SurgiColl
SURGICAL COLLECTIVE

Nemirov D, Kasper A, Siddiqui H, Ilyas AM. Evaluation of Isolated Metacarpal Fracture Characteristics: An Analysis of 4441 Consecutive Patients. *SurgiColl*. 2024;2(2). doi:10.58616/001c.88852

Research Articles

Evaluation of Isolated Metacarpal Fracture Characteristics: An Analysis of 4441 Consecutive Patients

Daniel Nemirov, MD[1][a], Alexis Kasper, BS[1], Hassan Siddiqui, BS[1], Asif M Ilyas, MD MBA[1]

[1] Rothman Orthopaedic Institute, Thomas Jefferson University, Philadelphia, PA, USA

Keywords: Hand, fracture, metacarpal, incidence, epidemiology

https://doi.org/10.58616/001c.88852

SurgiColl

Vol. 2, Issue 2, 2024

Objectives

This study aimed to assess the current epidemiologic attributes of isolated metacarpal fractures. Patient and fracture-related characteristics were included.

Methods

Patients presenting consecutively to a single large academic practice over five years with single acute metacarpal fractures were retrospectively reviewed. Baseline demographics and fracture-specific data were collected, including metacarpal involvement, location (base, neck, shaft), fracture laterality, and displacement. Patient data was compiled using CPT and ICD codes.

Results

A total of 4441 patients were included. The average patient age was 42.4 (with a standard deviation of 22.2 years), and most patients who were treated for metacarpal fractures in this investigation were men (2848/4441; 64.1%). The average BMI was 26.0 (± 5.87). Metacarpal fractures occurred most frequently on the right hands of patients (2778/4441; 62.6% of all fractures), and 51.7% of all fractures under investigation were displaced (2295/4441). Fractures of the fifth metacarpal were the most common (57.7% of all metacarpal fractures). Fractures of the fourth metacarpal were the second most common (17.0% of all fractures). Subsequently, in descending order of frequency, were third, first, and second metacarpal fractures (9.3%, 9.2%, and 6.5%, respectively). Fractures of the metacarpal shaft were most common by a narrow margin, followed by those of the metacarpal neck (36.5% and 35.1%, respectively). Fractures of the metacarpal base occurred least, but not uncommonly, in this study (27.1%).

Conclusions

This large-volume practice retrospective review identified the most common isolated metacarpal fracture presentation as the fifth metacarpal fracture in male patients, involving the shaft and neck.

Level of Evidence

III

INTRODUCTION

Hand fractures are considered among the most common presenting injuries in emergency departments.[1-3] Metacarpal fractures comprise a large subset of this patient population, most commonly as a sequelae of accidental falls or a direct blow.[2-4] Management strategies are predicated upon several patient-specific factors but largely are

a Corresponding Author:
Daniel Nemirov, MD
Rothman Orthopaedic Institute, Thomas Jefferson University, Philadelphia, PA, USA
925 Chestnut Street, 5th Floor, Philadelphia, USA
dxn038@jefferson.edu

driven by fracture morphology, stability, location, and concomitant surrounding soft tissue injury.

It has been demonstrated that in the setting of fractures to the hand, injury of the metacarpal bones occurs in 18-44% of patients.[2,5,6] Specifically, fractures of the fifth metacarpal are seen most frequently, with a preferential skew towards children, adolescents, and young adults.[3,6-9] In a 2007 prospective study, Stanton *et al.* investigated the patterns of digital fractures and their displacement across four age groups.[7] However, as their investigation aimed to elucidate tubular fractures of the hand in their entirety, only 309 metacarpal fractures were ultimately included, highlighting the need for further research.

Management strategies of metacarpal fractures are unique in hand and upper extremity surgery, given the range of angulations that can be managed nonoperatively without compromising long-term outcomes and the ongoing evolution of acceptable alignment parameters. Non-articular, stable metacarpal fractures in isolation have traditionally been managed conservatively with strategies including splinting, immobilization, pain control, and physical therapy.[10-12] Conversely, fractures with increasing articular involvement, displacement, angulation, and concurrent soft tissue disruption often warrant operative intervention. However, as the goals of management and our understanding of this fracture continue to evolve, it has become clear that no true consensus regarding metacarpal fracture treatment exists.[10]

A more complete understanding of epidemiological and morphological data is warranted to optimize management strategies and treatment of metacarpal fractures. Despite the regularity with which metacarpal fractures are seen and managed, there is a relative lack of current epidemiological data on the topic.[2,3,6] this study aims to elucidate the character and locations of isolated metacarpal fractures with the hopes of augmenting the epidemiologic foundations on the subject.

METHODS

Institutional review board approval was secured prior to proceeding with this retrospective study. Patients presenting with a single and new metacarpal fracture treated between 2017 and 2021 at a single academic institution were included for analysis, yielding 4441 cases. Baseline demographic data, patient-specific risk factors, and fracture morphological data were retrospectively collected. Baseline demographic data included age, race, sex, body mass index (BMI), smoking status, and history of diabetes. Diabetic and smoking history was self-reported by patients. Exclusion criteria included patients with multiple metacarpal fractures, concurrent bony injuries to the hand or upper extremity, and patients who presented following previously failed management of subacute and chronic metacarpal fractures.

Fracture laterality, presence of displacement, which metacarpal was affected, and at what location was documented for each patient. Displacement was recorded in a binary fashion, with any degree of displacement being considered as a displaced fracture. Metacarpal involvement was delineated one through five. Fracture location was recorded as either “base,” “shaft,” or “neck.”

Descriptive statistics were performed on all epidemiologic data.

Table 1. Preoperative demographics. Continuous data is presented as mean (standard deviation), and categorical data is presented as cell count (%).

	Total Patients (N=4441):
Age	42.3 (± 22.2)
BMI	26.0 (± 5.87)
Sex	
Female	35.9% (1593/4441)
Male	64.1% (2848/4441)
Diabetes	
Yes	5.1% (227/4441)
No	79.4% (3524/4441)
Unknown	15.9 (690/4441)
Laterality	
Right	62.6% (2778/4441)
Left	35.4% (1573/4441)
Unknown	2.0% (90/4441)
Displacement	
Yes	51.7%% (2295/4441)
No	47.0% (2088/4441)
Unknown	1.3% (58/4441)

RESULTS

The average patient age was 42.4 (with a standard deviation of 22.2 years) [Table 1]. Most patients treated for metacarpal fractures in this investigation were men (2848/4441; 64.1%). The average BMI of the patients included in the study was 26.04 (± 5.87).

The percentage of patients under investigation identified as “white” was 69.0%. Of the study population, 5.1% of patients had a self-reported history of diabetes. Regarding laterality, metacarpal fractures occurred most frequently on the right hands of patients (2778/4441; 62.6% of all fractures), while 51.7% of all fractures under investigation were considered displaced (2295/4441).

Fractures of the fifth metacarpal were the most common in the present investigation. 57.7% of all metacarpal fractures were in the fifth metacarpal (2562/4441) [Figure 1]. The second most common metacarpal involved was the fourth metacarpal, which constituted 17.0% of all fractures. Fractures of the third and first metacarpal were similar in frequency at 9.3% and 9.2% of all fractures, respectively. The second metacarpal was the least commonly fractured (6.5%).

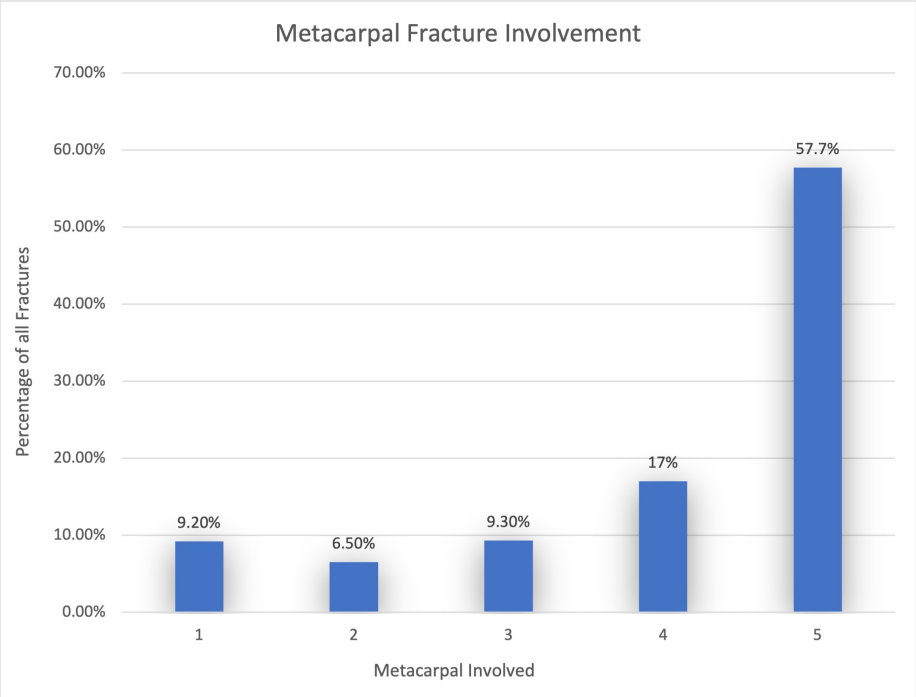

Figure 1. Relative frequency of metacarpal fractures broken down by metacarpal involvement. Fractures of the fifth metacarpal were most encountered. 99.7% of all patient fracture location-specific data was captured.

By a narrow margin, fractures of the metacarpal shaft were the most common metacarpal fracture location (36.5% of all fractures) [Figure 2]. The following most frequently encountered fracture locations were fractures of the metacarpal neck, seen in 35.1% of patients. Finally, fractures of the metacarpal base were the least common, seen only in 27.1% of all metacarpal fractures in the present investigation.

DISCUSSION

Metacarpal fractures are common presenting injuries warranting management in both the emergency room and outpatient clinical setting. The present study is among the largest inquiries into the epidemiology of isolated metacarpal fractures and provides critical data for better characterizing and understanding this pathology and associated clinical presentation.

In the present study, isolated fractures of the fifth metacarpal were the most common, comprising 57.7% of all fractures, with a significant male predominance (64.1%) corroborating the literature data.[2,3,5-7,9] Prior investigations have demonstrated that these fractures are classically seen in the setting of non-accidental trauma and are classically referred to as boxer's fractures.[6] In this study, as no information was collected regarding the underlying etiology of patients' presenting injury, no comment can be made on whether a similar trend was present. Fractures of the metacarpal neck are typically stable fractures and relatively tolerant to angulation.[5,13-17] Furthermore, data supports acceptable outcomes with nonoperative management of these injuries with angulation as high as 70 degrees.[5,13,14]

The other major finding this study presents is regarding the breakdown of metacarpal fracture location. Fractures of the metacarpal shaft were most common in the present study (36.5%), followed closely by those of the metacarpal neck (35.1%). This is a finding with significant clinical implications. Fractures of the metacarpal shaft are less tolerant of both shortening and angulation when compared to their metacarpal neck counterparts.[5,11,15] Thresholds for surgical management of metacarpal shaft fractures vary throughout the literature. However, generally, angulation of 10°-20° in the second or third finger metacarpal shaft or angulation greater than 30°-40° in the fourth or fifth metacarpal shaft are accepted indications. Given the relatively high incidence of these fractures, coupled with a lower threshold to operate on these injuries, a rigorous understanding of the epidemiology of these injuries is needed to anticipate best, triage, and manage these patients.

The strength of this study is its large size and consecutive nature. However, the study has several limitations. This retrospective population study lacked controls or study groups, thereby providing only descriptive data. All data was recorded from a single institution, which could limit generalizability to other regions. Notably, this data represents patients who presented to the outpatient clinic; this likely creates an underlying selection bias and does not necessarily encapsulate all metacarpal fracture incidence in its entirety. Similarly, only patients presenting with a single metacarpal were included for analysis to better understand fracture characteristics.

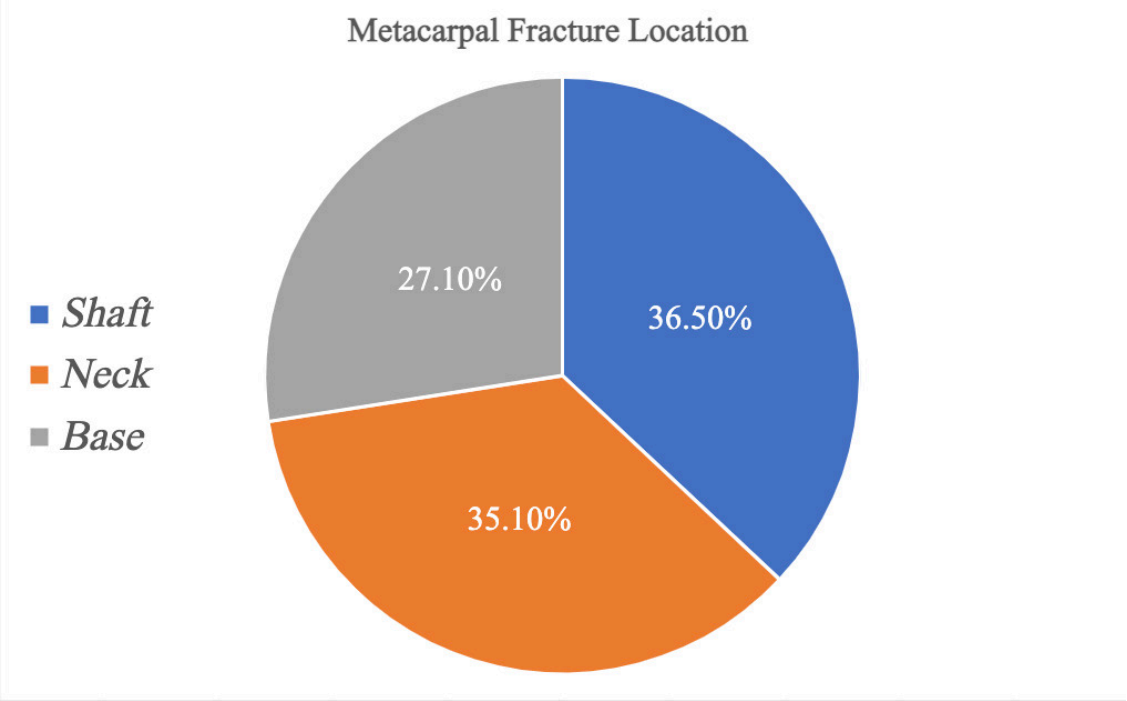

Figure 2. Relative frequency of metacarpal fractures broken down by metacarpal location. Fractures of the metacarpal shaft and neck were most encountered. 98.7% of all patient fracture location-specific data was captured.

CONCLUSION

This study supports the concept that isolated metacarpal fractures are most often encountered in the fifth metacarpal of men, most commonly at the metacarpal shaft and neck. The findings presented here provide epidemiological insight into the relative frequency and incidence of a fracture commonly encountered by Orthopaedic Surgeons, Hand Surgeons, Emergency Room physicians, other physicians, as well as policymakers. Given these results, studies are recommended to optimize the management of fifth metacarpal fractures.

DECLARATION OF CONFLICT OF INTEREST

The authors do NOT have any potential conflicts of interest for this manuscript.

DECLARATION OF FUNDING

The authors received NO financial support for the preparation, research, authorship, and publication of this manuscript.

DECLARATION OF ETHICAL APPROVAL FOR STUDY

IRB #13D.432 was obtained prior to study initiation.

DECLARATION OF INFORMED CONSENT

There is no information (names, initials, hospital identification numbers, or photographs) in the submitted manuscript that can be used to identify patients or participants.

Submitted: August 13, 2023 EDT, Accepted: October 08, 2023 EDT

REFERENCES

1. Angermann P, Lohmann M. Injuries to the hand and wrist. A study of 50,272 injuries. *J Hand Surg Br*. 1993;18(5):642-644. doi:10.1016/0266-7681(93)90024-a

2. Chung KC, Spilson SV. The frequency and epidemiology of hand and forearm fractures in the United States. *J Hand Surg Am*. 2001;26(5):908-915. doi:10.1053/jhsu.2001.26322

3. Hove LM. Fractures of the hand. Distribution and relative incidence. *Scand J Plast Reconstr Surg Hand Surg*. 1993;27(4):317-319. doi:10.1080/02844311.1993.12005647

4. Nakashian MN, Pointer L, Owens BD, Wolf JM. Incidence of Metacarpal Fractures in the US Population. *Hand (New York, N,Y)*. 2012;7(4):426-430. doi:10.1007/s11552-012-9442-0

5. Kollitz KM, Hammert WC, Vedder NB, Huang JI. Metacarpal fractures: treatment and complications. *Hand (N Y)*. 2014;9(1):16-23. doi:10.1007/s11552-013-9562-1

6. Gudmundsen TE, Borgen L. Fractures of the fifth metacarpal. *Acta Radiol*. 2009;50(3):296-300. doi:10.1080/02841850802709201

7. Stanton JS, Dias JJ, Burke FD. Fractures of the tubular bones of the hand. *J Hand Surg Eur Vol*. 2007;32(6):626-636. doi:10.1016/j.jhse.2007.06.017

8. Frazier WH, Miller M, Fox RS, Brand D, Finseth F. Hand injuries: incidence and epidemiology in an emergency service. *JACEP*. 1978;7(7):265-268. doi:10.1016/s0361-1124(78)80336-0

9. Bowman SH, Simon RR. Metacarpal and phalangeal fractures. *Emerg Med Clin North Am*. 1993;11(3):671-702. doi:10.1016/s0733-8627(20)30473-9

10. Neumeister MW, Winters JN, Maduakolum E. Phalangeal and Metacarpal Fractures of the Hand: Preventing Stiffness. *Plast Reconstr Surg Glob Open*. 2021;9(10):e3871. doi:10.1097/gox.0000000000003871

11. Jones NF, Jupiter JB, Lalonde DH. Common Fractures and Dislocations of the Hand. *Plastic and Reconstructive Surgery*. 2012;130(5):722e-736e. doi:10.1097/prs.0b013e318267d67a

12. Taghinia AH, Talbot SG. Phalangeal and Metacarpal Fractures. *Clinics in Plastic Surgery*. 2019;46(3):415-423. doi:10.1016/j.cps.2019.02.011

13. Poolman RW, Goslings JC, Lee J, Statius Muller M, Steller EP, Struijs P a A. Conservative treatment for closed fifth (small finger) metacarpal neck fractures. *Cochrane Database Syst Rev*. 2005;2005(3):CD003210. doi:10.1002/14651858.cd003210.pub3

14. Hunter JM, Cowen NJ. Fifth metacarpal fractures in a compensation clinic population. A report on one hundred and thirty-three cases. *J Bone Joint Surg Am*. 1970;52(6):1159-1165. doi:10.2106/00004623-197052060-00008

15. McNemar TB, Howell JW, Chang E. Management of metacarpal fractures. *J Hand Ther*. 2003;16(2):143-151. doi:10.1016/s0894-1130(03)80009-1

16. Ben-Amotz O, Sammer DM. Practical Management of Metacarpal Fractures. *Plast Reconstr Surg*. 2015;136(3):370e-379e. doi:10.1097/prs.0000000000001527

17. McKerrell J, Bowen V, Johnston G, Zondervan J. Boxer's fractures--conservative or operative management? *J Trauma*. 1987;27(5):486-490. doi:10.1097/00005373-198705000-00005