



Lesser carpometacarpal fracture dislocation complicated by a compartment syndrome: A case report

Francesco Marco Kistoris, Alberto De Mas

ABSTRACT

Compartment syndrome of the hand is a clinical entity with potential devastating consequences in terms of loss of function and quality of life outcomes if not diagnosed or treated early. We report a case of compartment syndrome of the hand caused by a crush injury in a young caucasian man. The surgical treatment was planned as two-steps surgery: the first procedure included early fasciotomies, percutaneous fracture fixation where it was possible, carpal tunnel decompression and retention suture application. After one week primary closure of the fasciotomies and the open reduction and internal fixation of a fracture dislocation of the base of a metacarpal bone were performed. The outcome was good with a Quick-DASH score of 6,5 and no residual pain. The review of the literature is focused on providing surgeons practical elements to diagnose and treat compartment syndrome of the hand and the associated lesions, such as fractures, tendons lesions, skin problems and nerve compression.

Key words: *Compartment syndrome, trauma, decompression, fasciotomy, fractures*

Introduction

The clinical features and the diagnostic criteria of the compartment syndrome have been well described but there is a paucity of papers on clinical indications about the management of the lesions that can occur at the same time of this clinical entity (lesions of tendons, bone, vessels and nerves). We report a case of a crush injury leading to a fracture dislocation of lesser carpometacarpal joints complicated by compartment syndrome. The surgical treatments and the clinical outcome are illustrated and the management of the associated lesions are discussed.

Case Report

A Caucasian male aged 25 that suffered a work-related injury (a crush injury of the dominant left hand with a 50 Kg weight) was referred to our Department. The X-rays revealed a fracture of the fourth metacarpal and a fracture dislocation of the second carpometacarpal joint (Figure 1). The pain was severe and an important swelling of the soft tissues was observed (Figure 2). No vascular deficit was present but the patient complained about paresthesias and numbness in the thumb, index and middle finger. As the hours went by, the symptoms worsened and the swelling increased.

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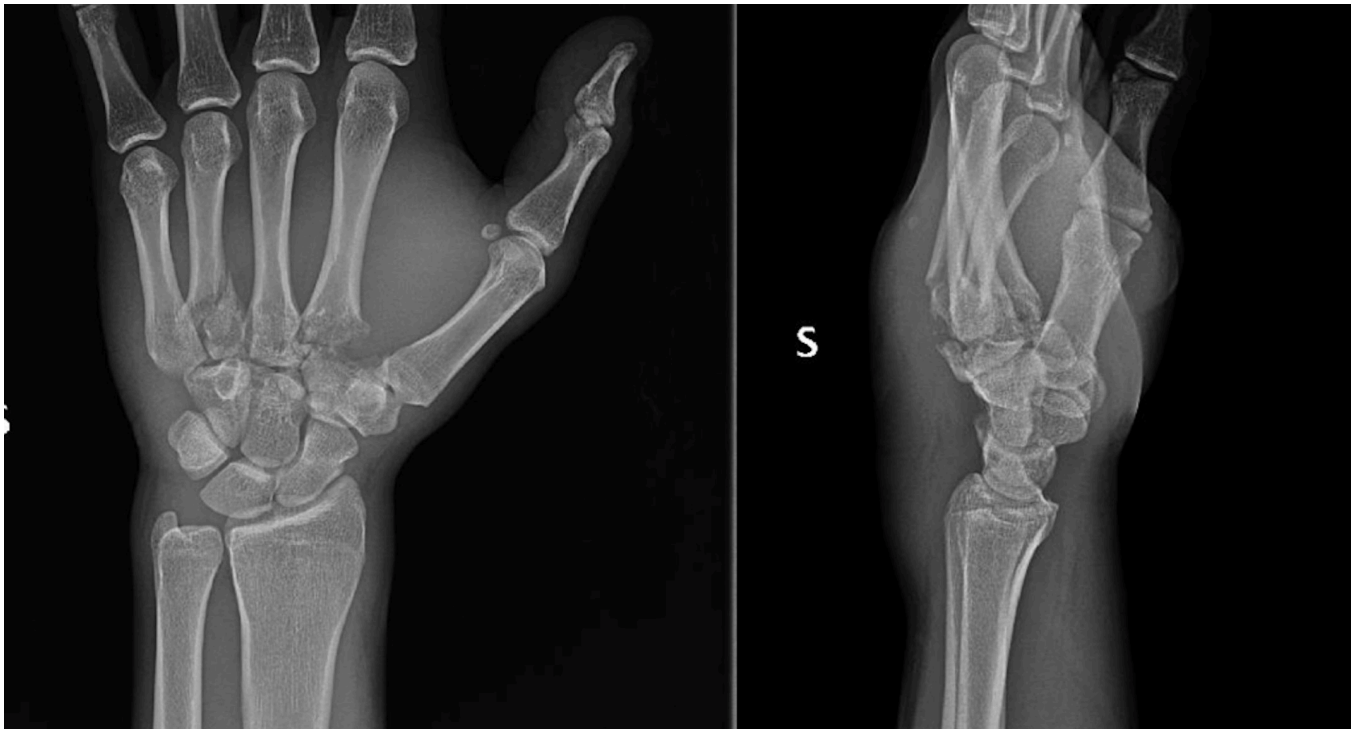


Figure 1. Xray of the left hand at the admission. Fracture of the base of the fourth metacarpal and fracture dislocation of the base of the second metacarpal can be seen in both views.



Figure 2. The clinical aspect of the hand.

Fasciotomies of the forearm and of the hand were performed after three hours: authors made a volar curvilinear incision along the forearm carried distally to the palm and the carpal tunnel was released. Two dorsal incisions in the hand were made (Figure 3). In addition the fracture of the fourth metacarpal was re-

duced and stabilized with K-wires. The closed reduction of the proximal aspect of the second metacarpal was not possible, for this reason the second metacarpal was stabilized to the third metacarpal with two K-wires (Figure 4). Retention sutures (shoelace technique) were applied, while the median nerve was covered with

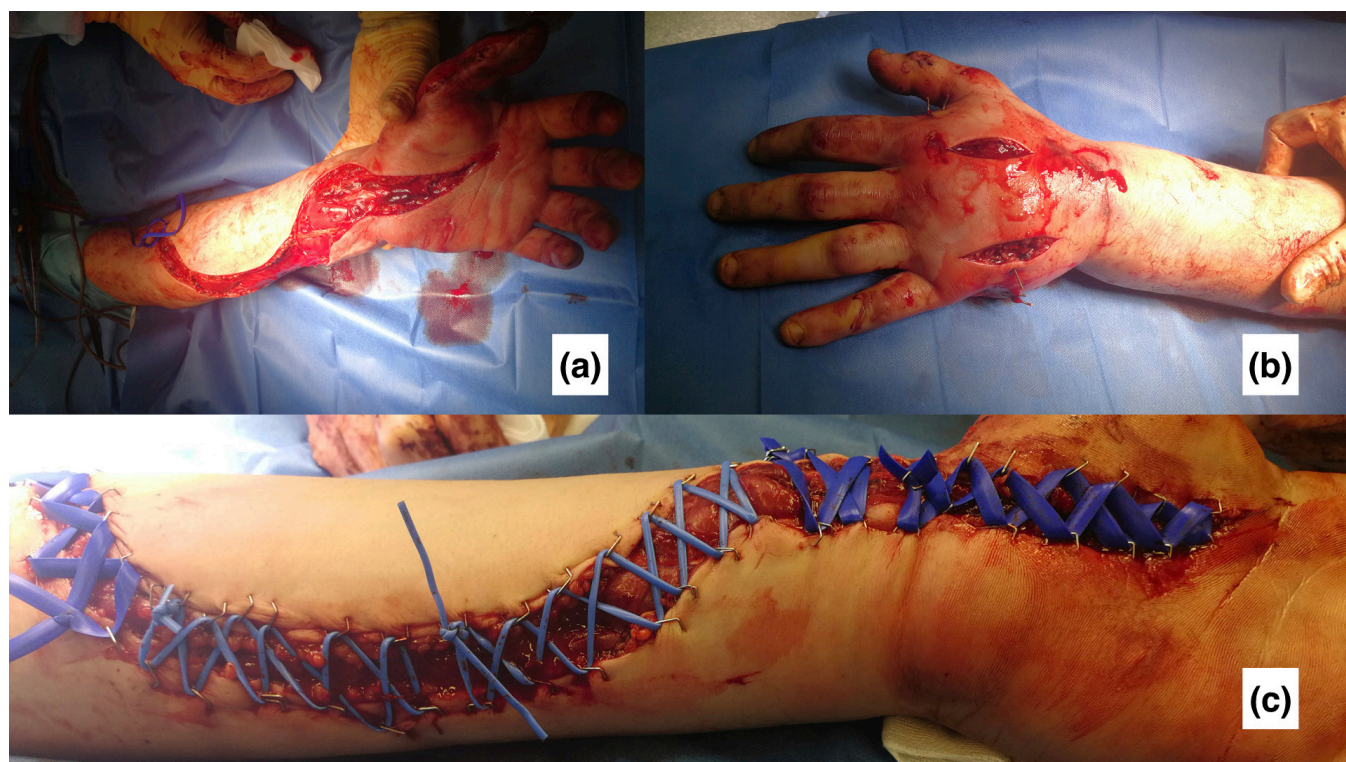


Figure 3. Intraoperative view of the volar (a) and the dorsal (b) fasciotomy. The application of retention sutures (shoelace technique) avoided retraction of the skin (c).

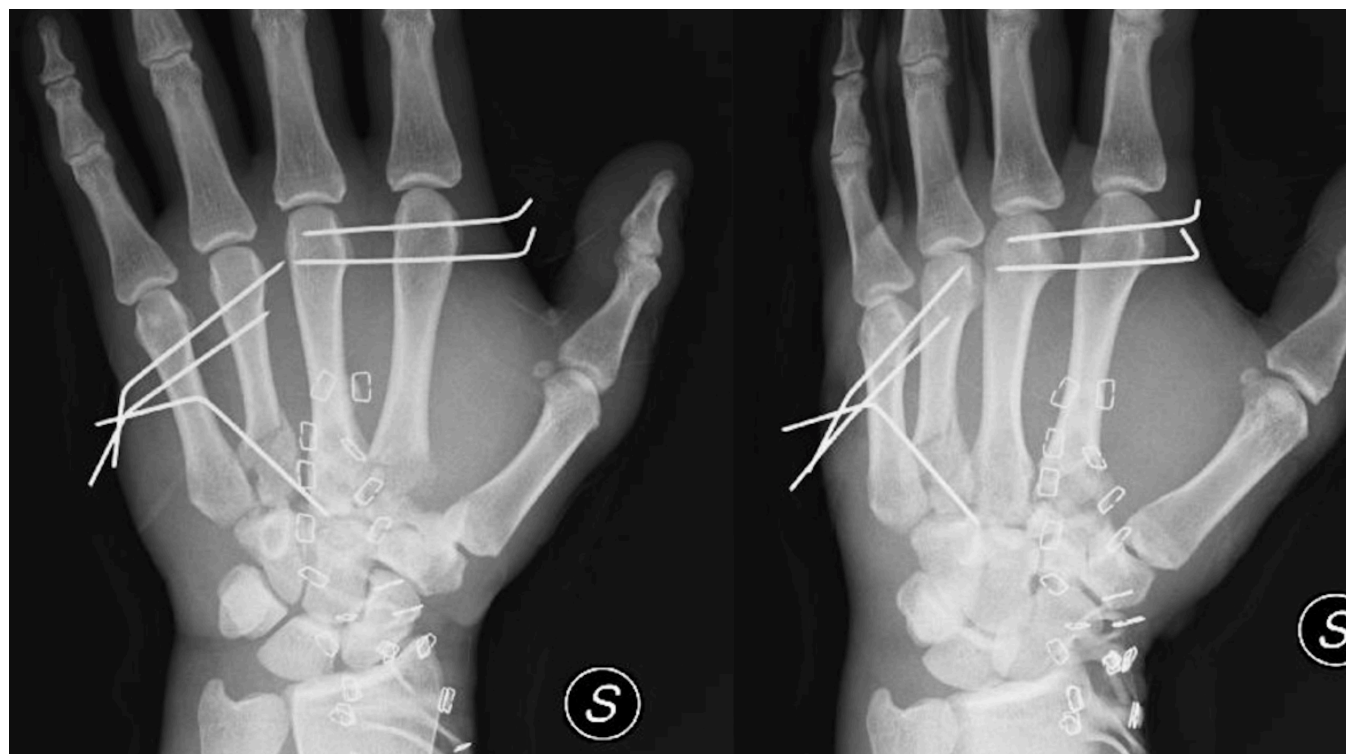


Figure 4. Postoperative xray of the hand. The fracture of the base of the fourth metacarpal was stabilized with K wires, the second metacarpal was stabilized to the third metacarpal with two K wires to keep the correct position of the shaft. The treatment of the fracture dislocation of the base was delayed to the second surgical time.

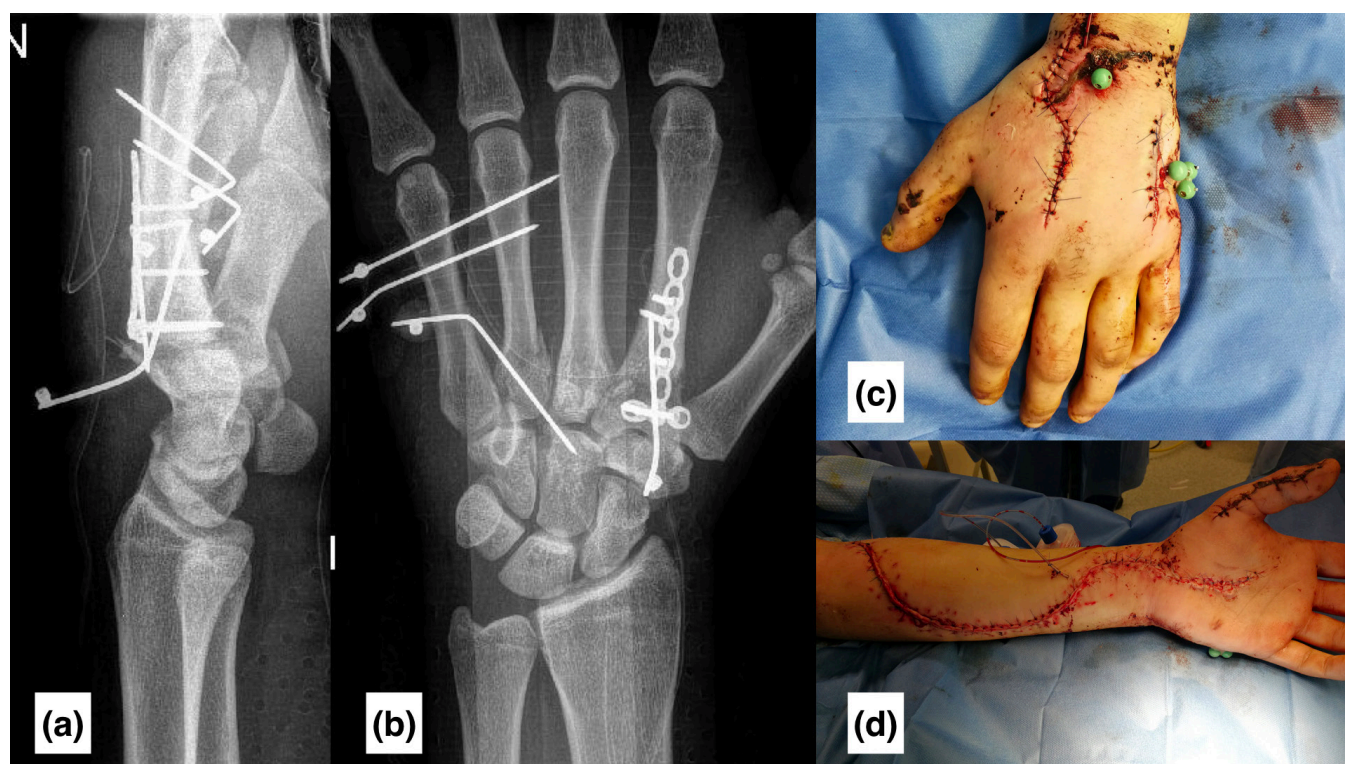


Figure 5. Postoperative xray of the hand after the second surgical time (a,b). The fracture dislocation has been treated with "T" plate. The primary closure of the fasciotomies (c,d) was possible and any skin graft was necessary.



Figure 6. Xray control of the hand two months after second surgical time. The bone healing is complete.



Figure 7. Clinical aspect of the hand and the forearm two months after surgery.

a Penrose drain (Figure 3).

In the next days the symptoms of median nerve compression solved and the swelling decreased rapidly but the patient complained about the impossibility to extend the index, and the difficult and limited extension of the wrist.

One week after the injury the second surgical time was performed: the fasciotomies were closed primarily. The open reduction of the fracture of the second metacarpal was difficult because of the displaced fragments, in addition there was comminution of the base of the third metacarpal involving the insertions of the extensor carpi radialis brevis (ECRB) and extensor carpi radialis longus (ECRL) tendons. The second metacarpal was fixed with a "T" plate; an additional K wire was implanted intramedullary to reinforce the osteosynthesis. The extensor tendons of the index were injured but it was possible to repair only one tendon. A total injury of the dorsal transverse branch of the radial artery was identified (Figure 5).

A volar splint was applied to the wrist and to the index for one month. Then the K wires were removed and active mobilization was allowed. Two months lat-

er the patient was evaluated: the wrist ROM (range of motion) was complete, the ROM of the metacarpophalangeal joint of the index was limited to 60° in flexion, while the extension was complete. The ROM of the other joints was complete.

The radiographic follow up revealed a complete bone healing (Figure 6) and the clinical outcome was good: the Quick DASH score 6,5 was and the Patient Rated Wrist Evaluation (PRWE) Score was 6, the VAS score was 0. The patient was satisfied with the aspect and the function of the hand and of the wrist (Figure 7).

Discussion

The pathophysiology of compartment syndrome is well established and known; the clinical signs and symptoms are classical described with the 5 Ps: pain, pallor, paresthesias, paralysis and pulselessness. The most important is the pain that is out of proportion to the clinical situation. The other P's are confounding because they are not always present and their absence does not rule compartment syndrome out [1]. These criteria are more useful to diagnose vascular injury rather than compartment syndrome. Another clinical sign is the intrinsic muscle minus position due to the irreversible damage to the muscles and the subsequent ischemic retraction [2].

To achieve an early diagnosis of compartment syndrome, intracompartmental pressure (ICP) measurement has been proposed; nevertheless nowadays there is no consensus about clinical indication for monitoring this parameter. The main reason is the absence of an optimum threshold for the ICP [3]. An absolute ICP of more than 30 mmHg or a PP (perfusion pressure), calculated as the difference between the DBP (diastolic blood pressure) and the ICP, of 30 mmHg, has an acceptable sensitivity but poor specificity [3]. Hayakawa stressed the importance of ΔP (DBP minus ICP) because there are different thresholds assumed by different authors. Taking into consideration only the ICP could lead to over diagnosis [4]. It is widely accepted that the diagnosis is based mainly on clinical suspicion

while the role of ICP measurement is really important in patients that are unconscious, that are difficult to assess, in young child and intoxicated patients, moreover in patients with limb anesthesia [3-5].

Timing for surgery is crucial. The paper by Hayakawa et al. highlighted that if fasciotomy is performed within 6 hours, 88% of patients have an acceptable outcome, while in the patients where fasciotomy is delayed more than 12 hours, only 15% have an acceptable outcome (limb with normal function, without any residual motor or sensory deficit). The amputation rates were 3,2% and 14% respectively for the two groups, and the death rates 2,0% and 4,3% [4].

It is mandatory to perform fasciotomy as soon as possible once the diagnosis is done, paying attention to decompress all the compartments of the hand and, if necessary, of the forearm too. In the hand there are 10 osteofascial compartments: 4 dorsal interossei, 3 palmar interossei, thenar and hypotenar compartments and adductor pollicis. Some authors consider the Loge de Guyon and the carpal tunnel as two additional separate compartments. In the fingers, there are spaces created by the boundaries of Grayson and Cleland ligaments, often considered as individual compartments [6-8].

The compartment of the adductor pollicis and of the interossei are decompressed through two dorsal incisions over the second and fourth metacarpal bone. The thenar and hypothenar compartments can be incised from the palmar side. The fingers can be decompressed over lateral mid axial incisions placed dorsally in order to avoid flexion contractures [8].

To decompress the forearm several approaches have been described, all incisions cross the antecubital fossa, then the forearm with curvilinear fashion on the volar side. Distally the incisions can be directed to decompress the Guyon Loge or carpal tunnel.

In literature only few indications about management of fractures associated with compartment syndrome exist. Dolan delayed the treatment of metacarpal fracture 3 days after fasciotomies [9]. Breda suggested

to fix the fractures with K wires in the same time of fasciotomies [10]. Kumar suggested to stabilize fracture, preferring external fixation [7]. It is important to avoid the use of pneumatic arm tourniquet in the setting of fasciotomy to assess the post decompression perfusion.

Closure of the fasciotomies wound can be challenging. The shoelace technique has proven to be effective in preventing the retraction of the skin; moreover this technique allows gradually closure of the wound with progressive tension of the sutures.

Often a split thickness skin graft is required to cover the remaining defect. This could be necessary if the closure is not possible within 5 days [6,7].

There is still a debate whether to decompress carpal tunnel or not. Rubinstein reported that at a tissue fluid pressure threshold of 40 to 50 mmHg, sensory and motor function of the median nerve demonstrated partial to complete blockade. This is the intracompartmental pressure at which carpal tunnel release is recommended [6]. Several authors recommend to decompress the carpal tunnel through the palmar incision used for fasciotomies [7,8]. On the other hand del Pinal released the carpal tunnel only if preoperatively the patient referred paresthesias in the median nerve distribution or if the tissue pressure in the carpal tunnel was higher than 30 mmHg [2].

According to the literature and our experience, the diagnosis of compartmental syndrome in the hand and in the forearm is based mainly on clinical signs and symptoms; the intracompartmental pressure measurement could be useful especially in patients that are unconscious or with limb anaesthesia.

It is mandatory to perform fasciotomies as soon as the compartmental syndrome has been diagnosed and to release all the compartments in order to avoid muscular necrosis and nerve damage. We recommend to decompress carpal tunnel whenever there is suspicion of compression of median nerve. If there are symptoms of compression of the radial and ulnar nerve it is important to decompress them as well.

According to us it is important to stabilize the fractures percutaneously or with external fixation, if it is possible in the same surgical time of fasciotomies, while if, open reduction is needed, it is better to fix fractures in a second surgical step.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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