ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 9| Issue: 1| January 2023|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2022: 8.205 || ISI Value: 1.188

ANATOMY, EPIDEMIOLOGY, DIAGNOSIS, MANAGEMENT AND TREATMENT OF THE METACARPAL FRACTURES

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Article DOI: https://doi.org/10.36713/epra12273
DOI No: 10.36713/epra12273

SUMMARY

Introduction: *The fracture of the neck of the fifth metacarpal, also known as "boxer's fracture", is one of the most frequent traumatic pathologies seen in the emergency department and is usually treated with conservative measures. The fifth metacarpal is the most frequently fractured, representing almost 25% of all metacarpal fractures and 10% of all fractures.*

Objective: *to define and explore the anatomy, epidemiology, approach, diagnosis, management and treatment of metacarpal fractures.*

Methodology: *a total of 40 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 26 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar, SciElo; the terms used to search for information in Spanish, Portuguese and English were: fractura del boxeador, fratura do metacarpo, fracture of the fifth metacarpal and boxer's fractures.*

Results: *About 30% of all hand fractures and 18% of all below-elbow fractures are metacarpal fractures. Small-finger neck fractures and ring-finger shaft fractures are among the most frequent metacarpal fractures.To diagnose the boxer's fracture and evaluate the degree of angulation, plain radiographs are the gold standard. Fractures with significant angulation require closed reduction and splinting. Surgical management can result in hardware-related issues such as adhesions, infection, and tendon rupture, whereas a more conservative approach may result in malunion or stiffness due to immobilization.*

Conclusions: *Uncomplicated fractures of the fifth metacarpal are usually treated with immobilization and splinting or neighboring strapping, with a comparable degree of functional outcome. In Metacarpal head fractures nonoperative treatment options include immobilization in the intrinsic plus position. Small finger metacarpal neck fractures are the most typical and are frequently referred to as "boxer's fractures". Metacarpal fractures that have no associated rotational deformity can typically be managed conservatively with immobilization and serial radiographs. The use of the Jahss maneuver can result in reduction of fractures with rotational deformity or pseudoclawing. The most common types of metacarpal shaft fractures are transverse fractures, oblique fractures, and comminuted fractures. Operative intervention should be taken into consideration if there is pseudoclawing, rotational deformity, significant metacarpal shortening, or a noticeable dorsal deformity. Despite being a rare injury, intra-articular base fractures of the index- through ring-finger metacarpals have been suggested to be an underreported and misdiagnosed condition. Complications related to these injuries are prevalent and may result from surgical or non-surgical treatment of the initial injury.*

KEYWORDS: *fracture of the fifth metatarsal, Boxer's Fracture, hand injury.*

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INTRODUCTION

The fracture of the neck of the fifth metacarpal, also known as "boxer's fracture", is one of the most frequent traumatic pathologies seen in the emergency department and is usually treated with conservative measures. The fifth metacarpal is the most frequently fractured, representing almost 25% of all metacarpal fractures and 10% of all fractures.(1–4).

The normal volar angulation of the metacarpal head increases at the time of injury. The fifth metacarpophalangeal joint (MTCF) may lose its normal prominence as a result of this angulation, shortening the metacarpal neck. Fifth metacarpal fractures with a palmar angulation of less than 40 degrees usually do not carry a corresponding rotational deformity and are usually treated conservatively without the need for fracture manipulation(3,5).

Several literatures report that functional results can be obtained with little or no correction of these sagittal plane fractures. However, severe angulation and subsequent poor healing can cause dorsal protrusion as well as loss of metacarpal head prominence when making a fist. Patients who work as manual laborers and need to perform forceful gripping activities may experience complications as a result of metacarpal shortening and angulation greater than 30 degrees(3,6,7).

The standard treatment of this fracture consists of closed reduction and immobilization with external splinting in intrinsic plus position (immobilization of the fourth and fifth radius from the wrist to the proximal interphalangeal joint). Functional treatment is an alternative (which does not restrict range of motion), which can be applied by using compression bandage on the whole hand or syndactyly between the fourth and fifth fingers. The wrist and finger joints can move freely with these procedures. Superior functional performance is theorized to be a benefit of this type of treatment. A third option is to treat patients fully dynamically (i.e., without using any immobilization), encouraging them to use the hand normally. Although insufficient statistical power was found to detect significant differences, further investigation was warranted because the evidence-based systematic review did not find a superior nonoperative treatment regimen for fifth metacarpal neck fracture(3,8).

Functional outcomes were consistent in the most recent randomized controlled trials and meta-analyses. Current data are insufficient to reach a consensus on the best course of action for patients with boxer's fractures because discomfort, hand function, and ability to work may be assessed differently depending on physician-patient interactions(3,9–11).

METHODOLOGY

A total of 40 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 26 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar, SciElo; the terms used to search for information in Spanish, Portuguese and English were: fractura del boxeador, fratura do metacarpo, fracture of the fifth metacarpal and boxer's fractures. The choice of the bibliography exposes elements related to the fracture of the fifth metacarpal, anatomy, epidemiology, approach; in addition to these elements, the diagnosis, management and treatment of the disease are investigated.

DEVELOPMENT

In terms of epidemiology, about 30% of all hand fractures and 18% of all below-elbow fractures are metacarpal fractures, making them one of the most common injuries evaluated in emergency rooms. Most of them (70%) happen in the second and third decades of life. Small-finger neck fractures and ring-finger shaft fractures are among the most frequent metacarpal fractures. Most fractures are caused by either accidental falls or direct blows to another object or person. Metacarpal fractures can appear in various situations, but most commonly appear as a result of direct trauma. As metacarpal bones are superficial, these often get fractured when the hand is used for evasive activity. When there are fractures of the metacarpal shaft, direct impacts on the dorsum of the hand form transverse fractures with varying degrees of comminution depending on the speed of the injury. Despite their prevalence, randomized controlled trials are challenging to implement given the wide range of fracture patterns and injury mechanisms, and the evidence for any given treatment strategy is typically limited to single-center studies. However, there is a wealth of information in the literature, including a sizable retrospective series with lengthy follow-up, that sheds light on the most efficient treatments for these frequent injuries(12–16).

Recalling a little of the anatomy of the region, we have that the palmar neurovascular structures and phalanges are supported by the metacarpals, which are the longest bones closest to the hand. The metacarpals form the bony base of the complex lever system of the flexor and extensor tendons of the hand. The metacarpals have flares at the bases and necks, forming a volar concave arc along their length.The distal carpal row and the metacarpal base articulate. A condylar joint, which allows for flexion, extension, radial, and ulnar motion, is formed by the cam-shaped metacarpal head and the base of the proximal phalanx. The metacarpophalangeal (MCP) joint is supported and resistant to hyperextension by the fibrocartilaginous volar plate, which runs along the palmar aspect of the joint. In addition to providing additional stability by preventing shortening from metacarpal shaft fractures, the deep intermetacarpal ligaments join the volar plates between neighboring digits. The proximal phalanx's volar aspect is where the collateral ligaments attach after emerging from the metacarpal head's dorsal side. The proximal phalanx and the volar plate are the sites of attachment for the accessory collateral ligaments, which are positioned volar to the proper collateral ligaments. The collateral ligaments lengthen and tighten when the MCP joint is flexed, stabilizing the joint as a result. The flexor and extensor tendons are less closely

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connected to the bony surface than are phalangeal fractures, and as a result, they may heal more successfully after injury. However, since a dorsal approach is typically used to treat these fractures, it is important to comprehend the extensor tendon apparatus.The interossei begin along the metacarpal shaft, insert along the base of the proximal phalanx, the extensor hood, and help to form the lateral bands of the extensor tendon apparatus. The volar plate, collateral ligaments, and deep transverse intermetacarpal ligaments are all joined by the sagittal bands, which also stabilize the extensor tendon over the head of the metacarpal. The metacarpal bases are where the wrist extensors and flexors insert more closely. Extensor carpi ulnaris (ECU) inserts at the base of the small-finger metacarpal, extensor carpi longus (ECRL) inserts at the base of the index metacarpal, and extensor carpi radialis brevis (ECRB) inserts at the base of the long-finger metacarpal. Similar to how the flexor carpi ulnaris tendon inserts at the base of the small finger, the flexor carpi radialis (FCR) tendon does the same for the index metacarpal(12,14).

In addition to the clinical history and physical examination, to diagnose the boxer's fracture and evaluate the degree of angulation, plain radiographs are the gold standard. It is necessary to obtain anteroposterior, lateral and oblique views, the use of CT scans is not frequent, however they are usually useful in cases of high suspicion of fracture without radiographic evidence(17).

Figure 1. X-ray Boxer's fracture.

Source: The Authors.

In terms of treatment to maintain the reduction of metacarpal neck fractures, numerous immobilization techniques have been described. Early treatments included banjo splinting and immobilization over a roller bandage. Modern therapies typically involve immobilization with a cast or splint after reduction using the Jahss maneuver. The use of fracture braces, adhesive tape, anterior-posterior splinting, ulnar splinting, and anterior-posterior-ulnar splinting are recent examples of immobilization techniques. With the MCP joints in flexion, all commonly immobilize the reduced fracture. Although the Jahss technique is usually effective in reducing these fractures, successful maintenance of the reduction has remained a difficult issue(12).

A different technique for reducing and immobilizing fifth metacarpal neck fractures has been developed over the last ten years and has proven to be very effective. The method is based on reduction by longitudinal traction only, followed by immobilization with a three-point cast that leaves the interphalangeal (IP) joints free. Efficacy, simplicity, freedom of movement of the IP joint and greater patient tolerance to this form of treatment are its advantages. This technique does not require anesthesia(12,18).

Alignment that is acceptable, reduction that is stable, bony union that is strong, and motion that is unrestricted are the main objectives of treatment. A thorough history should be

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taken from the patient, paying particular attention to hand dominance, occupation, the way the injury happened, when it happened, and any prior hand trauma or surgeries on the upper extremities. The presence of rotational deformity must be determined through a thorough physical examination because plain radiographs cannot do so. When the patient flexes and extends their fingers, the position of the nail plates is noted. Examining the other hand is frequently helpful because rotational deformity can be subtle. A 1.5 cm digital overlap with both aesthetic and functional deformity will result from even a small degree rotation. The digital cascade can be seen in patients who are unable to perform active flexion by flexing and extending the wrist in order to feel the tenodesis effect. In addition, it's important to take note of the hand's neurovascular status, active and passive range of motion, bony deformity, digit shortening, loss of knuckle contour, and soft-tissue injury. To evaluate hand fractures, specifically fracture geometry, comminution, angulation, and shortening, standard posterior-anterior, oblique, and lateral radiographs are typically sufficient. Bony apposition should be at least 50%, and bony shortening of about 5 mm is typically acceptable. To determine whether surgical intervention is necessary and whether nonoperative management might be successful, the initial evaluation is concentrated on assessing stability(12,18).

Table1. Characteristics of unstable fractures requiring operative intervention.

CHARACTERISTICS OF UNSTABLE FRACTURES REQUIRING OPERATIVE INTERVENTION	EXAMPLES
Irreducible fractures	>25% Involvement of the articular surface of the metacarpal head or 1-mm step-off
Open fractures	Displaced fractures of oblique shaft with rotational deformity on examination
Fractures with segmental bony loss	Displaced fractures of metacarpal base with dislocation or subluxation of the carpometacarpal joint
Multiple fractures	Displaced fractures of thumb metacarpal base
Fractures associated with significant soft-tissue injury	
Rotational deformity	
Angulation	

Source: Diaz-Garcia R, Waljee JF. Current Management of Metacarpal Fractures(12).

Fractures that involve 25% or more of the joint's articular surface or have a step-off of 1 mm or more are considered to be inherently unstable, as are displaced oblique fractures with rotational deformity, displaced fractures of the metacarpal base with CMC joint subluxation, and displaced Bennett or Rolando fractures. In the hand, a digit's rotational deformity is not acceptable and is cause for reduction and fixation. The efficiency of intrinsic muscle contraction is decreased by metacarpal shortening greater than 5 mm, and extensor lag is linked to a significant loss of power(12).

Metacarpal head fractures

Despite the rarity, hyaline cartilage and the possibility of osteonecrosis make metacarpal head fractures difficult to treat. Since fracture fragments are frequently small and comminuted, careful technique is needed during reduction and fixation to prevent damaging the collateral ligaments and devascularizing the bony fragments. Computed tomography scans, in addition to standard radiographs, may be useful for fractures to more accurately identify the fracture pattern. Nonoperative treatment options include immobilization in the intrinsic plus position for fractures affecting less than 20% of the joint surface.The aim of treatment for fractures with a more severe disruption of the articular surface is to stabilize and restore the shape of the metacarpal head to permit early range of motion. If at all possible, lag screws that are countersunk into the cartilage are the best way to treat these fractures. However, these fractures typically present with significant joint comminution and disruption. Some researchers have described the use of arthroplasty in the acute setting for the treatment of these complicated injuries, and external fixation that incorporates distraction and early motion may improve long-term function following these injuries. Nevertheless, late arthritis is not unusual despite aggressive treatment (19–21)

Metacarpal neck fractures.

Small finger metacarpal neck fractures are the most typical and are frequently referred to as "boxer's fractures" due to their prevalence in amateur boxers. The volar cortex fractures at the time of injury, leading to an apex-dorsal angulation fracture pattern and flexion of the metacarpal head. A pseudo claw deformity may result from an imbalance of the extrinsic and intrinsic musculature brought on by metacarpal

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shortening. The intrinsic muscles of the hand cross the MCP joint and maintain flexion of the metacarpal head. The proximal interphalangeal (PIP) joint flexes and the MCP joint hyperextends when the patient tries to extend their fingers. Metacarpal fractures that have an angulation of less than 10 for the index finger, less than 15 for the long finger, less than 30 for the ring finger, and less than 40 for the small finger and have no associated rotational deformity can typically be managed conservatively with immobilization and serial radiographs. Ring-finger and small-finger neck fractures caused by angulated fractures are lessened by increased mobility in the ulnar CMC joints of the hand. The CMC joints in the index and long fingers, on the other hand, are more fixed and poorly tolerant of greater degrees of angulation. The excellent patient-reported outcomes and function with greater degrees of angulation, particularly for small-finger metacarpal neck fractures, have been documented in numerous studies, proving that these recommendations are relative. For instance, McKerrell and colleagues observed 40 patients with angulated small-finger metacarpal neck fractures treated nonoperatively and with reduction and pinning and found no difference in hand function after treatment. Patients need to be informed about the potential long-term loss of dorsal joint/knuckle prominence with a more pronounced dorsal deformity closer to the palm and a palpable metacarpal head. However, conservative management is appropriate for patients who do not exhibit a rotational deformity or absent pseudoclawing upon examination. A cast or splint may be used to immobilize the wrist, MCP, and PIP joints for three weeks in the intrinsic plus position, followed by early active range of motion.(22).

Use of the Jahss maneuver can result in reduction of fractures with rotational deformity or pseudoclawing. It is possible to reduce the metacarpal head from a flexed position by fully flexing the MCP and PIP joints, applying dorsal force along the proximal phalanx, and rotating the metacarpal shaft. Additional manipulation along the flexed proximal phalanx can be done to correct rotational deformity and return the joint to its anatomic position. In order to keep the reduction in place and serve as an internal splint, percutaneous Kirschner (K) wires can be positioned in a number of different ways. Pins may be inserted transversely into the unharmed ring-finger metacarpal head next to the injured one or in a crossed pattern down the metacarpal shaft. K-wires are advantageous because they can be positioned quickly and easily percutaneously without requiring a significant amount of dissection. However, they don't offer a rigid fixation, and pin-site infections are common. Poor follow-up is common in this patient population, and external pins may be challenging for patients to manage. Other researchers have suggested using antegrade intramedullary pins that are percutaneously inserted at the base of the metacarpal. Despite reports of joint penetration, loss of reduction, and the need for additional surgeries, intramedullary fixation offers excellent stability with little soft-tissue dissection and protection of the extensor tendon mechanism from adhesions. For neck fractures, plate fixation using a mini-condylar plate is an option. But because this method calls for more dissection and an open approach, there may be a higher chance of adhesions and long-term stiffness(19).

Plate and screw reconstruction has been preferred because of its superior biomechanical stability over other methods. However, one particular trial found no significant difference in peak load or bone stiffness profile between plate and screw fixation and K-wire fixation.(23,24).

Figure 2. Kirschner wires.

Source: The Authors.

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Figure 3. Kirschner wires.

Source: The Authors.

Metacarpal shaft fractures

The most common types of metacarpal shaft fractures are transverse fractures, oblique fractures, and comminuted fractures. They can be caused by axial loading, torsion, or a direct blow. Similar to metacarpal neck fractures, injuries with little to no displacement, minimal angulation, rotational deformity, or shortening can be treated conservatively by immobilization. The ulnar digits are more tolerant of angulation than the index or middle finger. However, operative intervention should be taken into consideration if there is pseudoclawing, rotational deformity, significant metacarpal shortening, or a noticeable dorsal deformity. Displaced transverse metacarpal shaft fractures may be treated with closed reduction, but many of these injuries will need surgical fixation. Pins, wiring methods, intramedullary fixation, plate fixation, and interfragmentary compression screws are just a few of the fracture fixation techniques that are available. Even though some fracture patterns are best treated with a particular technique, the choice of fixation is largely determined by the fracture pattern and the surgeon's preferences. Pin fixation is advantageous because pins are easily accessible, require little dissection, and can be used in a variety of configurations, just like with metacarpal neck fractures. Lack of rigid fixation, distraction of the fracture, infection at the pin site, and pin migration are similar drawbacks. To create a more stable construct, composite wiring or cerclage wiring can be used in combination with pins. It can also be used for different types of fracture patterns. When a long oblique fracture has a length that is twice as large as the bone's diameter and can accommodate at least two screws, interfragmentary screws can provide compression. Compression is technically difficult to achieve with little room for error, necessitating soft-tissue dissection and anatomic fracture reduction. When two or three bicortical screws are inserted on either side of the fracture, dorsal metacarpal plating using stainless steel or titanium plates is easier to perform and might offer a more stable fixation than pin or wire techniques. Despite these benefits, plates are linked to hardware failure, infection, and subpar fracture healing, with complication rates as high as 35% in some series. With only a small amount of dissection, intramedullary fixation is an effective treatment option for multiple transverse shaft fractures. Last but not least, some researchers have supported the use of external fixators for shaft fractures, citing the minimal need for dissection that could potentially devascularize the bone and formation of a stable construct that permits early motion. However, issues could arise from overdistraction, extensor tendon nonunion, and pin-site infection. While bioabsorbable plates have grown in popularity for fracture fixation in craniofacial surgery, they have not yet become widely accepted in hand surgery. Bioabsorbable plates show stability comparable to that attained with titanium constructs, according to studies in cadaveric and animal models. Future research examining the use of these techniques in hand surgery may shed light on when they should be used for metacarpal fractures(12,19,25,26).

Metacarpal Base Fractures

Despite being a rare injury, intra-articular base fractures of the index- through ring-finger metacarpals have been suggested to be an underreported and misdiagnosed condition. These fractures are frequently caused by falling on a flexed wrist with the arm extended and loading the metacarpal axially.

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Their presence in the literature is restricted to a few case series due to their low incidence. Their leadership is debatable in some ways. While some have advocated for conservative management, there is a growing movement toward operative intervention. The argument for nonsurgical treatment is based on the second and third CMC joints' restricted range of motion, which downplays the significance of articular congruity. The argument in opposition is that failure to achieve anatomic reduction is thought to affect the dorsal insertions of the wrist extensors and may result in osteoarthritis, which can lead to decreased range of motion and diminished wrist extension, ultimately leading to weakness of grip. The most frequent of these injuries are fractures at the base of the small finger metacarpal, which have names like "reverse Bennett" and "baby Bennett" because they are mechanically comparable to fractures of the thumb. The deforming force that pulls the metacarpal dorsally, ulnarly, and proximally is the ECU. Due to the strong attachment to the intermetacarpal ligament and reinforcing insertion of the volar flexor carpi ulnaris, the volar-radial segment of the base articular surface is still present. There is no agreement as to the most appropriate method of management of Bennett's reverse fractures. Non-displaced fractures usually undergo non-interventional treatment. Conservative treatment with reduction and immobilization of slightly displaced fractures is also possible, with a 100% healing rate and return of grip strength, although 41% of cases show radiographic signs of osteoarthritis. The tendency of most researchers is to advocate surgical treatment of displaced reverse Bennett fractures, but the clinical data are contradictory and do not necessarily support such an indication. Regardless of the surgical or non-surgical approach, the results are similar in terms of recovery of functional capacity, occurrence of post-traumatic arthritis and long-term pain(12,19).

COMPLICATIONS OF METACARPAL FRACTURES

While most patients with metacarpal fractures recover well, complications related to these injuries are prevalent and may result from surgical or non-surgical treatment of the initial injury. Surgical management can result in hardware-related issues such as adhesions, infection, and tendon rupture, whereas a more conservative approach may result in malunion or stiffness due to immobilization. The frequency of complications is closely linked to the severity of the original injury, as open fractures and crush injuries diminish the prospects for uncomplicated healing(12,19).

Malunion

Malunion is the main complication in the management of metacarpal fractures, especially after the non-interventional approach to unstable fractures.The actual incidence of malunion is complicated to determine, due to the high percentage of closed metacarpal fractures that do not receive medical attention.The final outcome of the malunion can be predicted from the first radiograph, since certain fractures result in particular deformities. Spiral and oblique fractures may result in shortening due to the intrinsic musculature. Shortening of the finger may not only be unsightly because of dulling of the dorsal eminence of the metacarpal head, but may also change the existing balance between intrinsic and extrinsic muscle loads. Strauch et al. found that every 2 mm of metacarpal shortening resulted in 7 mm of secondary extensor lag. The MCP joint can be hyperextended to counteract this deformity, but it is usually limited to about 20. Consequently, more than 6 mm of metacarpal shortening requires a control ORIF to reduce the deformity. Angular malunion in the metacarpal usually occurs in the sagittal plane with an apex-dorsal deformity. This malunion usually occurs in transverse fractures of the shaft, as the conjunction of the long flexors and intrinsic flexors are stronger than the extrinsic extensors. Some sagittal angulation is permissible, although the angles vary from 10 to 30 as one moves from the metacarpal of the index finger to the metacarpal of the little finger, due to the increased mobility of the ulnar CMC joints. If a significant angular malunion occurs, it can be addressed with an opening or closing wedge osteotomy. A closing wedge osteotomy is a technically simpler procedure and does not involve significant shortening, as the effective length is achieved with angulation rectification. Rotational malunion is the most likely to result in impaired function, as the deformity is magnified distally, and is usually the product of an unstable spiral or oblique fracture. Five degrees of malrotation in the metacarpal shaft can result in a 1.5 cm digital overlap, with an unacceptable result. The examination requires attention to the alignment of the nail plates, as well as to detect "scissoring" or overlapping when the patient slowly clenches his or her fist. Correction of a rotational deformity can be performed through an osteotomy in the anterior region of the fracture or in the metaphysis. In the 1960s, Weckesser first described a corrective osteotomy proximal to the base of the metacarpal to address rotational malunion. Gross and Gelberman later outlined the limits of these osteotomies in cadavers, noting that the transverse metacarpal ligament was the major factor restraining rotation, and that 20 to 30 was the upper limit.(12,16,19).

In summary, malunion is the most common complication and can manifest as dorsal angulation or rotatory malunion. Dorsal angulation is primarily a cosmetic problem and may rarely appear as chronic pain due to tenosynovitis or sometimes as a manifestation of saddle syndrome. It can be corrected by open or closed wedge osteotomy. Rotational malunions are more bothersome and are expressed as a scissoring of the fingers that makes it difficult to hold objects. They are usually corrected with an osteotomy at the base of the metacarpal.(13).

Nonunion

Nonunion is the absence of bone healing four months after injury. Nonunion is rare after a closed metacarpal fracture, and is more common in the setting of a complex open injury with bone loss. Various authors define delayed union or nonunion as fractures without clinical or radiographic signs of healing at 4 months. The frequency of delayed union or nonunion can reach 6% after ORIF. Bony pseudarthrosis can be divided into

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hypertrophic or atrophic, and their management is somewhat variable. Hypertrophic pseudarthrosis is usually the result of improper stabilization, either due to fixation failure or noncompliance with immobilization. Treatment requires firm fixation, usually with ORIF. Atrophic pseudarthrosis are more common in open fractures and are associated with bone infection. Fibrous tissues or infected bone require intensive debridement, and bone grafting should be used to fill bone defects.(12,16,19).

Decreased Range of Motion

After conservative or surgical treatment, limitations of range of motion may be observed. While ORIF predisposes the patient to tendinous adhesions, prolonged immobilization leads to tightening of the joint capsules and collateral ligaments, emphasizing the importance of splinting in a functional or safe position. Factors favoring post-injury stiffness include crush injuries, open fractures, multi-finger involvement, segmental injuries and immobilization for more than 4 weeks.(12,19).

Infection

Acute infections, including osteomyelitis, are much more prevalent in open fractures of the hand. Even if metacarpal osteomyelitis is infrequent, it requires the removal of all metalwork, taking cultures from tissues, and rigorous debridement. The infection rate of open injuries is higher than closed fractures undergoing surgical treatment at 11% versus less than 0.5%. The infection rate is related to contamination and soft tissue injury, in addition to periosteal excision and devascularization. When osteomyelitis has set in, the risk of final amputation is greater than 50%. Traditional inflammatory markers such as erythrocyte sedimentation rate and C-reactive protein are of little value in the hand, and the diagnosis must be made by surgical bone biopsy and pathological examination. Treatment requires external fixation, aggressive debridement, systemic intravenous antibiotics and secondary reconstruction with bone grafting and internal fixation.(12,16,19).

Post-injury rehabilitation following a metacarpal fracture is based on numerous characteristics, including patient reliability, fracture location, fracture pattern stability, and fixation stability. Early displacement is commonly considered appropriate when intrinsically stable fracture patterns or rigid fixation are present, with the assumption that early displacement has the potential to improve outcomes. It remains unclear whether early mobilization with conservative treatment provides clinically relevant functional benefit, as most of the literature is based on limited retrospective case series.(12).

Protocols for postoperative rehabilitation of the hand are based in large part on surgical technique and on the safety of the stability of the structure. After CRPP, gentle active range-of-motion exercises without resistance usually begin 2 to 3 weeks postoperatively in adjacent or unaffected joints, and this activity is advanced with K-wire removal at 4 to 6 weeks. ORIF provides a more stable structure, so it is usually prudent to initiate active range of motion in the early postoperative period. The additional stability comes at a price, as it increases the frequency of tendon adhesions, so early initiation of treatment is not only feasible, but imperative.(12,19)

Most metacarpal fractures can be treated conservatively and only a few require surgical intervention. K-wires are most commonly used for fixation of metacarpal fractures. Lag screws and plates are of particular value in unstable fractures. Intramedullary screws have also opened a new window(13).

Figure 4. AP X-ray - metacarpal neck fractures.

Source: The Authors.

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 9| Issue: 1| January 2023|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2022: 8.205 || ISI Value: 1.188

Figure 5. Oblique radiography - metacarpal neck fractures.

Source: The Authors.

CONCLUSION

The metacarpophalangeal (MCP) joint is supported and resistant to hyperextension by the volar fibrocartilaginous plate, which extends along the palmar aspect of the joint. The volar aspect of the proximal phalanx is where the collateral ligaments attach after emerging from the dorsal aspect of the metacarpal head. About 30% of all hand fractures and 18% of all below-elbow fractures are metacarpal fractures. Small-finger neck fractures and ring-finger shaft fractures are among the most frequent metacarpal fractures. To diagnose the boxer's fracture and evaluate the degree of angulation, plain radiographs are the gold standard. Uncomplicated fractures of the fifth metacarpal are usually treated with immobilization and splinting or neighboring strapping, with a comparable degree of functional outcome. Fractures with significant angulation require closed reduction and splinting. There are very specific situations in which surgical treatment is considered preferable to conservative treatment. In Metacarpal head fractures nonoperative treatment options include immobilization in the intrinsic plus position. Small finger metacarpal neck fractures are the most typical and are frequently referred to as "boxer's fractures". Metacarpal fractures that have an angulation of less than 10 for the index finger, less than 15 for the long finger, less than 30 for the ring finger, and less than 40 for the small finger and have no associated rotational deformity can typically be managed conservatively with immobilization and serial radiographs. The use of the Jahss maneuver can result in reduction of fractures with rotational deformity or pseudoclawing. Plate and screw reconstruction has been preferred because of its superior biomechanical stability over other methods. The most common types of metacarpal shaft fractures are transverse fractures, oblique fractures, and comminuted fractures. They can be caused by axial loading, torsion, or a direct blow. Operative intervention should be taken into consideration if there is pseudoclawing, rotational deformity, significant metacarpal shortening, or a noticeable dorsal deformity. Despite being a rare injury, intra-articular base fractures of the index- through ring-finger metacarpals have been suggested to be an underreported and misdiagnosed condition. While most patients with metacarpal fractures recover well, complications related to these injuries are prevalent and may result from surgical or non-surgical treatment of the initial injury. Surgical management can result in hardware-related issues such as adhesions, infection, and tendon rupture, whereas a more conservative approach may result in malunion or stiffness due to immobilization.

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