3 Carpal Fractures Excluding the Scaphoid and Hook of Hamate

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Introduction

Fractures of the wrist in athletes most commonly involve the scaphoid and hook of the hamate and thus require a full discussion in separate chapter. While other fractures of the carpus are rare, it remains critical for the physician to help determine when a player may return to sport early versus when the athlete must be managed with longer periods of immobilization versus when the athlete requires surgery.

Injuries can be divided into three main groups depending on the mechanism of injury: perilunate injuries, axial injuries, and avulsion injuries [40, 48].

The work-up of carpal fractures typically starts with physical examination. Plain radiographs are enhanced with specific views depending on the type of fracture suspected. If there is concern but no obvious fracture is identified on plain radiographs, CT or MRI scans provide invaluable information.

Many carpal fractures occur with other injuries, including other carpal fractures and carpal dislocations. In any case of carpal dislocation, careful examination of the neurovascular status should be performed with particular attention paid to the median nerve, which can be seen in up to 50% of cases, as median nerve injury can lead to persistent symptoms [11].

Triquetral Fractures

Triquetral fractures are second only to scaphoid fractures and comprise 3–5% of all carpal fractures [4, 6, 8, 21, 38]. Physical examination can be difficult to isolate in these injuries given its proximity to the ulnar side of the wrist, including the TFCC. They are typically identified on radiographs. A 45° pronated oblique XR of the wrist can be helpful in the evaluation [12, 13]. If there is concern for injury that is not identified on plain radiographs, then CT scans are helpful in identifying them.

These fractures can occur within three varieties: dorsal chip fractures, volar avulsion fractures, and body fractures. Dorsal triquetral chip fractures typically occur with extreme palmar flexion and radial deviation and result from the pull of the radiotriquetral and triquetroscaphoid ligaments [6, 20]. They are seen most easily on the lateral view as shown in Fig. 3.1. Alternatively, these fractures can occur with a fall onto an ulnarly deviated wrist that is in dorsiflexion, in which case the ulnar styloid is driven as a chisel into the dorsal cortex of the triquetrum [13–15, 23]. In fact, a large ulnar styloid has been proposed as a predisposition to this type of fracture [14]. Dorsal chip fractures can be an incidental finding on a

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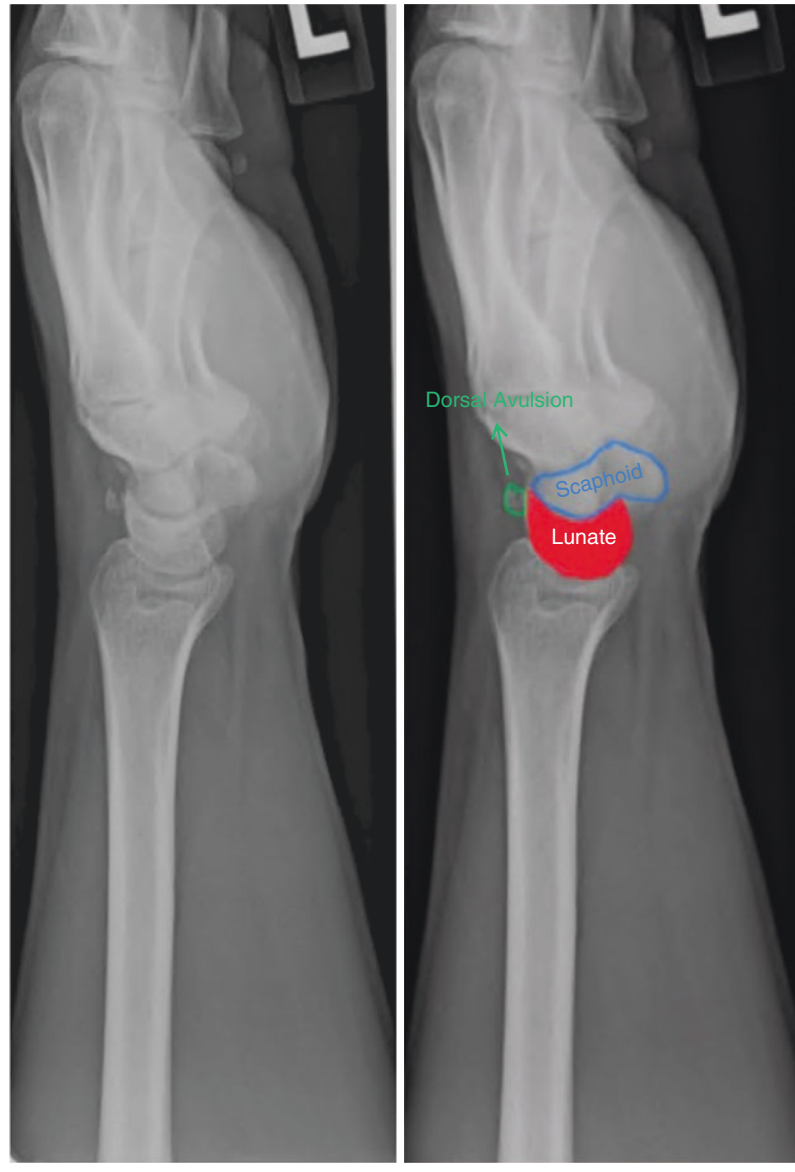

Fig. 3.1 Triquetral fracture. Representation of a dorsal triquetral chip fracture

lateral radiograph. If acute injury is suspected, then short periods of immobilization of 1–2 weeks with interim evaluation can help determine the appropriate time to return to play. However, if there is marked swelling of the wrist, then a MRI should be obtained. If pain persists beyond 8 weeks, MR arthrography is recommended to investigate the possibility of a concurrent intercarpal ligament injury or TFC tear [24].

Volar triquetral avulsion fractures are considered avulsion of the palmar ulnar triquetral ligament or the lunotriquetral ligament. Radiographic evaluation includes radial deviation views. These fractures are indicative of carpal instability, which is the primary focus of treatment. Thus, volar triquetral avulsion fractures do not require specific treatment but should alert the treating provider of possible carpal instability [39, 40].

Triquetral body fractures are typically high-energy injuries that are associated with greater arc perilunate fracture dislocations [25]. It is imperative for the treating physician to be aware and

look for these types of fractures in the setting of a perilunate dislocation. Treatment of triquetral body fractures varies depending on the characteristics of the injury. For perilunate injuries, we recommend pinning of the lunotriquetral joint. A displaced triquetral body fracture warrants open reduction internal fixation [11, 36]. For chronic cases that have led to pisotriquetral arthritis, excision of the pisiform has been helpful [1, 41].

Hamate Fractures

Fractures of the hamate are slightly less common than triquetral fractures and occur in 2% of all carpal fractures [16]. The hook of the hamate fractures occurs more frequently and is covered elsewhere. Hamate body fractures typically occur with high-energy axial loads and occur concomitantly with fourth and fifth carpal-metacarpal fracture dislocations. Hamate body fractures can be difficult to detect on plain radiographs, but obtaining CT imaging with the hands in the praying position has been shown to be beneficial for detecting them, as is shown in Fig. 3.2 [3, 22].

Hamate fractures primarily occur during stickhandling sports such as baseball, golf, and tennis [33]. They are frequently misdiagnosed, but the treating physician should be aware when a patient presents with diminished grip strength, ulnar nerve paresthesias, or mild carpal tunnel syndrome [32, 44].

Hamate body fractures can be broken down into four major groups: sagittal oblique fractures, dorsal coronal fracture, proximal pole fractures, and fractures of the medial tuberosity [14, 15, 28]. The most common types of hamate body fractures are coronal body fractures and hamato-metacarpal fracture-dislocations [33].

Treatment involved open reduction internal fixation if there is involvement of more than 1/3 of the hamate body or articular involvement, typically performed with compression screws or low profile plates for bone stabilization. K-wires can be used for joint stabilization. Care must be taken when drilling from dorsal to palmar to avoid the motor branch of the ulnar nerve. If there is extensive dorsal comminution, then CMC capsular repair may be indicated.

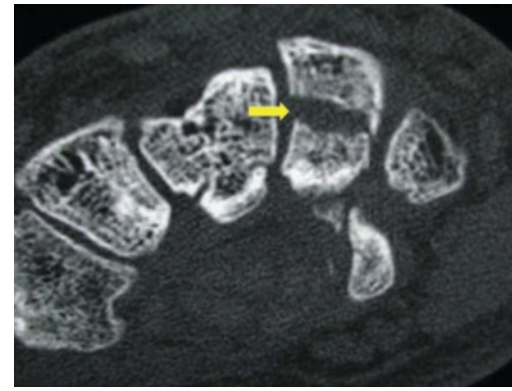

Fig. 3.2 Hamate fractures. The CT shows a comminuted hamate fracture as shown by the arrow. (From Suh Carpal Fractures JHS 2014)

Trapezium Fractures

Fractures of the trapezium comprise 4–5% of carpal fractures [10, 17, 34]. Given the association of trapezium fractures and first metacarpal fractures, care should be taken to look for trapezium fractures in the setting of a first metacarpal fracture and vice versa [10, 27, 35]. These fractures can be described as body fractures, trapezial ridge fractures, or fracture dislocations [40]. These fractures are typically high-energy fractures and occur with a fall onto an outstretched hand in which an axial load on the dorsiflexed wrist drives the metacarpal into the trapezium [18]. Examination will reveal point tenderness at the volar base of the thumb. These fractures are commonly identified on standard views of the hand, but identification can be enhanced with a Bett's view, in which the hand is slightly flexed and the thumb is pronated to give a true lateral of the thumb and to better visualize the trapeziometacarpal articulation [46]. A carpal canal view can be useful to identify trapezial ridge fractures, which are often missed with standard radiographs [26]. CT can be useful for identifying occult cases.

Given the intimate relationship of the trapezium with the first metacarpal at the first CMC joint, treatment varies depending on the morphology of the fracture. Nondisplaced fractures should be treated with thumb spica immobilization for 4–6 weeks. Comminuted fractures with reduced joints can be treated nonoperatively, as seen in Fig. 3.3a–e. Intra-articular fractures,

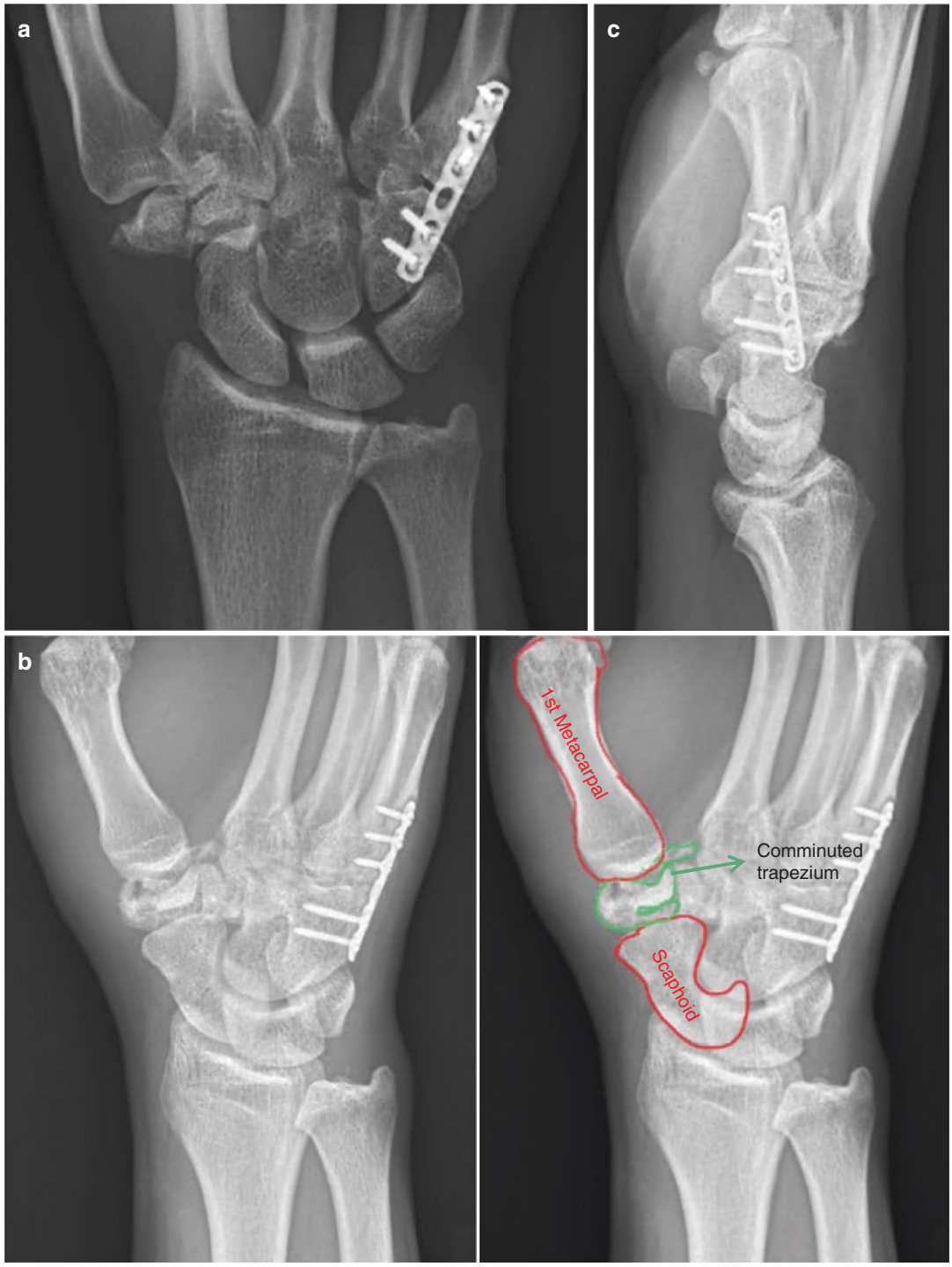

Fig. 3.3 Trapezium fracture. This 30-year-old male "jammed" his right thumb while playing flag football and presented with pain, swelling, and bruising at the base of the thumb. He had a prior CMC arthrodesis for a right small finger fracture. XR showed a comminuted fracture of the trapezium. CT demonstrated comminution of the articular surface and multiple small pieces. Given the amount of comminution, he was treated nonoperatively in a thumb spica splint for 8 weeks. At 16-month follow-up, he was not noted to have any pain in the thumb CMC joint. (**a**) PA of the hand. (**b**) Oblique of the hand. (**c**) Lateral of the hand. (**d**) The coronal CT slice. (**e**) 16-month follow-up XR. At 16-month follow-up, he was not noted to have any pain in the thumb CMC joint

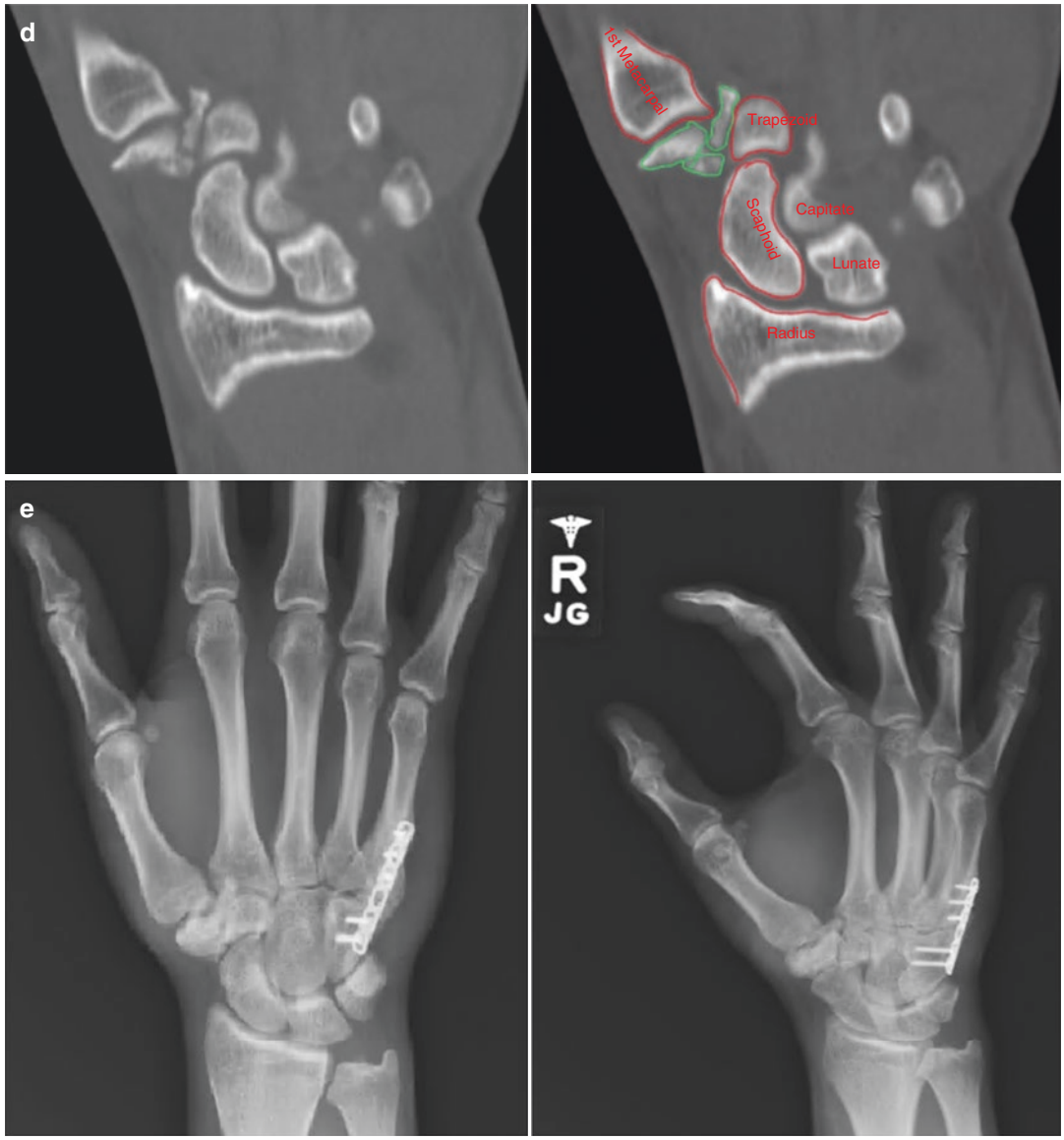

Fig. 3.3 (continued)

including ridge fractures, with >2 mm of displacement or carpometacarpal subluxation should be treated with open reduction internal fixation with pin or minifragment screws. McGuigan and Culp present 11 patients with intra-articular fractures of the trapezium with mean follow-up of 47 months with good results from open reduction internal fixation [27].

Capitate Fractures

Capitate fractures are rare given that it is protected in the center of the hand and comprise 1–2% of all carpal fractures [16]. Given its surrounding protection, isolated fractures are rare. It is more commonly associated with perilunate fracture dislocations.

Isolated fractures result from a direct blow from a baseball pitch or by indirect axial load through the third metacarpal with the wrist flexed. However, these more frequently occur in conjunction with perilunate injury, especially transverse fractures, the so-called scaphocapitate syndrome. Work-up includes a careful physical examination and plain radiographs. However, CT or MRI is frequently required to help identify capitate fractures, as is seen in Fig. 3.4 [2, 9].

Treatment of capitate fractures generally consists of nonoperative treatment for nondisplaced fractures until there are radiographic and clinical signs of healing. In cases of displacement, open reduction internal fixation with a combination of pins and/or screws can be pursued. Cases that go on to nonunion can be treated with open bone grafting and screw fixation, as seen in Fig. 3.5a–c.

It should be noted that the capitate has a retrograde interosseous blood flow, which places the proximal pole at risk for AVN with fractures through the mid-body [19, 45].

Trapezoid Fractures

Trapezoid fractures are exceedingly rare and constitute less than 1% of carpal fractures given that it is protected within the carpus [7]. There are only a few isolated case reports in the literature [29, 31, 37, 47, 49, 50]/[5]. The trapezoid is the keystone of the carpus given that it is twice as wide on the dorsal side compared to the volar side. Given its protection within the carpus, this is most commonly found in conjunction with other carpal fractures or carpometacarpal dislocations. Evaluation starts with physical examination, which would reveal point tenderness at the base of the index metacarpal. Standard radiographs can usually detect fractures of the trapezoid. Special attention should be put on the AP view to evaluate the trapeziometacarpal joint. As with all carpal fractures, CT can augment evaluation if there is concern but no obvious fracture on plain radiograph. Treatment for nondisplaced injuries consists of immobilization, as seen in Fig. 3.6. Nagumo et al. present a case report of an occult fracture in a 21-year-old male baseball player of the trapezoid which was treated with excision of the fragment resulting in improvement in function and pain relief [30]. The individual was able to return to baseball at 8 weeks and was still playing without pain and with full motion of the wrist and fingers at 4-year follow-up [30]. Nammour et al. present a case of a 23-year-old male baseball player who presented with right wrist pain resulting from a dynamic exercise movement in which he moved from a standing position down into a push-up position and was managed nonoperatively in a cast for 6 weeks who went on to have no pain and a return to baseline function at 12-week follow-up [31]. Surgical management consists of a combination of pins and screw fixation to help stabilize both the trapezium and the trapeziometacarpal joint.

Pisiform Fractures

Fractures of the pisiform are also rare, and make up 1% of carpal fractures in the Major League Baseball population. The pisiform has unique anatomy given that it articulates with the triquetrum dorsally, is the origin of the abductor digiti minimi, and serves as the attachment for the flexor carpi ulnaris, and serves as an attachment point for the transverse carpal ligament. Examination reveals point tenderness over the pisiform. The shuck maneuver could raise concern for suspicion for fracture. Given its proximity to the ulnar nerve in Guyon's canal, examination involves evaluation of the ulnar nerve.

Radiographic examination involves standard series including AP and lateral. Additional views include a carpal tunnel view and a reverse oblique view, in which the wrist is placed in 30° of supination to obtain a profile view of the pisiform, as seen in Figs. 3.7 and 3.8.

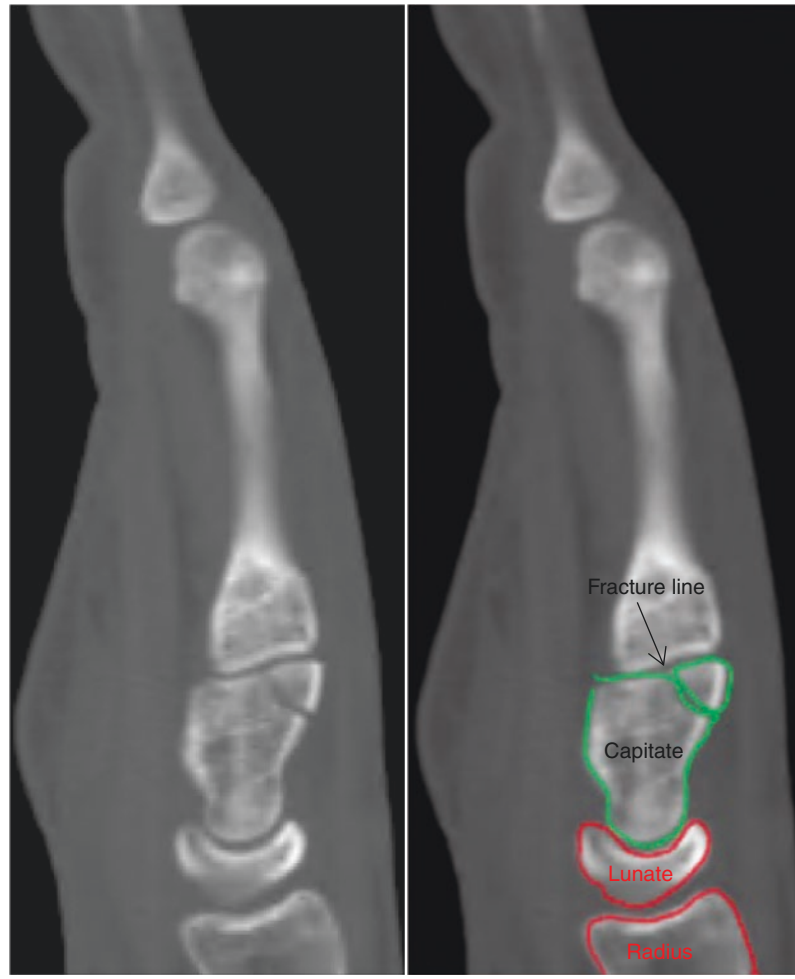

Fig. 3.4 Capitate fracture. 40F who punched a car. Small dorsal fragment. This fracture was treated nonoperatively

Nonoperative management consists of cast immobilization for 4–6 weeks. Treatment can include pisiform excision to provide expedient and safe return to sport, but that is rarely needed.

Lunate Fractures

Lunate fractures are another rare carpal fracture, comprising approximately 1% of all carpal fractures [42]. These fractures occur when the lunate is compressed between the distal radius and capitate with extreme wrist hyperextension and ulnar deviation that occurs when falling on an outstretched hand [24]. Lunate fractures have been described following a blow to the hand by a ball in line with the forearm [43]. Physical examination consists of looking for tenderness on the dorsal aspect of the lunate. Radiographic evaluation consists of AP and lateral with supplemental CT scan as needed. There is no consensus as to causal relationship between acute lunate fractures and avascular necrosis.

Lunate fractures can be managed with short courses of immobilization and re-examination in the setting of small marginal chip fractures, as seen in Figs. 3.9 and 3.10. Displaced fractures and fractures resulting in DISI or VISI deformity demand operative fixation. Therefore, careful examination for DISI and VISI on lateral radiographs is imperative (Table 3.1).

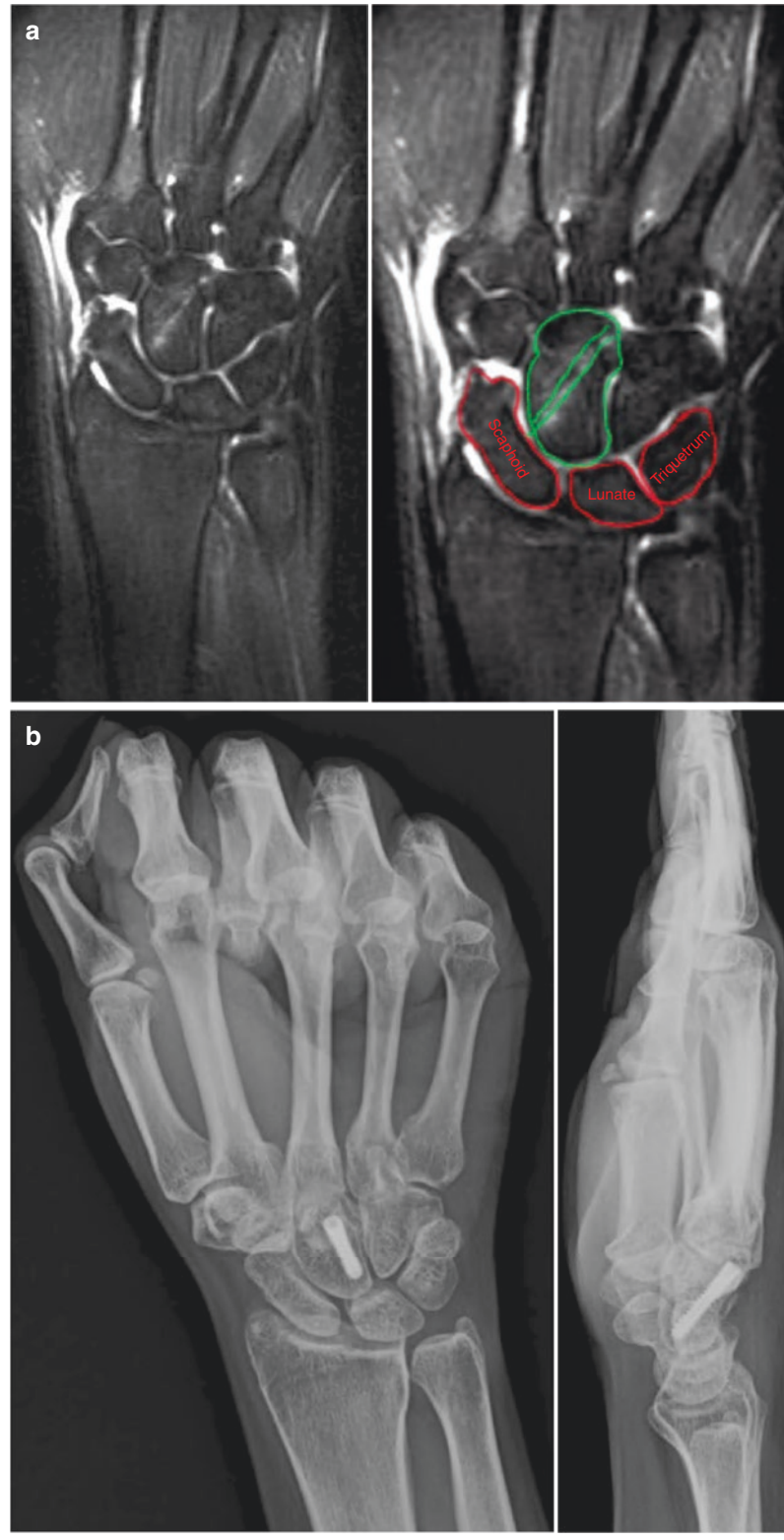

Fig. 3.5 Capitate fracture. 23F RHD with right capitate fracture nonunion after 6 months of nonoperative treatment. Surgery was a dorsal approach through the 3–4 interval, cancellous bone was harvested from the 3rd metacarpal, and fracture was stabilized with Acutrak screw. (**a**) T2 coronal cut of the MRI showing the oblique fracture line. (**b**) PA and Lateral of the right hand postoperatively

Fig. 3.6 Trapezoid fractures. 27-year-old male with left trapezoid fracture after punching a heavy bag. Initial XR were negative for fracture, but significant pain prompted advanced imaging. CT demonstrated nondisplaced trapezoid fracture. Given the nondisplaced nature, reduction of the trapeziometacarpal joint, and excellent healing potential, this was treated nonoperatively in a short-arm cast. (Case and Imaging Courtesy of Brandon Prioreschi, MD)

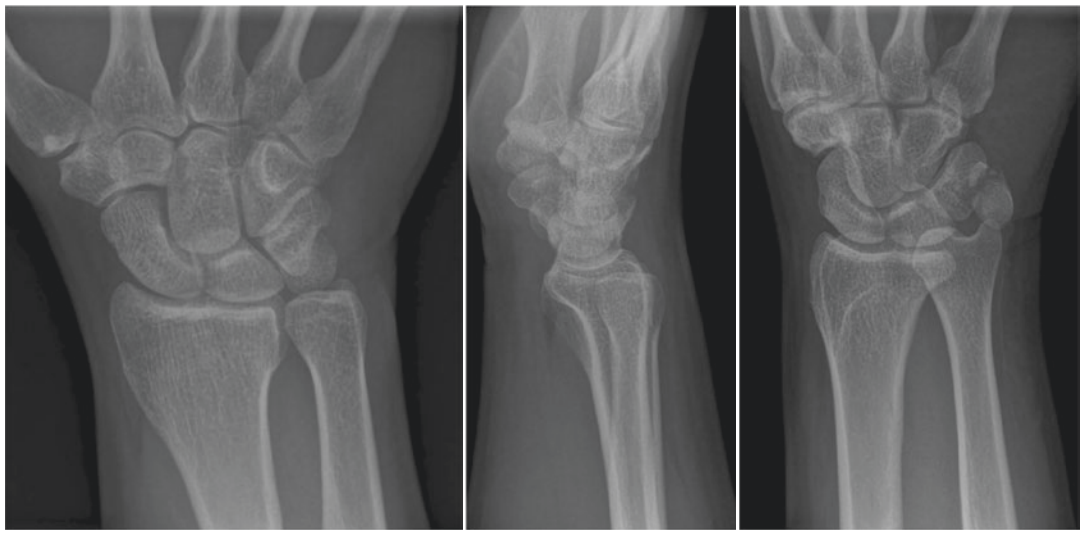

Fig. 3.7 Pisiform fractures. 33M sliding into a base playing softball. Presented with swelling, ecchymosis, and pain over the volar ulnar aspect of the hand. Best visualization of the fracture is on the oblique view

Fig. 3.8 Pisiform fractures. 51F who was evaluated for left-sided volar/ulnar wrist pain. Diagnosed with pisiform avulsion fracture. Treated nonoperatively

Fig. 3.9 Lunate fracture. 26M professional hockey player presenting with right wrist pain. MRI showed right lunate stress reaction. Treated with splint immobilization and bone stimulator. Pain resolved within 1 month

Fig. 3.10 Lunate fracture. The curvature of the lunate surfaces and position of the bone in the proximal row can obscure lunate body fractures on standard radiographs (**a**). CT clearly illustrates a lunate body fracture on axial, coronal, and sagittal views (**b**–**d**). (From Hand Clinics Marchessault 2009)

Table 3.1 Overview and highlights for the management of carpal fractures in the baseball player

Carpal fracture	Additional radiographic views	Treatment	Pitfalls
Triquetrum fractures	45° pronated oblique XR	*Dorsal chip*: short period of immobilization with repeat clinical and radiographic exam at 1–2-week intervals *Body fractures*: operative	Body fractures are associated with perilunate dislocations
Hamate fractures	CT in the "praying position"	Operative treatment	
Trapezium	Bett's view	*Nondisplaced*: cast for 4–6 weeks *Displaced*: operative	Be aware of first CMC dislocation
Capitate fractures	CT scan	*Nondisplaced*: cast for 4–6 weeks *Displaced fractures*: operative	Be aware of perilunate dislocation Retrograde blood supply – be aware of AVN
Trapezoid	Evaluate trapeziometacarpal joint	Operative	Be aware of high energy
Pisiform	Carpal tunnel review and reverse oblique view	*Nonoperative:* immobilization for 4–6 weeks Excision allows expedient return to play	
Lunate	Frequently need CT scan	*Marginal chip fractures*: short course of immobilization *Body fractures or associated DISI/VISI*: operative fixation	

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