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Traumatized Hand – Update at the First Visit

Mão traumatizada – Atualização no primeiro atendimento

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Abstract

The hand is the segment most exposed to trauma, with a large volume of care in urgent and emergency services. Therefore, it is necessary that physicians on duty have the essential knowledge to effectively manage these injuries. In the present article, we will review the main conditions and conduct guidelines.

Keywords

- hand injuries
- emergencies
- bone fractures

Resumo

A mão é o segmento mais exposto ao trauma, com grande volume de atendimento em serviços de urgência e emergência. Portanto, faz-se necessário que os médicos plantonistas tenham conhecimento primordial para a conduta eficaz frente a essas lesões. Neste artigo, revisaremos as principais afecções e orientações de condutas.

Palavras-chave

- traumatismos da mão
- emergências
- fraturas ósseas

Introduction

The hand is the segment most exposed to trauma, and it corresponds to a significant portion of the demand for emergency services: ~ 20% of the number of visits in general.[1–4] This number of injuries is due to constant exposure to work, home or leisure environments. Therefore, we find a predominance of hand trauma in all age and population groups.[5–11]

For the economically-active population, hand traumas imply temporary or permanent losses and result in social and economic costs, which involve the period of treatment and rehabilitation.[12] Appropriate management, especially in the first visit to hospital, optimizes the functional recovery process of the hand and prevents undesirable sequelae.

The present article aims to review the main emergency hand traumas and provide guidance on the first care, with an emphasis on the key points that can help professionals involved in the care of traumatized hands.

Primary assessment

Appropriate anamnesis, with an emphasis on the trauma mechanism, is essential for the correct diagnosis and management. In this process, causal factors and the environment of the occurrence are evaluated, which are useful to delineate the extent of the lesions to provide the necessary treatment.[13]

Particular attention should be paid to multiple-trauma patients, in which trauma to the extremities may be less

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evident than severe systemic injuries, especially if the patient is unable to signal complaints.[14] The physical examination should be repeated in greater detail after the initial assessment and stabilization of the overall picture, following the principles of Advanced Trauma Life Support (ATLS).

General physical examination of the hands

- General inspection: wounds, edema, ecchymosis, limb posture, angular deformities (flexed fingers should point towards the scaphoid tubercle);
- Active and passive motion test (range of motion). Isolated evaluation of each finger. Search for tendon integrity; and
- Motor and sensory neurological tests, tested comparatively with the non-injured side.

Complementary diagnostic tests

In the emergency room, radiography is the most indicated complementary test. It identifies the main lesions when performed in radiographic projections appropriate to the area to be investigated. There are particularities in relation to radiographs of the hand due to the overlap and number of bones. Pay attention to the projections in the correct form to be requested as specified below:

- FINGERS: posteroanterior (PA) and profile, centered on the finger;
- HAND: PA, oblique and lateral (in this one, angulations in the coronal plane and fracture of the base are better visualized); and
- CARPAL BONES: PA and wrist profile.
  - Special cases:
    - suspected scaphoid fracture – PA with ulnar deviation of the hand; and
    - in scapholunate ligament injury – pencil grip PA.[15,16]

It is important to remember that contralateral radiographs can help to compare structures and diagnose lesions, and that, after the initial approach, other imaging tests may be necessary to establish a diagnosis of the lesions not shown on radiography or even to grade those already identified.

Management of specific injuries

Skin

The dorsal skin of the hand is thin, little keratinized, and provides great gliding, but little resistance to impact absorption. Contrarily, the palmar portion has thick skin and a thick layer of keratin. This skin is very resistant to pressure; however, the adherence to the palmar fascia makes gliding difficult.[17] These characteristics require some care in the face of wounds and sutures in the hand, which is listed schematically below:[17]

- Wounds on the back of the hand can lead to injury to the extensor tendons: test the complete extension of the metacarpophalangeal (MCP) joint;
- Sutures should not cause tension: especially on the palmar skin, in which there is little resistance to traction;
- Pay attention to the lines related to flexion-extension movements of the fingers and hand: longitudinal wounds to the flexion creases in the palm will have a greater tendency to scar retraction with limitation of the full extension of the fingers;
- Finger wounds: a careful tourniquet at the base of the finger helps control bleeding and detail the injury;
- Suture stitches in hand and finger wounds should be removed after 15 days;
- The dressing with dry gauze must remain while the suture stitches are maintained;
- After removal of the suture stitches: provide guidance on healing care (hydration and mobilization);
- Healing by secondary intention: small areas, with no possibility of complete approximation of the sides, and no exposure of bone, nerve, vessel, and tendon without sheath;
- Local flaps: the flap popularized by Atasoy (V-Y) is preferably indicated for digital losses and transverse extremity amputations; and
- Extensive skin loss or with exposure of specific structures: carry out first cleaning and dressing care, guiding the patient to the possible next procedures (grafts and flaps).

Nail

Compressive nail trauma is very common. In young children, from 0 to 6 years of age, it is the area of greatest trauma to the hand.[18,19] Nail avulsions should be reinserted using a "U" point to guide the tip of the finger.[20]

Aseptic drainage of subungual hematomas that cover more than 25% of the bed is recommended, although some authors mention 50%.[21–23] Hematomas greater than 50% associated with a fracture suggest bed injury, and removal of the nail is considered for repair with fine suture threads (of 6.0 or 7.0), which provides adequate growth and adherence of the nail. The use of magnification is advised due to the fragility of the structures.

Tendons

Even small hand injuries cause tendon injuries, with high rates of failure to diagnose. Therefore, the physical examination must be individualized for each muscle group: superficial and deep finger flexors, MCP and interphalangeal (IP) extensors, thenar muscles (mobility of the thumb), hypotenar muscles (mobility of the fofth finger), lumbrical (MCP flexion) and interosseous muscles (adduction and abduction). The frequent association of digital nerve injuries with flexor tendon injuries is noteworthy.

In identifying the tendon lesion, the guidelines for tenorrhaphy are followed, which should be performed at an early stage. Certain lesions, such as those to the back of the hand, are easily accessed during emergency care, and enable suturing without great technical difficulty, as long as the use of non-absorbable sutures with an atraumatic needle is followed. Lesions to other sites, such as to the flexor tendons

in Verdan zones I and II (osteofibrous tunnel), require technical experience and the application of a specific protocol for functional rehabilitation of the hand. In these cases, it is important to conduct the initial procedure: cleaning the wound, suturing the skin, dressing, and instructing the patient about the need for tenorrhaphy (►**Figure 1**).

The most common tendon injury is the deformity known as "hammer finger", which commonly results from axial trauma.[4] A lateral X-ray of the affected finger is mandatory to investigate associated fractures. The treatment of a closed injured, as long as there is no palmar subluxation of the distal phalanx, presents good results with the continuous use of an aluminum splint or prefabricated orthosis, maintaining a slight hyperextension of the distal joint of the finger (►**Figure 2**). Replacements need to be supervised, and immobilization, maintained for six to eight weeks. The greater the initial flexion of the distal IP joint, the greater the injury to the terminal extensor band and its expansions. In these cases, and especially if there is subluxation of the distal phalanx, reduction and transarticular fixation with a 1.0-mm Kirschner wire is recommended. The same parameters apply to the lesion to the closed central band – "buttonhole deformity", which occurs in the proximal IP area of the finger. Immobilization should be performed with a splint only on the proximal IP joint, keeping it in extension.[24,25]

Such closed injuries to the extensor system of the fingers, when diagnosed within two weeks of the trauma, are subject to conservative treatment with good results.[24]

Nerves

Similar to tendon injuries, neurological injuries can go unnoticed. Reasons for the failure to diagnose these lesions are: small or punctiform wounds, alterations in sensitivity incorrectly attributed to edema, or, absence of test before anesthesia.

A thorough and comparative examination, testing movements and sensitivity (a patient with eyes closed better perceives differences), helps to identify nerve damage. If nerve damage is observed, it must be repaired early with microsurgical techniques, preferably within less than three weeks of the trauma:[26–28]

Below, the innervation of the hand is highlighted:

- RADIAL NERVE. Motor function: thumb and MCP extension. Sensory function: dorsum of the first commissural web;
- MEDIAN NERVE. Motor function: opposition of the thumb and pinch grip with flexion of the pulps of the first and second fingers. Sensory function: pulp of the distal phalanx of the second finger;

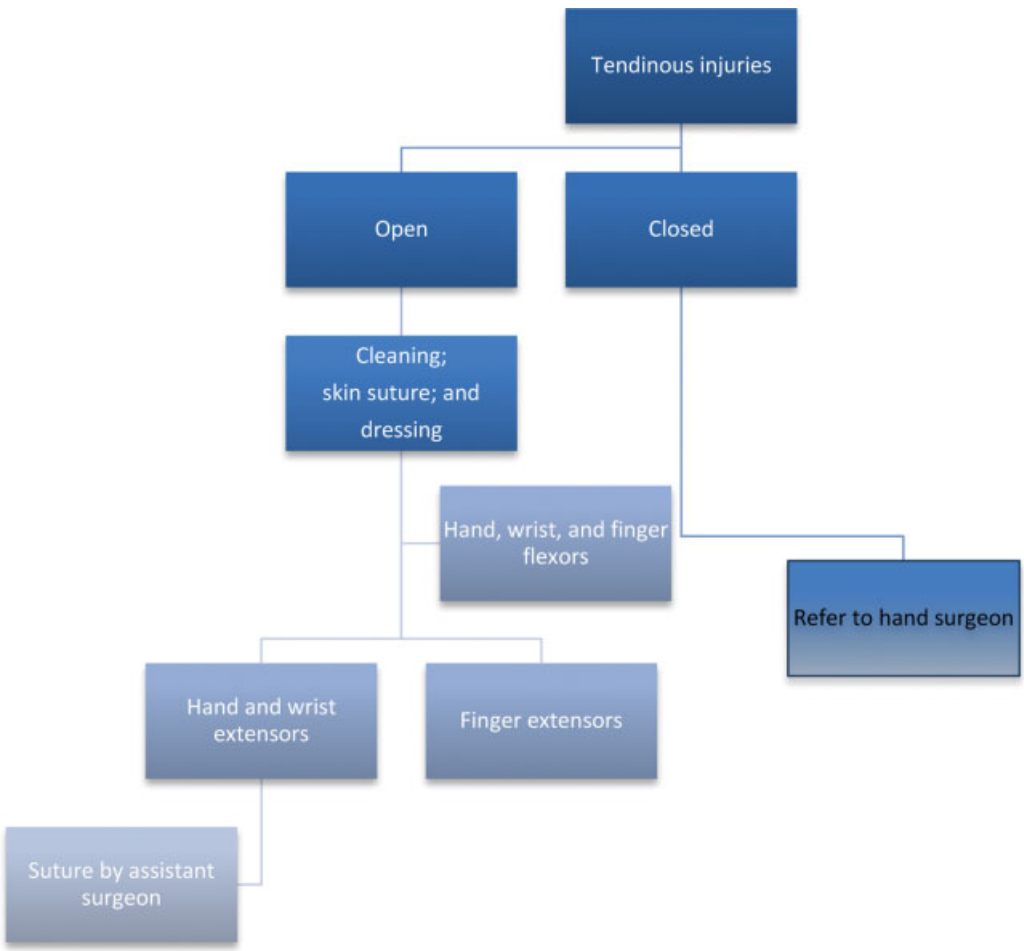

Fig. 1 Instructions regarding the management of tendon injuries.

Fig. 2 (**A**) Hyperextension splint (hammer finger). (**B**) "U" splint for distal phalanx. (**C**) Semi-flexed splint.

- ULNAR NERVE. Motor function: finger adduction/abduction and thumb adduction. Sensory function: ulnar edge of the fifth finger.

Fractures

Phalanx

Phalangeal fractures have a higher incidence among fractures in general, between 19% and 28%, including in sports.[4] A considerable part of these fractures will have satisfactory results with the conservative treatment, as long as their particularities and acceptable deviations for eventual angulations are respected.[29] When intra-articular, there may be a relationship with subluxation in the IP joints, better evidenced on the lateral radiograph of the finger. Avulsion-fracture of the volar base, in the middle and distal phalanges (insertion of the superficial and deep flexors respectively), has great potential for instability and subluxation, especially if the bone fragment is greater than 40% of this joint.[29,30] If they are stable, phalangeal fractures are best treated with a dorsal splint, blocking the extension of the respective joint.

Extra-articular phalangeal fractures can suffer the action of tendon insertion in the region, resulting in angular deviations. ►**Table 1** lists phalangeal fractures with the trauma mechanism, possibility of conservative treatment, and suggested immobilization (►**Table 1**).

During conservative treatment, especially in the first two weeks, pay attention to the relationship between the fracture site and tendon insertions. Blocking muscle action prevents displacement and loss of fracture reduction. The immobilization time comprises three to four weeks, which are necessary for the clinical consolidation of these fractures.

Some fracture patterns are indicated for surgical reduction and fixation:

- Unstable extra-articulars fractures after reduction and immobilization;
- Intra-articular fractures with deviation or unstable after reduction;
- Dislocated or subluxated intra-articular fracture (fragment greater than 40% of the joint on lateral radiographs); and
- Open fractures.

When there is an indication for reduction, most phalangeal fractures evolve to a good outcome with closed reduction and percutaneous fixation (with a 1.0-mm Kirschner wire), maintained for about four weeks. However, plates and screws of specific size for the phalanges can be used, which are preferred for the treatment of joint, multiple and complex injuries, as they provide more stability and enable early mobility of the fingers. Soft-tissue trauma and the learning curve required to properly master the technique must be considered when using these syntheses.[30–32]

Metacarpals

The common injury mechanism in metacarpal fractures involves axial or compressive trauma.[33] It can be accompanied by associated cutaneous and tendinous injuries, usually caused by sharp trauma to the back of the hand. Fracture location and displacement, association with other metacarpals, soft-tissue injury and bone exposure guide the limits of the conservative treatment.

Table 1 Relationship between the phalanx of fingers, trauma mechanism, fracture pattern/acceptable deviations and suggested immobilization in the conservative treatment of extraarticular fractures

Phalanges	Most common trauma	Fracture pattern	Type of immobilization
Distal	Axial or compressive	Tophus (extremity); longitudinal; no angulation	"U" aluminum splint up to the proximal interphalangeal joint (►**Figure 2**)
Middle (diaphysis)	Torsional or direct	Rotational: 0°; coronal plane: $< 5°$; sagittal plane: $< 10°$	"U" aluminum splint up to the metacarpophalangeal joint
Proximal (diaphysis)	Torsional	Rotational: 0° coronal plane: $< 5°$; sagittal plane: $< 10°$	Volar aluminum splint, metacarpophalangeal joint in semi-flexion (►**Figure 2**)

The limitations for the conservative treatment include:

- ABSENCE of rotational or sagittal deviations;
- Shortening < 5mm;
- First, fourth and fifth metacarpals: deviations of up to 30° (on lateral radiographs); and
- Second and thrid metacarpals: deviations up to 10° (on lateral radiographs).

Regarding diaphyseal fractures, the wider mobility of the 1st, 4th and 5th carpometacarpal joints contributes to the acceptance of greater deviations, compared to fixed radii, without prejudice to the pinch function and grip strength.

Fractures to the metacarpal neck with accentuated volar angles can cause pseudoclaw deformity due to changes in the action vector of the common extensor tendon of the fingers. The Jahss maneuver helps to reduce displaced fractures.[31] The volar deviations of the head of the metacarpals considered acceptable are different in each area, being of 15° for the 2nd and 3rd metacarpals, between 30° and 40° for the 4th, and between 50° and 60° for the 5th metacarpal.[30]

Intra-articular MCP fractures can be treated conservatively, as long as the deviation is not greater than 1 mm, and the involvement of the articular surface is lower than 25%.

Fractures that affect the base of the metacarpals are frequently associated with instability or carpometacarpal dislocation due to insertions of the carpal tendons and ligaments. They rarely have satisfactory results with the conservative treatment.[30,31]

When there is an indication for surgical treatment for fractures to one of the metacarpal segments, plates, specific screws and Kirschner wires may be used. The choice will depend on factors previously discussed and the surgeon's experience.

For the conservative treatment, immobilization is recommended with the following parameters: wrist at 0° to 30° of extension; metacarpophalangeal at 70° of flexion; allow for interphalangeal mobility; interpose gauze between the fingers in order to avoid skin lesions.[30,31,33]

Carpus

Fractures to the carpal bones are usually caused by a fall with the hand flat, in which the scaphoid is placed in an impact position, comprising about 60% to 70% of the fractures in this region.[34–36] Due to its peculiar structure and vascularization, fractures to this bone may not be observed on radiographs following trauma. If the clinical picture is positive (pain on dorsal and palmar palpation of the scaphoid and positive pistoning of the thumb against the scaphoid), even with inconclusive radiographs, the wrist should be immobilized as a precaution until return in 7 to 15 days.[35–37]

Tomography and magnetic resonance exams are used in some cases to identify the scaphoid fracture, considering the costs and functional requirements of the patient. Fractures to the neck or distal pole of the bone that are stable and do not present a deviation can be treated conservatively and have a good prognosis. Bone fixation is indicated for unstable fractures (those with deviation > 1.0mm, fragmented, or to the proximal pole) in which there is a risk of developing pseudarthrosis and consequent radiocarpal arthrosis.[35–37]

Scaphoid fractures associated with injuries to other carpal bones, dislocations, or distal fractures of the radius are unstable and caused by high-energy trauma. Surgery with stabilization and ligament reconstruction are indicated for these severe and complex injuries.[35–37]

Isolated fractures in other carpal bones are uncommon, as well as deviations. In general, the treatment is satisfactory with the use of simple immobilization for four weeks.

Ligament injuries

Interphalangeal and MCP sprains are common hand traumas that may be associated with small joint fractures, diagnosed with appropriate radiographs. Having ruled out the possibility of fractures and after a comparative examination of joint stability, immobilization for two weeks is sufficient for a good result.[38] The constant edema in the IPs and MCPs leads to stiffness and dysfunction. Therefore, in these sprains, treatment that enables joint mobility, even if partial, is preferable, such as bandaging an injured finger to an uninjured one (buddy taping).

Complete ligament ruptures are rare. Once instability is diagnosed with the joint stress test (which can also be performed during radiography), there will be indication for surgical repair, especially in weight-bearing areas, such as in the rupture of the ulnar collateral ligament in the MCP of the thumb.

Dislocations in IPs and MCPs require reduction under anesthesia, aiming to relax structures that may be interposed and that prevent the reduction.[38,39] After joint congruence, maintain a splint for 15 to 20 days, avoiding the movement that caused the dislocation.

Carpometacarpal and intercarpal dislocations may go unnoticed. They are often related to high-energy trauma. A careful clinical examination must be performed, requesting appropriate radiographs and observing the correct angulations between metacarpals, carpal bones, and the distal thirds of the radius and ulna (►**Figure 3**).[40] Comparative radiographs of the unaffected side helps in the diagnosis of these severe lesions treated with surgical reconstruction.

Multiple and complex injuries

Complex hand injuries involve multiple structures or even amputation of segments. There is a relationship with high energy and risk of function impairment. The emergency assessment must follow the concept of care for the multiple trauma patient (ATLS).

Essential measures in the first care include:

1. Control of bleeding
   Due to the caliber of the vessels in the hand region, hemostasis is often already contained by thrombus formation. Pressure on the wound for a few minutes or an occlusive dressing with an elevated limb should be used in the presence of active bleeding. Ligation of vessels in the hand or wrist in the emergency room is contraindicated,

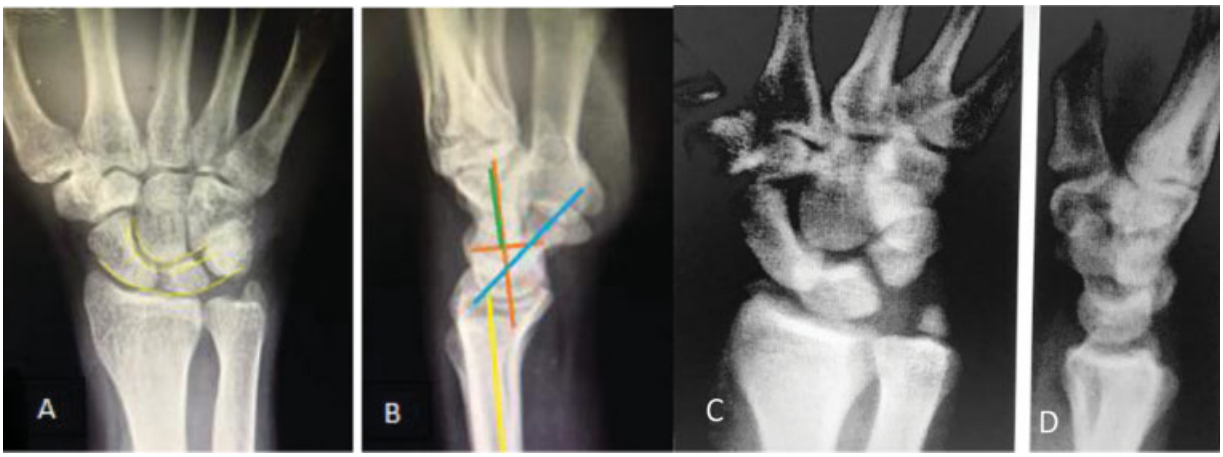

Fig. 3 (**A**) Gilula arches and (**B**) axes of the carpal bones with the radius (necessary for measuring misalignments and dislocations). (**C** and **D**) Posteroanterior (PA) and lateral radiographs of a perilunar fracture-dislocation, with involvement of radial and ulnar styloid. Note the broken arches and loss of normal angulations.

as there is a risk of involving structures such as nerves and tendons.[41]

2. Antibiotic therapy
   The use of first-generation cephalosporin (active against Gram-positive organisms) and gentamicin (active against Gram-negative organisms) is recommended. Include penicillin in the case of rural environments.[42,43]
3. Debridement
   Debridement must be performed in the operating room under adequate anesthesia, in a cautious manner, respecting the limit of live, bleeding tissue. Good tissue healing will be achieved if this procedure is properly performed.[41,42,44]
4. Bone stabilization
   Osteoarticular stabilization, whether temporary or permanent, is an essential part of the first care. It enables bone alignment, preserves vascularization, reduces edema, and prevents infection. Kirschner wires are recommended for this initial purpose.[41,42,44]
5. Complementary procedures
   After performing the first emergency care, new procedures may be necessary as required. Dressings under anesthesia after 24 to 48 hours are appropriate for the reassessment and to schedule the next steps. Definitive fixation of osteoarticular injuries, neurotendinous repair and skin coverage will be defined in the following days, in accordance with the severity of the injury and the patient's clinical conditions.

Final Remarks

Regarding hand injuries, some important aspects of care are highlighted:

- MOBILIZATION: instruct early mobility of the hand and fingers;
- DRAINAGE: intersperse periods of limb elevation, and avoid compartment syndrome;
- SKIN: protect contact areas with gauze (especially between the fingers), instruct care with dressings.

The number of patients with hand trauma who seek emergency care is expressive, and the trauma comprises a wide range of injuries. It is up to the physician on duty to observe the particularities of each lesion, with special attention to the anatomy, promoting the first adequate care and thus avoiding irreversible consequences to the function of the hand.

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