Crimson Publishers
Wings to the Research

Editorial

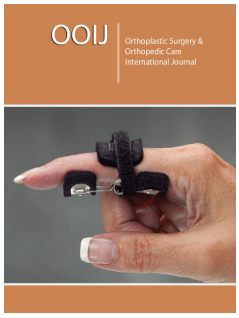
Unstable Fractures of Fifth Neck Metacarpal (Boxer Fracture): A New Classification System

Kastanis G[1]* and Pantouvaki A[2]

[1]Department of Orthopaedic, General Hospital of Heraklion -Venizeleio, Greece

[2]Department of Physiotherapy, General Hospital of Heraklion -Venizeleio, Greece

ISSN: 2578-0069



***Corresponding author:** Grigorios Kastanis, Department of Orthopaedic, General Hospital of Heraklion -Venizeleio, Crete, Greece

Submission: March 22, 2021
Published: April 08, 2021

Volume 2 - Issue 3

How to cite this article: Kastanis G, Pantouvaki A. Unstable Fractures of Fifth Neck Metacarpal (Boxer Fracture): A New Classification System. Ortho Surg Ortho Care Int J . 2(3). OOIJ.0005387. 2021.
DOI: 10.31031/OOIJ.2021.02.000537

Abstract

The fifth metacarpal neck fractures or Boxer fracture is the most common injury of upper extremity fracture treated in the emergency department. It usually occurs in young population with aggressive conduct. The majority of them are stable and the conservative treatment is the gold standard while the unstable fractures need operative intervention, but an important hypothetical question is posed. Are all these fractures the same or do they differ? In literature there is not clear classification about the pattern or the type of fifth metacarpal neck fractures. The aim of this study is to present a classification system based on the type of fractures and the most appropriate method of fracture fixation, with the scope to achieve the goal of treatment which is the full range of motion and return to previous functional status.

Keywords: Metacarpal neck fractures; Boxer's fracture; Classification system; Operative treatment

Introduction

Metacarpal fractures are common orthopaedic injuries treated in the emergency department with an incidence of 18%-44% of all hand fractures and 23% of forearm fractures [1]. Metacarpal neck fractures are present and account to 10% of all hand fractures and 25%-36% of all metacarpal fractures [2]. Index, middle and ring metacarpal neck fractures account to 6%,2% and 5% respectively while little finger is the most commonly involved and accountsto 25% of the overall total [1,3]. The Fifth Metacarpal Neck Fracture (FMNF) also called "Boxer fracture" occurs usually in young population with aggressive conduct. The paradox is that professional boxer's present fracture of neck in the index finger and not in the little finger of the hand.

Male individuals have five times higher incidence than females, while the mean male age with the greater incidence ranges from 19 to 29 years old [4]. It occurs most commonly after alcohol intake and violence and also at athletic events [2,5]. The main typical cause of this fracture is fighting, following by sporting injury, a traffic accident and rarely falls [6]. During direct blow to solid object or another person, an axial load is transmitted to metacarpal bone through knuckle, resulting fracture at the metacarpal neck area with dorsal angulation in apex, due to the forces exerted by the pull of the interosseous muscles [7,8]. Displaced FMNFs lead to rotational malalignment, volar angulation, loss of extension range of motion, loss of strength and cosmetic distortion with loss of prominence of fifth metacarpal [9].

Despite the fact that volar angulation lead to metacarpal shortening, the transition zone between shaft and the distal segment has not been defined [10,11]. A thorough search was carried out through the electronic databases of Pubmed, Cochrane libraries, Google Scholar from January 2000 to December 2020 using the following keywords «fifth metacarpal neck fractures " AND "Boxer fractures" AND "Classification fifth neck metacarpal fractures" and 1162 reviews or research articles were retrieved. Only one manuscript refers a classification for the metacarpal fractures from the Orthopaedic Trauma Association (OTA) according to which, metacarpal fractures are divided into distal, shaft and proximal segments [12]. All these manuscripts report their aspects to the topic indirectly, presenting results either by applying a therapeutic method (conservative or surgical) or comparing implant interventions. No researcher actually mentions any clear fracture pattern so can

anyone really draw safe conclusions about the proper treatment? Kvernmo ok that the fact of unclear diagnostic fracture pattern leads to erroneous conclusions comparing different studies, which hypothetically referred to the same topic mentioned as the fifth metacarpal neck fractures [10]. Sletten et al. [11] reported that metacarpal neck area is defined as the squared distance between the insertions of the collateral ligament in the metacarpal head. We believe that the OTA classification is very general based on the anatomical elements of the bone and does not define any type of fracture which occurs in subcapital area of fifth metacarpal bone. In the present article a new classification system is proposed based on the fractures pattern observed and the most appropriate method of these fractures fixation is also suggested with the scope toachieve the goal of treatment which is the full range of motion and returning to previous functional status.

Classification System of 5th Neck Metacarpal Fracture

The study was performed at the Orthopaedic department of General Hospital of Heraklion- "Venizeleio" from January 2013 to December 2019. The Institutional Ethical Committee approved the study. Inclusion criteria were adults more than 18 years old with a traumatic unstable fracture of neck of fifth metacarpal (less than 10 days) and multiple fractures involving other metacarpals. Exclusion criteria included patients who had a history of metabolic bone disease, age <18 years with fracture of immature bone; old or operated fractures, neurologic involvement, or inability to return for follow-up care. One hundred twenty three patients wereincluded in this study. One hundred twelve were males and eleven were females, with an average of 29 years old (range 20-54yrs old). The main cause of injury was punching a hardsurface with a clenched fist, and the second statistical cause, was sport contact injuries. The right hand was involved in 100 and the left in 23 cases. In four cases the fracture was bilateral and caused by violent fight. In seven cases the fractures were open classified by Gustilo & Anderson in Grade 1(5 cases (4%)) and letter I (2 cases (1,6%)). Twelve patients were presented with a diaphyseal fracture of 4th metacarpal and fracture of neck of fifth (Table I).

Table 1: Demographic characteristics of patients.

Gender(male/female)		112/11(91,1%/8,9%)
Mean Age		29(18-54)
Hand Involved (Rigth/Left)		101/22(82,1%/17,9%)
Hand Dominance (Rigth/Left)		100/23
Open Injuries		7(5,7%)
Bilateral		4(3,25%)
4th Metacarpal		12(9,8%)
Cause	Sport Injuries	22(17,9%)
	Vehicle Accident	16(13%)
	Punching a hard surface with a clenched fist	85(69,1%)

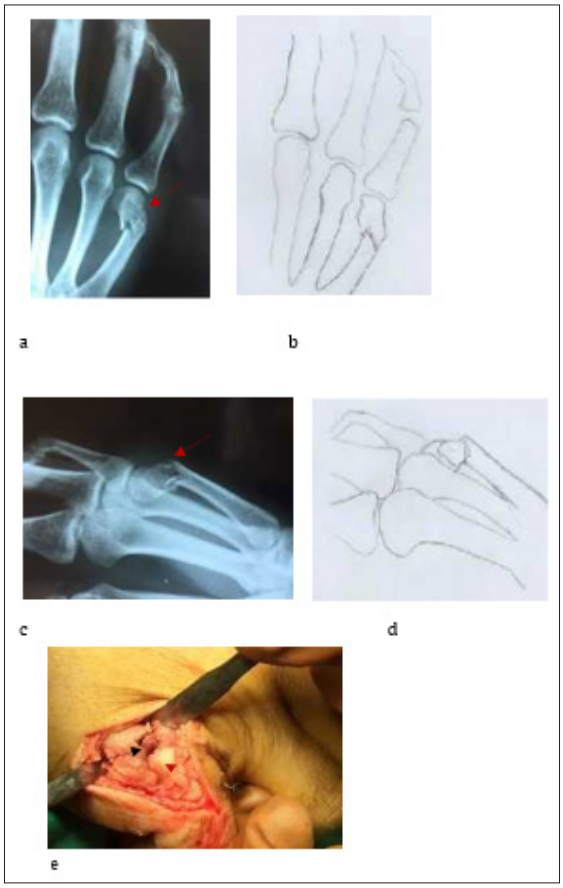


Figure 1: Type I fractures x-Rays (red arrow) AP (a,b), Oblique (c,d), (e) surgical evidence (dorsal comminution of neck - black arrow, head of metacarpal red arrow).

Initial radiographic examination with Anteroposterior (AP) and lateral radiographs were performed. With preoperative x-rays data and during surgical procedure findings, we noticed that all the fractures did not have the same type in terms of comminution, fracture line, and localization of fracture and seem different referring to the neck of fifth metacarpal. We classified all these fractures in three categories based on the fracture pattern mentioned above. We suggest as Type I, the fracture in which line extends obliquely from dorsal surface of the neck and expands proximally to diaphyses. In dorsal surface, there is comminution and in this area of metacarpal neck, the cancellous bone disappears (eggshell) while in volar surface there is more integrity respectively. In majority of cases the fracture presents also rotational deformity and a volar angulation (Figure 1). We suggest as Type II, the fracture in which line extends more proximally to diaphyses of metacarpal, without significant comminution and in the majority of fracture there is a volar angulation (Figure 2). We suggest as Type III, oblique fracture in which the proximal segment includes the head and neck of fifth metacarpal and presents shortening of the bone length and rotational deformity (Figure 3), (Table 2). In cases where simultaneous fractures of 4th diaphyseal metacarpal exist, the metacarpal neck fracture was type I.

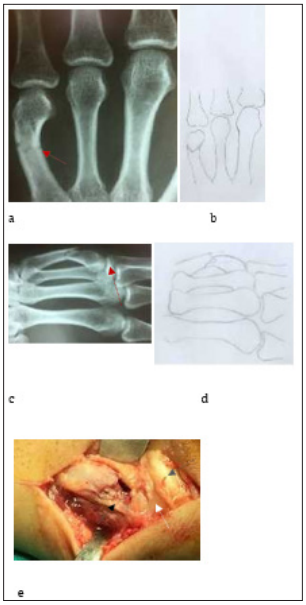


Figure 2: Type II fracture, x-Rays (red arrow) AP (a,b), Oblique (c,d), surgical evidence (black arrow fracture, white arrow neck 5th metacarpal, grey arrow extensor digit minimi) (e).

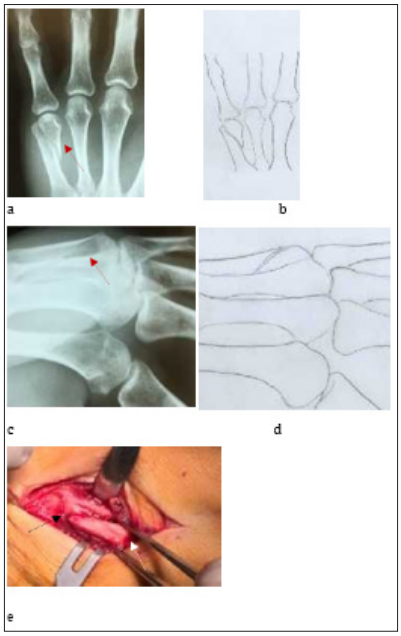


Figure 3: Type III fracture, x-Rays (red arrow) AP (a,b), Oblique (c, d), surgical evidence (black arrow oblique fracture of 5th metacarpal, white arrow head of metacarpal) (c).

Table 2: Classification of fractures.

Type of fracture	Percentage
Type I	62(50,4%)
Type II	38(30,9%)
Type III	23(18,7%)

Author's Surgical Treatment Option

All operations were performed by author and the indications of surgical treatment were: angulation more than 40°, shortening >3mm, rotational deformity and open injuries. After regional anesthesia and tourniquet hemostasis control, all fractures were operated with dorso-ulnar approach (except four cases with type I fracture) with preservation of collateral ligament. In all cases the internal fixation was provided with plates (locking and convectional) and screws (Table 2). In "type I" fracture and in 32 cases the implants were blade plate convectional, while in rest cases anatomical locking plate was used. In this group of fractures the implant was applied in ulnar side of metacarpal in 56 cases and in the rest cases the implant was applied on dorsal side of the bone but with 3 screws on the neck area. In "type II" fractures a locking plate in dorsal side of the metacarpal bone was applied in twelve cases (with two or three locking screws in head of metacarpal), while in the rest cases it was appliedin ulnar side (in 11 patients the plate was convectional and in 9 locking plate). In six cases from this category of fractures a mini osteosynthesis is performed with retrograde intramedullary headless cannulated screws.

In "Type III' fracture a lag screw was applied in all cases which compress the oblique fracture line and a plate was added to support the fracture. In thirteen cases the screw applied separate (ulnar) and the implant in dorsal side while in the rest cases, it was applied threw the plate in ulnar side of the bone.

Postoperatively a palmar splint was worn for 5-7 days in order to assist soft tissue healing while passive range of motion exercises of the digits were initiated from the second postoperative day. The sutures were removed in two weeks and functional support was applied to protect the fixation until union. In this period all the patients started a rehabilitation program which included scar tissue management, edema control, continuous passive movement, self-assisted and active exercises of fingers and home exercise program. The median time of fracture union was 5,2 weeks.

In international literature the ideal management of boxer fracture is still a matter of debate.[14] In recent years as the surgical technology progresses, implants are developed (low profile locking plates) for these specific fractures. Internal fixation of FMNF is based on the presumption that restoration of anatomy of metacarpal bone and metacarpophalangeal joint with early mobilization of digits was achieved and wrist will improve the ultimate functional outcomes. Another reason for increased number of the internal fixation it was the better understanding of biomechanical principles of internal fixation.[15] International literature presents many reports which describe a wide range of surgical techniques for the treatment of FMNF: intramedullary K-wires, transverse K-wires, tension band, locked intramedullary nailing, external fixation, and locking plate fixation [13].

Zong et al. [14] report a meta- analysis of six studies and suggest that locking plate is the first choice of surgical fixation of FMNF [14]. These literature reviews compared all therapeutic procedures based on criteria such as: complications (infection, refracture, tendon injury, revision surgery, complex regional pain syndrome), cost effective, time to healing and time to return in daily activities [14-17]. The major complication is secondary volar angulation post surgery which cause functional limitation of 5th metacarpophalangeal joint [18]. Zhu et al. [18] compared internal fixation of FMNF applied dorsal locking plates with two and three locking screws in neck metacarpal area to determinate the final angulation, and he suggested that "the fixation with three distal locking screws could decrease the percentage of secondary displacement and improve clinicaloutcomes". It was also recommended in order to achieve the three-screw fixation of distal fragment, T-shaped plates (three distal holes) should be adopted instead of Y-shaped (two distal holes) plates. In our series we have posted operative volar angulation only in type I fractures and in four cases, but the plate was applied in ulnar side of the bone and the two locking screws were cut out. The paradox in this case was that the patients have full range of motion [19,20].

Finally, our suggestion for the surgical treatment is in type I fracture condylar blade plate inulnar side of the bone or dorsal locking plate with three distal screws in, to avoid postoperative angulation. In type II locking low profile plates or fracture antegrade intramedullary nail seems clinically to be an effective surgical procedure. The retrograde intramedullary headless cannulated screw is also a promising technique. In type III that the oblique line of the fracture must be restored to secure the initial length of bone a lag screw is obligatory to use for this reason and final a plate to secure the osteosynthesis must be performed. An alternative surgical procedure with antegrade intramedullary nail with two or three K-wires or an antegrade locking intramedullary nail is our surgical suggestion.

Conclusion

Fifth metacarpal neck fracture is the most common type of hand injury met in emergency department. It seems that every pattern of this fracture is not the same, so conclusively the therapeutic options should be different for best functional outcomes. In this article a new classification system is proposed which is based on the clearest definition of the main characteristics of fracture patterns in fifth metacarpal of the hand. The scope of this new suggested classification system is to define in details the type of fracture in order to choose the best surgical treatment achieving the goal of treatment which is the full range of motion and the regaining of previous functional mobility.

Conflict of Interest

The authors declare that have no conflict of interest.

Acknowledgments

We gratefully acknowledge the assistance of Miss Evagelia Kastani for her helpful sketchingin this manuscript.

Ethical Approval

Our institution does not require ethical approval for reporting individual cases or case series.

References

1. Padegimas EM, Warrender WJ, Jones CM, Ilyas AM (2016) Metacarpal neck fractures: a review of surgical indications and techniques. Arch Trauma Res 5(3): e32933.
2. Gudmundsen TE, Borgen L (2009) Fractures of the fifth metacarpal. Acta Radiol 50(3): 296–300.
3. Schadel Hopfner M, Wild M, Windolf J, Linhart W (2007) Antegrade intramedullary splinting or percutaneous retrograde crossed pinning for displaced neck fractures of the fifth metacarpal? Arch Orthop Trauma Surg 127(6): 435-440.
4. Nakashian MN, Pointer L, Owens BD, Wolf JM (2012) Incidence of metacarpal fractures in US population. Hand (NY). 7(4): 426-430.
5. Cotterell IH, Richard MJ (2015) Metacarpal and phalangeal fractures in athletes. Clin Sport Med 34(1): 69-98.
6. Farag HE, Essawy OM (2015) Fifth metacarpal fractures: Treatment by low cost syringe fixator. Al – Azhar Assiut Medical Journal 13(Suppl 2): 134-138.
7. Kamath JB, Harshvardhan, Naik EM, Bansal A (2011) Current concepts in managing fractures of metacarpal and phalanges. Indian J Plast Surg 44(2): 203-211.
8. Malik S, Herron T, Rosenberg N (2021) Fifth metacarpal fractures. Stat Pearls Publishing 29261999.
9. Amsallem L, Pierrart J, Bihel T, Sekri J, Lafosse T, et al. (2018) Simplified internal fixation of fifth metacarpal neck fractures. Orthop Traumatol Surg Res 104(2): 257-260.
10. Kvernmo HD (2018) Metacarpal neck fractures. In: Michel EH (edt.) Fractures of the hand and carpus. FESSH 2018 Instructional Course Book, Thieme E-Books, Algeria.
11. Sletten IN, Hellund JC, Olsen B, Clementsen S, Kvernmo HD, et al. (2015) Conservative treatment has comparable outcomes with bouquet pinning of little finger metacarpal neck fractures: a multicentre randomized controlled study of 85 patients. J Hand Surg Eur 40(1): 76-83.
12. Marsh JL, Slongo TF, Agel J, Broderick JS, Creevey W, et al. (2007) Facture and dislocation classification compendium 2007: Orthopaedic Trauma Association classification database and outcomes committee. J Orthop Trauma 21(10 Suppl): S1-133.
13. Zhu H, Bao B, Zheng X (2017) Three screws versus two screws fixation of distal fragment in fifth metacarpal neck fractures stabilized with locking plate. Sci Rep 7(1): 12516.
14. Zong SL, Zhao G, Su LX, Liang WD, Li LG, et al. (2016) Treatments for the Fifth Metacarpal Neck Fractures: A Network Meta-analysis of Randomized Controlled Trials. Medicine Baltimore 95(11):e3095.
15. Corkum JP, Davison PG, Lalonde DH (2013) Systematic review of the best evidence in intramedullary fixation for metacarpal fractures. Hand (N Y) 8: 253–260.
16. Facca S, Ramdhian R, Pelissier A, Diaconu M, Liverneaux P (2010) Fifth metacarpal neck fracture fixation: locking plate versus K-wire? Orthopaed Traumatol Surg Res 96(5): 506–512.
17. Kollitz KM, Hammert WC, Vedder NB, Huang JL (2014) Metacarpal fractures: treatment and complications. Hand (N Y). 9(1): 16–23.
18. Zhu H, Xu Z, Wei H, Zheng X (2017) Locking plate alone versus in combination with two crossed Kirchner wires for fifth metacarpal neck fracture. Sci Rep 5(7): 46109.
19. Sletten IN, Nordsletten L, Husby T, Ødegaard RA, Hellund JC, et al. (2012) Isolated, extra-articular neck and shaft fractures of the 4th and 5th metacarpals: a comparison of transverse and bouquet (intra-medullary) pinning in 67 patients. J Hand Surg Eur Vol 37(5): 387-395.
20. Westbrook AP, Davis TR, Armstrong D, Burke FD (2008) The clinical significance of malunion of fractures of the neck and shaft of the little finger metacarpal. J Hand Surg Eur Vol 33(6): 732–739.

