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Original Article

Epidemiology of Closed Metacarpal Fractures in A Tertiary Care Centre

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ABSTRACT

Background: Fractures of the metacarpals represent a significant volume of hand trauma cases managed by orthopaedic surgeons. Displaced closed fractures require careful attention, as improper treatment can lead to long-term functional deficits and anatomical distortion. **Aim:** The objective of this research was to analyse the epidemiological patterns of closed metacarpal fractures among patients admitted to a tertiary care facility. **Materials and Methods:** We conducted a prospective observational analysis over six-month duration at the Department of Orthopaedics, GMC Kathua. The study cohort consisted of 100 individuals between the ages of 18 and 65 presenting with closed fractures of the second through fifth metacarpals. We collected and statistically examined data regarding demographics, injury mechanisms, fracture morphology, and concomitant injuries. **Results:** The study population was dominated by young males (85%). The primary mechanism of injury was road traffic accidents (39%). Injuries to the right hand were significantly more frequent (76%). In terms of anatomical location, the fifth metacarpal was the most frequently fractured bone (41%). The majority of cases presented as isolated injuries without other associated fractures (83%). **Conclusion:** Closed metacarpal injuries are predominantly seen in young men, with vehicular accidents serving as the major precipitating factor. The fifth metacarpal is the most vulnerable bone in this group.

Keywords*: Metacarpal trauma, hand fractures, displaced fractures, injury epidemiology.*

INTRODUCTION

Functional integrity of the hand is essential for performing vocational tasks and activities of daily living; consequently, skeletal injuries involving the hand can significantly compromise a patient's quality of life. Traumatic injuries to the hand and wrist constitute a major proportion of emergency department visits worldwide, accounting for nearly one-third of all injury-related presentations. Among these, fractures of the phalanges and metacarpals represent the most commonly encountered clinical entities in orthopaedic practice **[1,2]**.

Metacarpal fractures predominantly affect younger individuals of working age, particularly males below 40 years, reflecting their greater exposure to occupational hazards, physical activities, and interpersonal violence. This demographic group represents a critical component of the economic workforce, and hand injuries within this population may result in considerable functional disability and socioeconomic burden. Although often regarded as minor injuries, metacarpal fractures carry a substantial risk of long-term functional impairment if inadequately treated **[3–5]**.

The management of metacarpal fractures is challenging due to the complex anatomy and specialised biomechanics of the hand. Treatment decisions are influenced by multiple factors, including the location of the fracture, degree of displacement or angulation, rotational deformity, and associated soft-tissue injury. An inappropriate management strategy may lead to malunion, stiffness, and compromised grip strength, thereby affecting hand function **[6]**.

Conservative treatment remains the standard of care for stable, well-aligned metacarpal fractures and has been shown to yield satisfactory outcomes in selected fracture patterns. However, unstable fractures, those with significant displacement or angulation, irreducible fractures, and fractures associated with rotational deformity often require surgical intervention to restore anatomical alignment and optimise functional recovery **[7–9]**.

Among operative modalities, K-wire fixation is the standard method of treatment whereas low-profile mini-plate osteosynthesis has gained popularity for the fixation of metacarpal shaft fractures as this technique provides rigid stabilisation, allows early mobilisation, and facilitates restoration of hand function. Despite these advantages, postoperative complications—particularly stiffness of the metacarpophalangeal joints—remain a concern, underscoring the importance of early and structured physiotherapy in the postoperative period **[10]**.

Fractures involving the neck of the fifth metacarpal, commonly referred to as boxer's fractures, are among the most frequently encountered injuries in emergency departments. These fractures are often managed conservatively due to their relative stability and acceptable functional outcomes with non-operative care. The fifth metacarpal is the most commonly fractured bone of the hand, accounting for approximately one-quarter of all metacarpal fractures and nearly one-tenth of all fractures overall **[11]**.

MATERIALS AND METHODS

This prospective observational study was executed within the Department of Orthopaedics at Government Medical College, Kathua, spanning a six-month timeline. The study population comprised 100 consecutive patients falling within the 18 to 65-year age bracket who presented with closed fractures involving the second through fifth metacarpals.

Inclusion Criteria

- Patients aged between 18 and 65 years.
- Confirmed closed fractures of the 2nd to 5th metacarpals.
- Patients consenting to participate in the study.

Exclusion Criteria

- Paediatric patients (<18 years) or elderly patients (>65 years).
- Open or compound injuries.
- Fractures extending into the joint surface (intra-articular).
- Injuries involving the first metacarpal (thumb).
- Fractures secondary to pathology (e.g., tumours or cysts).

Data Collection Following the acquisition of ethical clearance and informed patient consent, we proceeded with data collection. Each patient underwent a detailed clinical evaluation to document deformity, soft tissue status, and neurovascular integrity. Diagnosis was substantiated using standard anteroposterior and oblique radiographic views of the hand. All gathered data were subsequently subjected to descriptive statistical analysis.

RESULTS

A total of 100 patients with closed metacarpal fractures were included in the present study conducted over a six-month period. The age of patients ranged from 18 to 65 years, with a mean age of approximately 36 years. The highest incidence was observed in the 18–29 year age group (34%), followed by the 30–39 year group (27%), indicating a clear predominance of these fractures among young adults. A progressive decline in fracture incidence was noted with advancing age [Table 1].

There was a marked male predominance, with 85 male patients (85%) and 15 female patients (15%), resulting in a male-to-female ratio of approximately 5.7:1. The right hand was involved more frequently, accounting for 76 cases (76%), while 24 cases (24%) involved the left hand. No bilateral metacarpal fractures were observed in the study population [Table 2].

Regarding the mechanism of injury, road traffic accidents were the most common cause, responsible for 39 cases (39%), followed by assault in 33 cases (33%) and falls in 28 cases (28%) [Table 3].

Analysis of fracture characteristics showed that the fifth metacarpal was the most commonly involved bone, fractured in 41 patients (41%), followed by the second metacarpal in 27 patients (27%), the fourth metacarpal in 15 patients (15%), and the third metacarpal in 5 patients (5%). Multiple metacarpal fractures were identified in 12 patients (12%) [Table 4]. With respect to fracture pattern, transverse fractures were the most frequently observed, accounting for 50 cases (50%), followed by oblique fractures in 29 cases (29%), spiral fractures in 16 cases (16%), and comminuted fractures in 5 cases (5%).

Most patients presented with isolated metacarpal fractures, seen in 83 cases (83%). Associated injuries were present in 17 patients (17%), with ulna shaft fractures (6%), distal radius fractures (4%), lower limb fractures (4%), and head injuries (3%) being the most commonly associated injuries [Table 5]**.**

Table 1: Age Distribution

Age Group (Years)	Number	Percentage (%)
18–29	34	34
30–39	27	27
40–49	18	18
50–59	13	13
60–65	8	8
Total	**100**	**100**

Table 2: Sex Distribution

Sex	Number	Percentage (%)
Male	85	85
Female	15	15
Total	**100**	**100**

Table 3: Fracture Pattern

Fracture Pattern	Number	Percentage (%)
Transverse	50	50
Oblique	29	29
Spiral	16	16
Comminuted	5	5
Total	**100**	**100**

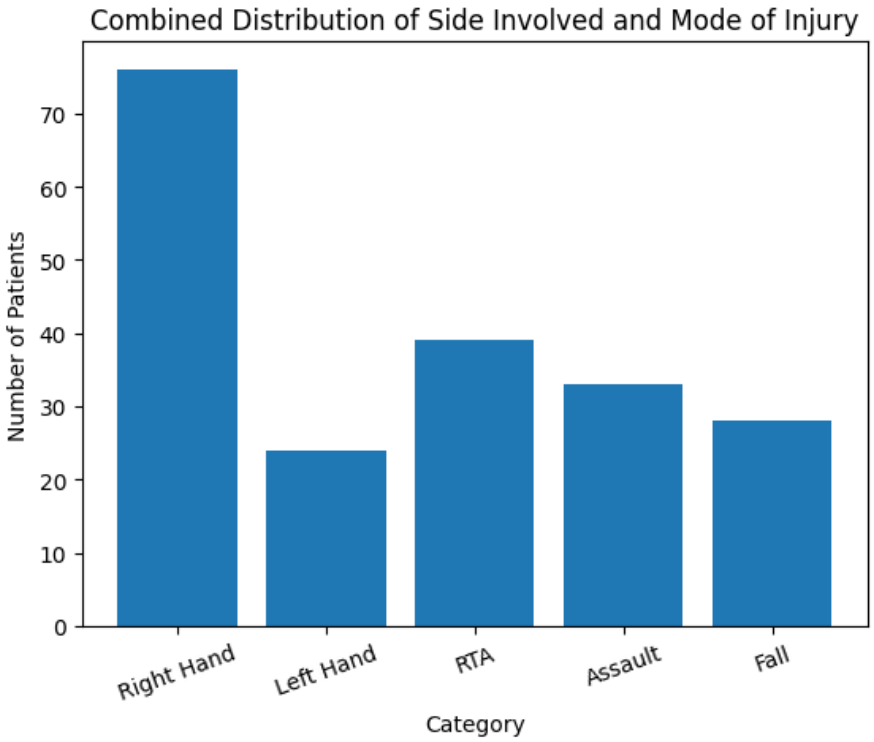
Table 4: Metacarpal Bone Involved

Metacarpal	Number	Percentage (%)
Isolated Second	27	27
Isolated Third	5	5
Isolated Fourth	15	15
Isolated Fifth	41	41
Multiple	12	12
Total	**100**	**100**

Table 5: Associated Injuries

Associated Injuries	Number	Percentage (%)
None	83	83
Ulna shaft fractures	6	6
Distal radius fractures	4	4
Lower limb fractures	4	4
Head injuries	3	3
Total	**100**	**100**

The bar chart illustrates that injuries involving the right hand were significantly more frequent than those involving the left hand. Among the mechanisms of injury, road trafficaccidents constituted the most common cause, followed by assault and falls. This combined illustration highlights both the predominance of right-hand involvement and the leading role of road traffic accidents in closedmetacarpal fractures.



DISCUSSION

Our investigation highlights a strong demographic trend toward young men sustaining these injuries, a finding that likely correlates with higher participation in high-risk outdoor activities and manual labour. The high frequency of road traffic accidents (39%) as the primary mechanism aligns with broader trends in increasing vehicular density and trauma.

The right hand was disproportionately affected, which is likely associated with hand dominance and protective reflexes. The fifth metacarpal neck region(often termed the "boxer's fracture") was the most prevalent injury site; this is attributable to its anatomical exposure and susceptibility to axial loading forces during impact. The high incidence of isolated fractures suggests that while these injuries are forceful, the energy is often dissipated locally within the metacarpal shaft rather than disrupting the entire limb architecture.

In the present study, a clear **male predominance (85%)** was observed, with a higher involvement of the **right hand (76%)**. This finding is consistent with previous studies reporting a greater incidence of metacarpal fractures among young and middle-aged males, which may be attributed to increased exposure to occupational activities, road traffic incidents, and interpersonal violence **[12,13]**. With regard to the mechanism of injury, **road traffic accidents (39%)** constituted the most common cause, followed by **assault (33%)** and **falls (28%)**. These findings highlight the continued importance of preventive strategies aimed at reducing trauma related to vehicular accidents and high-risk activities **[14]**.

Analysis of fracture distribution revealed that the **fifth metacarpal was the most frequently involved bone (41%)**, followed by the second (27%), fourth (15%), and third metacarpals (5%). This predominance of fifth metacarpal fractures is in agreement with existing literature describing the vulnerability of the ulnar metacarpals, particularly in injuries resulting from direct impact mechanisms such as punching or accidental trauma **[15]**. In the present study, **transverse fractures (50%)** were the most commonly observed fracture pattern, followed by oblique (29%), spiral (16%), and comminuted fractures (5%). Although different fracture configurations were identified, assessment of functional outcomes based on fracture type was not within the scope of this study and therefore no direct correlation with recovery patterns could be established, as reported in some previous studies **[16]**.The majority of metacarpal fractures can be successfully treated using **non-operative methods**, particularly when the fractures are stable and show minimal displacement. Injuries involving the **fifth metacarpal** are especially amenable to conservative management in most cases. Nevertheless, surgical treatment becomes necessary in specific situations, such as **intra-articular involvement, polytrauma, extensive soft-tissue damage, open fractures, bone loss, or unstable fracture patterns**. Additionally, fractures that cannot be adequately reduced or those that demonstrate secondary displacement following initial reduction warrant **subacute surgical intervention[17,18]**.

CONCLUSION

In conclusion, this prospective analysis at GMC Kathua establishes that closed metacarpal fractures are a significant source of morbidity among the young adult male population, with a striking 85% male predominance and a mean age of 36 years. This demographic represents the core of the economic workforce, making the timely and effective restoration of hand function a socioeconomic priority. The study identifies Road Traffic Accidents (39%) and Physical Assaults (33%) as the primary drivers of these injuries, with a distinct predilection for the dominant right hand (76%) and the fifth metacarpal (41%).

The anatomical complexity of the hand dictates that treatment must be meticulously tailored to the fracture's morphology; while conservative management remains the standard for stable, non-displaced fractures, the study emphasizes that surgical intervention is required in certain cases. K- wire fixation is the mainstay of operative interventions. Low-profilemini-plate osteosynthesisis indicated for unstable or significantly displaced fractures. This surgical approach is vital to counteract the deforming forces of the intrinsic hand muscles, allowing for early mobilization, which is the single most important factor in preventing joint stiffness and ensuring a return to pre-injury levels of manual dexterity.
Ultimately, these findings highlight the need for targeted trauma prevention strategies and the implementation of specialized orthopaedic protocols to mitigate the long-term functional and economic impact of hand injuries in a tertiary care setting.

Summary of Highlighted Key Points:

- Primary Demographic: Young males (avg. age 36) are most at risk, representing the economically active population.
- Dominant Injury Site: The 5th Metacarpal (41%) is the most frequent site of injury, largely due to its susceptibility to axial loading forces during impact and exposure during impact.
- Leading Causes: High-energy trauma from Road Traffic Accidents and Assaults account for over 70% of cases.
- Mainstay Of Treatment: Closed methods using POP splints.
- Standard Operative Intervention: K-wire fixation fordisplaced and unstable fracture patterns especially transverse fractures and fractures with dorsal angulation.
- The "Gold Standard" for irreducible fractures and fractures with secondary displacements: Surgical stabilization with mini-plates is preferred to allow for immediate postoperative physiotherapy.
- Clinical Goal: The priority is not just "bone healing" but the prevention of stiffness and the restoration of grip strength.

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