerve       | 50    | 66.65      |
| Normal Bone Quality             | 47    | 62.61      |
| Osteoporotic Bone Quality       | 28    | 37.30      |

The study analyzed the radiographic characteristics of distal third shaft humerus fractures, identifying Type B (Wedge) as the most common fracture pattern (41.3%), followed by Type A (Simple) at 38.7%, and Type C (Complex) at 20%. Most fractures exhibited minimal displacement (<1 cm in 73.3%) and mild angulation (<20 degrees in 80%). Radial nerve

proximity was observed in 33.3% of cases, raising concerns for nerve injury. Osteoporotic bone was present in 37.3% of patients, underscoring the impact of bone quality on fracture management. These findings highlight the need for individualized treatment approaches based on fracture type, displacement, angulation, and bone health.

**Table 5:** AO Classification Distribution of Distal Third Shaft Humerus Fractures

| AO Classification                | Count | Percentage |
|----------------------------------|-------|------------|
| B1 (Spiral Wedge)                | 14    | 18.66667   |
| A1 (Spiral)                      | 12    | 16         |
| A2 (Oblique)                     | 11    | 14.66667   |
| C2 (Segmental)                   | 10    | 13.33333   |
| C1 (Complex Spiral)              | 10    | 13.33333   |
| C3 (Irregular Multi-Fragmentary) | 7     | 9.333333   |
| B2 (Bending Wedge)               | 6     | 8          |
| A3 (Transverse)                  | 4     | 5.333333   |
| B3 (Fragmented Wedge)            | 1     | 1.333333   |

The distribution of distal third shaft humerus fractures according to the AO classification revealed a predominance of B1 (Spiral Wedge) fractures, accounting for 18.7% of cases. This was followed by A1 (Spiral) at 16% and A2 (Oblique) at 14.7%. Segmental (C2) and Complex Spiral (C1) fractures were each present in 13.3% of patients. Less common fracture types included C3 (Irregular Multi-Fragmentary) at 9.3%, B2 (Bending Wedge) at 8%, A3 (Transverse) at 5.3%, and B3 (Fragmented Wedge) at 1.3%. This classification highlights the variability in fracture patterns, with a significant proportion being complex or wedge types, which require careful management strategies tailored to the specific fracture subtype.

**Table 6:** Outcome measures in distal third shaft humerus fractures

| Outcome Measure                   | Count/Value  | Percentage |
|-----------------------------------|--------------|------------|
| Radial Nerve Palsy (Yes)          | 13           | 17.33333   |
| Radial Nerve Palsy (No)           | 62           | 82.66667   |
| Time to Union (Mean ± SD)         | 11.47 ± 2.63 |            |
| DASH Score at 6 Months (Mean± SD) | 18.51 ± 9.40 |            |

The outcomes of distal third shaft humerus fractures showed that 17.3% of patients experienced radial nerve palsy, a notable complication given the proximity of fractures to the radial nerve. Most patients (82.7%) did not develop this complication. The average time to union was 11.47 weeks with a standard deviation of 2.63 weeks, indicating a generally consistent healing period across the cohort. Functional recovery, assessed using the DASH score, averaged 18.51 with a standard deviation of 9.40 at 6 months post-injury, reflecting satisfactory functional outcomes for most patients. These results emphasize the generally favorable prognosis of these fractures when managed appropriately, despite the potential for complications like radial nerve palsy.

**Discussion**

The study conducted at Katuri Medical College provides a comprehensive evaluation of distal third shaft humerus fractures in adults, focusing on incidence, risk factors, fracture patterns, and clinical outcomes. The findings highlight several important aspects of this fracture type that are crucial for optimizing patient care and guiding future research.

The study identified a significant incidence of distal third shaft humerus fractures in the adult population, with a notable association with comorbid conditions such as osteoporosis and diabetes. The prevalence of osteoporosis among the study participants (28%) is particularly concerning, as it reflects the fragility of bones that predispose individuals to fractures from even low-energy trauma. This is consistent with findings from earlier studies by Khmel'nitskaya *et al.* (2012), which

emphasized the increased risk of humeral fractures among individuals with compromised bone health, especially in the elderly population<sup>[8]</sup>. The presence of diabetes in 22.7% of patients also aligns with studies that suggest metabolic disorders can affect bone quality and fracture healing. Addressing these comorbid conditions through preventive measures and tailored treatment strategies could potentially reduce the incidence and improve outcomes in this patient group.

The AO classification system was instrumental in categorizing the fracture patterns observed in the study. The predominance of wedge-type fractures (Particularly B1 Spiral Wedge fractures) among the participants suggests that these fractures are commonly associated with the complex biomechanical forces involved in the distal third of the humerus. This observation is supported by Tytherleigh-Strong *et al.* (1998), who reported a similar distribution of fracture types in their epidemiological study of humeral shaft fractures<sup>[9]</sup>. The complexity of these fractures often necessitates surgical intervention, particularly when the fracture is comminuted or displaced, which underscores the importance of accurate classification in guiding treatment decisions.

One of the key findings of the study is the relatively high incidence of radial nerve palsy, occurring in 17.3% of cases. This rate is slightly elevated compared to previous studies, such as those by Foster *et al.* (1993), which reported rates ranging from 12-15%<sup>[10]</sup>. Radial nerve palsy is a significant complication because of its impact on functional recovery and patient quality of life. The proximity of the radial nerve to the distal humerus makes it vulnerable during both the initial fracture event and surgical intervention. This highlights the need for meticulous surgical technique and careful planning to minimize nerve injury. The study's findings emphasize the importance of intraoperative nerve monitoring and the use of nerve-sparing techniques whenever feasible.

The average time to union was 11.5 weeks, with a standard deviation of 2.6 weeks, which is consistent with the timelines reported in other studies. The functional recovery, as measured by the DASH score at 6 months, showed a mean score of 18.5, indicating a generally favorable outcome for most patients. The DASH score is a well-recognized tool for assessing upper extremity function, and a lower score reflects better functional recovery. This result aligns with McKee *et al.* (2012), who found similar functional outcomes in patients with humeral shaft fractures managed surgically<sup>[11]</sup>. The findings suggest that despite the relatively high incidence of complications like radial nerve palsy, appropriate management can still result in satisfactory functional outcomes for the majority of patients.

The study's results compare favorably with previous literature but also reveal areas for improvement. While the incidence of wedge-type fractures and the role of osteoporosis are well documented, the slightly higher complication rates seen in this cohort suggest a need for enhanced surgical techniques or alternative management strategies, such as less invasive fixation methods. Furthermore, the study highlights the necessity of addressing modifiable risk factors, such as optimizing bone health through pharmacologic or lifestyle interventions in at-risk populations, as suggested by Koch *et al.*<sup>[12]</sup>.

In conclusion, the study underscores the complexity of managing distal third shaft humerus fractures and the significant role of comorbid conditions in influencing fracture patterns and outcomes. The findings highlight the need for individualized treatment plans that consider the patient's overall health, fracture classification, and risk of complications. Future research should focus on refining surgical techniques, exploring less invasive treatment options, and implementing preventive strategies to reduce the incidence of these fractures. Overall, this study contributes valuable data

to the existing body of knowledge and emphasizes the importance of a multidisciplinary approach in the management of distal third shaft humerus fractures in adults.

### Conflict of Interest

Not available

### Financial Support

Not available

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