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THE CHOICE STRATEGY OF INTERNAL FIXATION IN BOXER FRACTURE: A LITERATURE REVIEW

Harahap R[1]* and Meisari PA[2]

[1]*Department of Orthopedics and Traumatology, Faculty of Medicine, Muhammadiyah University Semarang/Dr. Adhyatma MPH Hospital, Semarang, Indonesia.*

[2]*Faculty of Medicine Muhammadiyah University Semarang, Indonesia*

**rudiharahap2016@gmail.com*

Abstract: A “Boxer” fracture is the fracture of the neck of the fifth metacarpal due to direct trauma to the fist. One of the most common causes is punching an object with a closed fist during a fight or punching a hard object. As many as 33% of patients with hand fractures are metacarpal fractures, the majority involving the fifth metacarpal. Men dominate the incidence of "boxer fracture". The peak incidence is at the ages of 10-29 years. Conservative management of "boxer fracture" tends to dislocate easily, causing flexion contractures in the finger joints and skin necrosis in the hands. Some researchers suggest surgical treatment because functionally and aesthetically the results look better. In addition, factors such as longitudinal shortening, angulation, malrotation, bone loss and soft tissue injury are indications for internal fixation. The population of boxer fracture patients mostly occurs in males of young age or productive age working with a high economic burden, so that faster recovery of hand activity is ensured. Internal fixation is an option so that the hands immediately function to work. The choice of internal fixation depends on the type and location of the fracture, soft tissue damage, age and occupation. Several internal fixation modalities for boxer's fractures such as percutaneous fixation with Krischner wire, cerclage with suture wire, intermedullary nail, plate screw to arthroplasty. By knowing the implant choice strategy according to the type and location of the fracture, soft tissue damage, age, and occupation, it is hoped that it will provide the best functional and aesthetic results in the treatment of boxer fractures.

Keywords: boxer's fracture, internal fixation, implant choice strategy.

Introduction

Boxer fracture is a fracture of the neck of the fifth metacarpal resulting from direct trauma to the fist. The mechanism of injury varies from axial loading to a direct blow to the dorsal hand. One of the most common causes of this case is punching an object with a closed fist, when involved in a fight or punching a hard object1 Men dominate the incidence of boxer fractures, the peak incidence is found at the age of 10-29 years.[3]

As many as 33% of patients with hand fractures are metacarpal fractures with the majority of metacarpal fractures involving the fifth metacarpal. Based on the study by Feehan LM et al, boxer

*Corresponding Author’s Email: rudiharahap2016@gmail.com

fracture is the most common type of hand fracture (5% of all fractures in the upper limb) with the most typical presentation to the emergency department[22]. The management of fifth metacarpal fractures are varies. This fracture can be managed conservatively through several methods such as manual reduction of the Jahss maneuver, ulnar gutter and buddy taping but tends to dislocate easily after reduction. The Jahss maneuver was also abandoned because it caused flexion contractures of the finger joints and skin necrosis of the hands[5]. Strub et al suggested that residual dorsal angulation, patient satisfaction and aesthetic results appeared to be better in the operational group than in the conservative group[6]. Several factors such as longitudinal shortening, angulation, malrotation, bone loss, and soft tissue injury are indications for internal fixation[7]. Nakashian et al. in his research said that men in the two and three decades of life are more likely to get metacarpal fractures[3]. This is because this patient population has a high economic burden, productive age of work8. Thus requiring rapid recovery to full use of the hand[8]. There are several methods of internal fixation for the treatment of metacarpal fractures, and the proper use of each technique is still debated[1]. The choice will depend on the type and location of the fracture within the metacarpals, and generally includes the use of percutaneous Kirschner-wire fixation, intramedullary nails, plate and screw fixation or arthroplasty[1]. The scope of this article includes the results of a literature review examining management strategies for these fractures.

Mechanism

The mechanism of boxer fractures due to direct trauma to a clenched fist provides an axial load that transfers energy or strength to the metacarpal bones and the presence of intraosseous muscle strength can result in fractures in the most frequent part, namely the neck of the 4&5 metacarpal bones[9.] This can lead to angulation at the dorsal apex and depression of the MCP joint and loss of contour.[9] Boxer fractures sustained by facial blows, the teeth receiving the blow can cause lacerations or abrasions or known as Fight bites.[9]

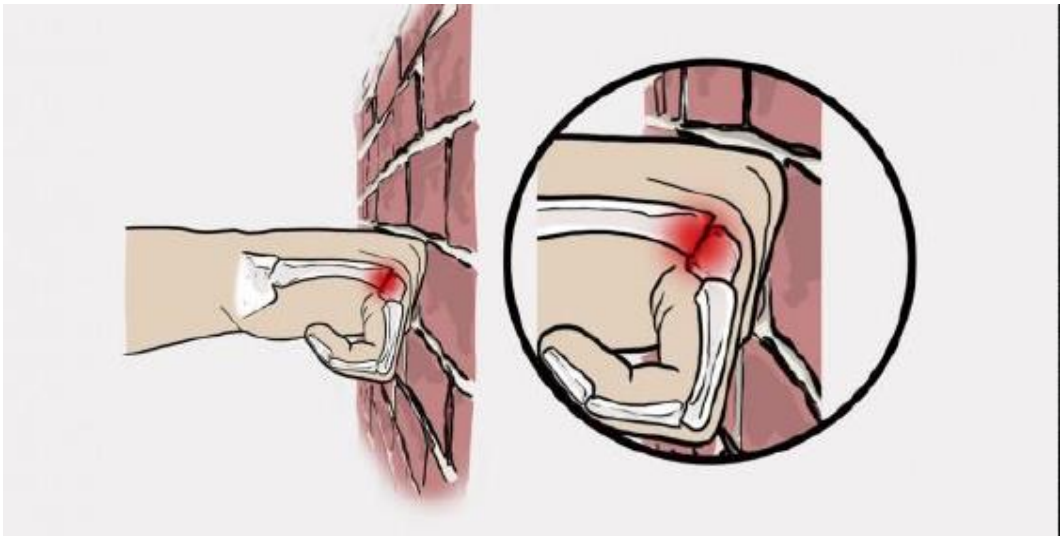

Figure 01: mechanism of boxer fracture.[9]

Diagnosis

Boxer's fractures are usually the result of direct trauma to the fist where energy is transferred axially through the fifth metacarpal and mostly results in angulation due to traction of the interosseous muscles of the hand.[9] As with fractures of other long bones, fractures of the metacarpal bones also follow the same pattern of descriptive classification. is open or closed, intraarticular or extraarticular, oblique, spiral, transverse, or comminuted.[10] The neurovascular network surrounding the metacarpal can be disrupted in a displaced fracture requiring surgical intervention.[11] When examining a suspected fifth metacarpal fracture, the clinician should observe any damage to the skin (fight bites), neurovascular tissue, rotational alignment, and perform comparisons with with the uninjured hand.[11]

X-Ray (anteroposterior, lateral, and oblique) are the gold standard for diagnosis and for determining angulation (Fig. 3-4)[11]. The angulation should be measured at more than 15 degrees, because the normal angulation of the neck of the fifth metacarpal is 15 degrees[11].

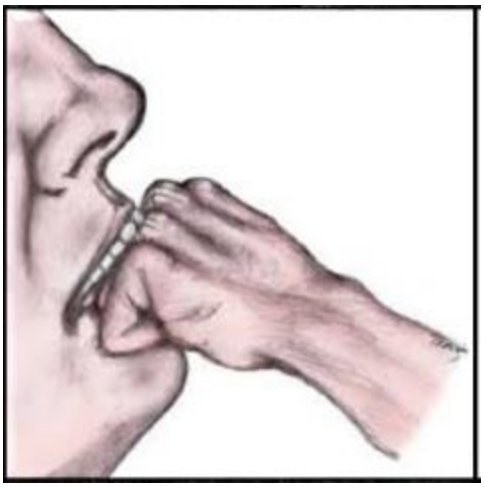

Figure 02: mechanism of Fight Bites[9]

Figure 03: Normal Allignment of metacarpals 2,3,4,5[9]

Figure 04 :X-ray example (PA position) of the right manus showing a comminuted extra-articular fracture at the neck of Metecarpal V1

Figure 05: X-ray example (oblique position) showing extra-articular, comminuted fracture of the neck fifth metacarpal with volar angulation.

Internal Fixation

Surgery should only be chosen when there is a strong indication for it. The following are some of the indications for surgery that have been mentioned in the literature:[13,14,15]

1. Open fracture: which requires irrigation and wound debridement

2: Multiple fractures or multiple fractures involving multiple metacarpals and/or phalanges;

3: Intra-articular fracture especially when a fragment prevents smooth movement of the joint;

4: Fracture extends to the head of the metacarpal with a displacement of >1 mm;

5: Volar angulation and distal fragment displacement

6: >5 mm shortening;

7: Malunion and non-union

8: Inability to repair the fracture by conservative methods;

9: Rotational deformity.

Several surgical techniques are currently used to treat boxer fractures. Selection of the best technique depends on surgeon preference. It is necessary to consider the advantages and disadvantages of each technique, pathoanatomy and other things.

Internal Fixation Close reduction

Kirschner Wires (K-Wire)

Closed metacarpal fractures can be managed conservatively by flexing the finger at the metacarpophalangeal and proximal interphalangeal joints. Stable fractures can be splinted externally. However, if the fracture is unstable then further stabilization with K-wire can be used[12.] Boxer fractures of the subcaput and neck types usually use K-wire fixation[12.] It is minimally invasive and easy to use, making K-wire the implant of choice for percutaneous and open fracture stabilization[12,13]. However, there are disadvantages of K-wires such as possible neurovascular injury, tendon adhesions, pin site infection and pin loosening.[12,13] Several diameters available, the K-wire is drilled into the bone in an ulnoradial direction. The K-wire must pass through the fracture site, ideally at an angle greater than 45 degrees[12]. K-Wire inserted with several techniques described below:

Cross-pinning: Two wires are inserted bicortically retrograde from the distal entry point to the fracture site. The pins are prevented from crossing at the fracture site to avoid rotational changes in the fragments. Using K-wire diameter of 0.9 or 1.1 mm .[13,14,15]

Crucifix pinning: A thinner diameter wire of 1.6 mm is introduced through the metacarpal head retrograde into the medullary canal. A thinner wire is pushed from the radial aspect to the fractured head of the metacarpal and the adjacent metacarpal, forming a cross. [13,14,15]

Bouquet pinning ; Several or often three K-wires are pushed anterograde centrally through the intramedullary cavity. The resulting pattern resembles a wreath. [13,14,15]

Single K-Wire in 'lazy-S' fashion: One study has reported that only 1 in 28 patients required repeated fixation at final follow-up. A single K-wire is bent at a 5 mm point, in the opposite direction. The wire is pushed antegrade into the medullary canal. The study reported that at final follow-up, there was no evidence of rotational or angulation deformity[16.]

Transverse pinning: Commonly used for fractures of the 4th and 5th metacarpals, a K-wire is pushed from the ulnar aspect of the 5th and 4th metacarpals to stabilize the fractured fragment to the nearest unfractured site. Two studies compared the results of this technique with intramedullary insertion and noted that the operative time is shorter, and the complication rate is lower for the transverse insertion. However, intramedullary techniques produce better functional results[14,15]

Figure 06: K-Wire Internal fixation with cross pinning method [17]

Figure 07: K-wire internal fixation with transverse pinning method [17]

Intramedullary fixation

As discussed above, a single K-wire can also be used for intramedullary fixation[13.] When compared with K-wire cross pinning, intramedullary fixation is proven to produce better Range of Motion and lower incidence of shortening. One study described the use of intramedullary fixation for neck and metacarpal shaft fractures, and concluded that the functional outcome was very good, resulting in a total ROM of over 240 degrees[19] However, Padegimas et al. suggesting the use of intramedullary fixation only for metacarpal neck fractures[13]. The intramedullary fixation is inserted through a small incision at the metacarpophalangeal joint along a guide wire drilled retrograde into the distal fragment. The screw is driven into the bone[19]. Tobert et al suggest this technique because it provides an advantage over other techniques, such as the K-wire, which require repeated procedures to remove the wire[19]. Intramedullary fixation is reported to produce biomechanical stability similar to that of Kirschner wire[19.]

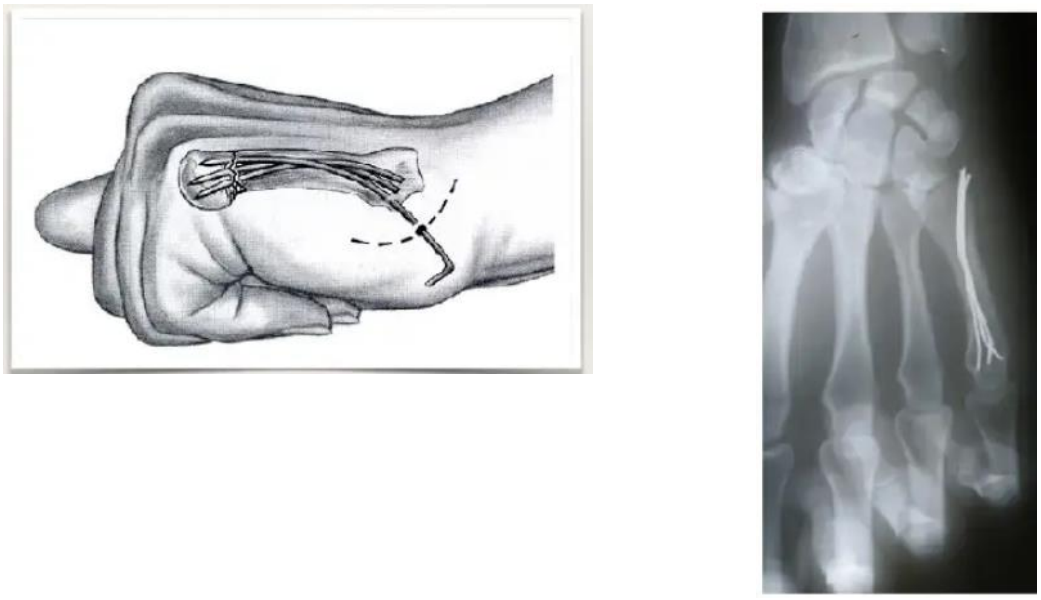

Figure 08: intramedullary internal fixation[17]

Internal Fixation Open Reduction

Plate and Screw Fixation

This method is often chosen because of its superior biomechanical stability compared to other methods[13]. However, focused studies did not find significant differences in peak load and bone stiffness profile for plate and screw vs K-wires fixation. However, this study only focused on CMC joint fixation using cadaveric bones[20].

Short oblique, transverse, or significant comminuted fractures require internal fixation with plates and screws. This is because the plate and screw have more rigid fixation properties.[13] Facca et al compared the advantages and disadvantages of the plate and screw vs K-wire method and found that although plate and screw offer a clear advantage with direct mobilization compared to K-wire, which requires 6 weeks of immobilization, plate and screw is a more costly procedure. height [21].

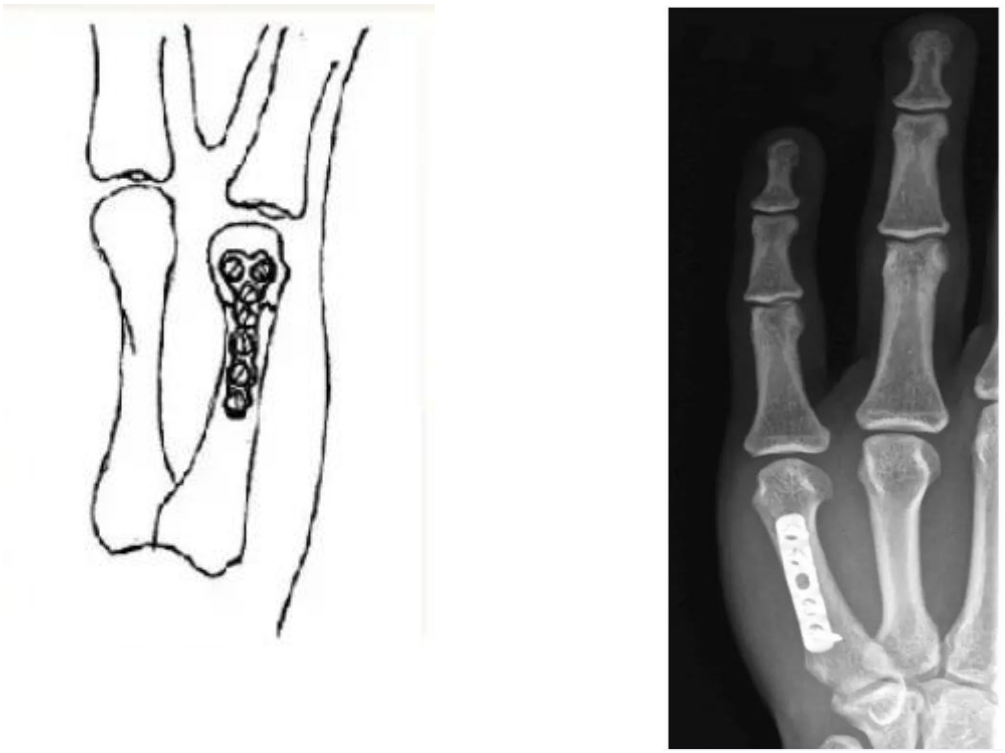

Figure 09 : internal fixation with plate and screw[21]

Arthroplasty

Facial arthroplasty was first used on the hands nearly 40 years ago. It has been shown to provide pain relief, mobility, and stability in the treatment of arthritis and metacarpophalangeal joint complex (MCP) trauma.[22] The MCP joint is critical to finger function, and injury to this joint can cause major disability23. Intra-articular damage with loss of bone and cartilage following trauma to the MCP joint is a difficult problem to treat and often results in post-traumatic arthritis, pain and disability[22]. These intra-articular injuries are prone to become severe because it is difficult to keep the joint moving at the time of trauma[22]. Prolonged immobilization after bone stabilization can also lead to tendon and soft tissue adhesions[22]. This can result in ROM obstacles during the healing process. One strategy of maintaining motion for MCP joint injuries and treatment for complex and unsalvageable fractures of the MCP joint is arthroplasty.[22] Nagle et al reported the use of direct arthroplasty for the treatment of 14 intra-articular phalangeal fractures in the MCP and PIP joints[24]. It has proven to be a reliable alternative treatment for unsalvageable intra-articular fractures of the MCP joint with minimal pain and maintenance of good joint ROM[24]. In these patients, apart from pain relief and maintenance of good joint ROM, arthroplasty can also provide aesthetic and functional improvements.

Figure: post MCP joint arthroplasty operation in a patient with intra-articular 4 metacarpal fracture. (A) Anteroposterior view. (B) Oblique view26

Conclusion

Boxer fractures with subcaput and neck metacarpal defects are advised to use internal fixation with one of the K-Wire knot methods. Such as cross pinning, transversal pinning, crucifix pinning, bouquet pinning and Single K-Wire in 'lazy-S' fashion. For fractures with damage to the metacarpal base and neck, the headless intramedullary fixation method can be used. Short oblique, transverse, or comminuted fractures require internal plate and screw fixation. While intra-articular damage is accompanied by loss of bone and cartilage after trauma to the MCP joint, arthroplasty is the best option. There are specific indications that surgical management is preferable to a conservative approach. Selection of the best technique depends on surgeon preference. It is necessary to consider the advantages and disadvantages of each technique, pathoanatomy and other factors. Moreover, the morphological variations in fracture state require certain methods of surgical fixation over other methods. Nonetheless, there is no consensus as to the absolute superiority of any one surgical technique.

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