# Palmar Perilunate Dislocations or Fracture-Dislocations

# 6

## 6.1 Introduction

The first case of palmar trans-scaphoid perilunate dislocation was probably published by Goulioud and Arcelin in 1908 [1].The palmar perilunate dislocations constitutes about 3 % of all perilunate injuries [2–4]. Witvoet and Allieu [5] in a retrospective study among 85 cases of perilunate injuries, found five palmar perilunate dislocations (6 %). Saunier and Chamay [6] in a review of the literature, reported only 12 cases of palmar perilunate dislocations, 50 % of which had an associated fracture of the scaphoid. Finally, in a multicenter study, Herzberg et al. [2] found that from 166 cases of perilunate injuries, 5 (3 %) were of palmar type.

Our knowledge about these injuries derives only from a few isolated cases that have been reported in the literature. The earliest report of a dorsal dislocation of the lunate proven by radiographic examination was published in 1906, by Thebault (quoted by Taleisnik [1]).

## 6.2 Mechanism of Injury

There is ambiguity in the literature regarding the mechanism of injury, since these injuries have not been experimentally reproduced and the patients can rarely recall the mechanism of injury.

The mechanisms that have been described so far are listed below:

- Forced hyperflexion after falling on the dorsum of the wrist [7–9], or hyperflexion with the wrist being trapped in machinery [10].
- Forced hyperflexion and supination of the wrist relative to the radius [3].
- Hyperflexion of the wrist associated with ulnar deviation [6, 11].
- Hyperflexion, ulnar deviation and pronation of the wrist [12].
- Wrist hyperflexion with a longitudinal loading force transmitted through the capitate [13].
- Axial force on a volarly flexed and radially deviated wrist, with the forearm in pronation [14].
- Fall on a hyperextended wrist with supination of the forearm and proximal row on the fixed hand and distal row [15, 16].
- The midcarpal displacement could be recreated by supination of the proximal segment on the extended distal segment, with the rotation occurring around the triquetrum. (Based on a postmortem study of a wrist with a volar perilunate dislocation of a patient who died 2 weeks later from associated injuries) [17].

From the above we assume that two main force components are implicated: (a) Hyperflexion (combined with palmar translation of metacarpals) which is often produced after a direct blow to the dorsum of the wrist and (b) The rotational component, where the distal carpal row and metacarpals are forced to pronation, while the proximal carpal row together with the forearm are forced to supination. This rotational dissociation is the same mechanism of injury

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responsible for the palmar radiocarpal dislocations, except that the level of the disruption is located at the radiocarpal rather than the midcarpal joint.

Pournaras and Kappas [18] suggested that a predisposing anatomical factor may contribute to this injury pattern since the contralateral healthy wrist of the patient they presented with volar perilunar dislocation, showed a VISI alignment of the wrist. A preexisting abnormal radio-luno-capitate alignment has also been mentioned by Roman et al. [19]. Park and Steinberg [20] stated that prior wrist injuries, may contribute to subtle wrist instability, thus predisposing to an acute volar perilunate dislocation while Niazi [16] considered that laxity of the ligaments makes a wrist susceptible to dislocations.

## 6.3 Pathologic Anatomy of the Injury

Like the more frequent dorsal perilunate dislocations these extremely rare injuries are produced after a progressively increasing ligamentous injury in which the head of the capitate is dislocated volar to the lunate. At a more advanced stage, the lunate dislocates dorsally and the rest of the wrist returns to its original position. This constitutes the purely ligamentous form of the injury [16, 21], where the ligamentous attachments of the lunate to the scaphoid initially and to the triquetrum subsequently, rupture, while at the final stage of this perilunar instability, the SRL and the ulnolunate ligaments rupture and the lunate dislocates dorsally. It seems that this perilunar instability progresses with the axis of rotation located at the triquetrum.

Following the above, we assume that the progressive stages of this injury evolve as follows: Stage I: Fracture of the scaphoid or SL dissociation; Stage II: The capitate head (i.e., distal carpal row) dislocates volarly with or without the palmar fragment of a fractured lunate; Stage III: LT dissociation; and Stage IV: The lunate, deprived of soft tissues dislocates dorsally.

As an example, the cases presented by Minami et al. [22] and by Youssef and Deshmukh [4] represented a Stage II injury, where the lunate and triquetrum remained in their normal position with the radius, while the scaphoid and distal carpal row had migrated volarly.

In trans-scaphoid volar perilunate dislocations (like their dorsal equivalent) concomitant scaphoid fracture and scapholunate dissociation have been described in a case presented by Nishiyama et al. [14].

Like their dorsal counterpart, the volar perilunate injuries exhibit a transverse disruption of the volar carpal ligaments [8, 20, 23].

Often, the volar perilunate injuries are manifested as a fracture-dislocation injury, like their corresponding dorsal variants are evidenced as greater arc injuries. The most frequent concomitant fracture is that of the scaphoid, but of particular interest is the next most common fracture which is the fracture of the lunate. Equally interesting is that the fracture of the lunate is oriented at the frontal plane, usually involves its central part and less frequently its palmar pole. This means that the frequently referred mechanism of palmar hyperflexion, must be associated with a longitudinal loading force transmitted through the capitate, where its head impinges to the distal articular surface of lunate separating it into two fragments. In that case, the capitate and consequently the entire distal carpal row, in association with the palmar fragment of the lunate are palmarly subluxated in different degrees, while the dorsal part of the lunate is displaced dorsally. Probably, in cases of volar perilunate fracture-dislocations with the lunate fractured and the scaphoid intact, the existence of a radial component of the injury, e.g., rupture of STT ligaments must be speculated.

According to the classification of Teisen and Hjarbaek [24], the transverse fracture through the body of the lunate constitutes a type V fracture, which is highly unstable since the head of the capitate maintains the two fragments apart. Treated conservatively these fractures usually end up with a nonunion as the case mentioned by Ruijters and Kortmann [25].

In trans-scaphoid volar perilunate injury the fractured surface of the scaphoid lies on the frontal plane which means that during hyperflexion of the wrist, the scaphoid fractures after impaction to the volar rim of the radius. In such cases, the proximal scaphoid fragment remains with the lunate [26] (Fig. 6.1a–e).

Usually, the volar perilunate fracture-dislocation is associated with fracture of the scaphoid [2, 6, 7, 9, 10, 27, 28], the lunate [25, 29, 30], or both [11, 13, 31]. The impaction of the scaphoid to the radial styloid can cause fracture of the latter without fracture of the scaphoid [8, 12] or fractures of both the scaphoid and radial styloid [6, 32].

Irregular forms of volar perilunate injury, resembling greater arc injuries, have also been mentioned in the literature [11, 19, 23, 33], while Mueller [34] reported a case of volar perilunate dislocation leading to avascular necrosis and fragmentation of the lunate.

### 6.3.1 Dorsal Dislocation of the Lunate

The dorsal dislocation of the lunate represents the end stage of the volar perilunate dislocation (just as a volar lunate dislocation represents the end stage of the more common dorsal perilunate dislocation injury pattern) [20].

Bilos and Hui [8] reported two cases with dorsal dislocation of the lunate, both of which were treated with open reduction, ligaments suturing, and pin fixation, since after the initially closed reduction the dislocation recurred easily. After 12 and 15 months follow-up the results were good, despite the fact that in one of the patients, increased density of the lunate without collapse was noted at 1 year.

Schwartz et al. [35] reported a patient with a 2 months old dorsal lunate dislocation and carpal collapse, who presented pain, limited wrist motion, and inability to extend the long, ring and small finger metacarpophalangeal joints. Closed reduction was impossible and the patient was treated operatively with proximal row carpectomy and tendon reconstruction. The lunate was deprived of soft tissues and subsequent histologic examination showed complete avascular necrosis. Rupture of extensor tendons, which were trapped between the midcarpal joint preventing closed reduction of a volar perilunate dislocation, have also been mentioned by Minami et al. [22]. The authors were not aware if the tendons were torn or subsequently ruptured because of vascular compromise.

Bjerregaard and Holst-Nielsen [12], also report a case of dorsal dislocation of the lunate where through a transverse rent of the dorsal capsule the lunate was found beneath the fourth extensor compartment. The patient was treated 2 months postinjury with scapholunocapitate fusion.

One of two patients presented by Park and Steinberg [20] had dorsal lunate dislocation caused by an acute on chronic injury which was rupture of the lunotriquetral ligament. Probably the patient previously had a complex type of instability (CIC) due to insufficiency of both lunotriquetral and radiotriquetral ligaments that resulted in VISI alignment which was the predisposing factor to dislocate the lunate dorsally after the new trauma episode.

Markiewitz et al. [36] supported that dorsal dislocation of the lunate may be associated with rupture of the long and short radiolunate ligaments, which must be repaired through a palmar approach, since their deficiency may allow ulnar translation of the wrist.

Patients with dorsal lunate dislocation usually present with prominence of the lunate on the dorsum of the hand [4].

Certainly there are cases of neglected dorsal lunate dislocation which were accidentally found during a routine X-ray for another reason (Fig. 6.2a, b). In such cases the treatment is dictated by the symptoms [4].

## 6.4 Diagnosis

In acute cases physical findings consist of a swollen painful wrist and a silver fork deformity, which is more distal than in the fracture of the distal radius with volar displacement (Smith's fracture) [6]. Because of the rarity of this injury,

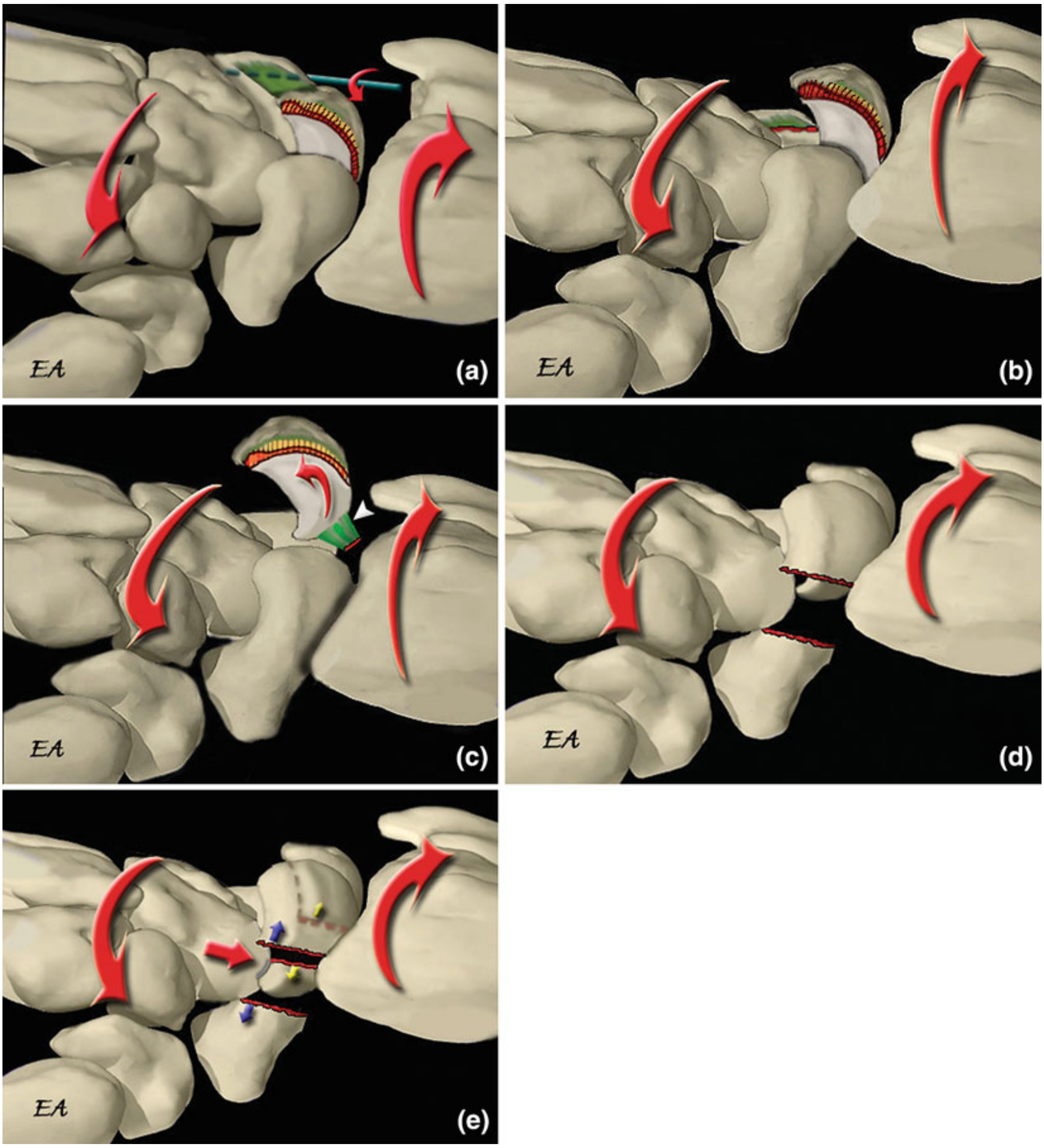


**Fig. 6.1** Electronical depiction of the presumed mechanism of injury: The rotational dissociation of the wrist at the midcarpal level (*arrows*) could produce a palmar perilunate dislocation. The axis of rotation is located at the triquetrum, the metacarpals and distal carpal row are rotated in pronation, while the proximal carpal row together with the forearm are forced in supination. At an initial stage the SL ligament ruptures and all carpal bones apart from the LT complex, subluxate volarly (**a**); at a next stage, the LT ligament also ruptures and all carpal bones except the lunate, are volarly dislocated, while the head of the capitate forces the lunate to displace dorsally and at the same time rotate volarly (**b**); at a final stage, the wrist relocates to its normal position, while the lunate is ejected dorsally with simultaneous rupture of the short and long RL ligaments (*white arrow*) (**c**); in volar perilunate fracture-dislocations the most frequently involved fractures are those of the scaphoid and/or lunate, with their fractured surfaces oriented at the frontal plane. This finding correlates with a mechanism of hyperflexion injury, where the scaphoid fractures after impaction to the volar radial rim and the lunate after impaction from the head of the capitate (**d**, **e**). With permission from [42]

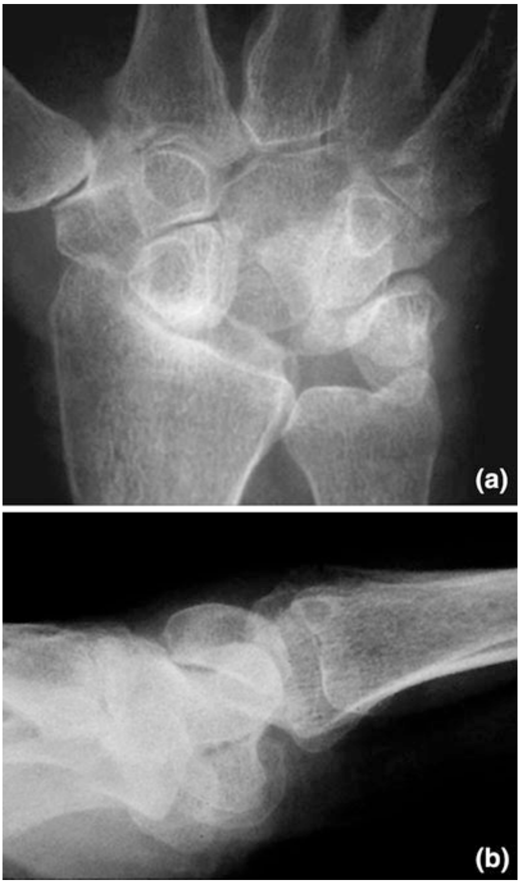


**Fig. 6.2** **a**, **b** Female, 70-years old. A case of neglected dorsal lunate dislocation, which was found accidentally after a minor wrist injury. With permission from [42]

the proper diagnosis is likely to be missed. The two classic X-ray views are usually diagnostic. Because any coexisting fractures of the scaphoid or the lunate are oriented in the frontal plane, their recognition is difficult on the standard PA view. The diagnosis is most easily made on the lateral view [36, 37].

Klein and Webb [38] described the « crowded carpal sign» which is due to the overlapping of the proximal and distal carpal rows (however, it can also be found in the more frequent dorsal variant). Plain X-rays with the wrist distracted under anesthesia or a CT-scan in selected cases may add to diagnosis [23].

Fractures of the palmar pole of the lunate could be an ominous sign, hiding an incomplete or reduced volar perilunate dislocation [13, 39].

Numbness in the median nerve distribution has also been reported, early [22] or late in a missed volar perilunate dislocation [4].

## 6.5 Management

The rare volar perilunate injuries are exceedingly unstable injuries and should be managed like the more frequent dorsal perilunate dislocations, with open reduction using both palmar and dorsal approaches and internal fixation [3, 15, 37]. Closed reduction should be the initial step in management when open reduction is not possible immediately after injury.

Taleisnik [1] described the manipulation of closed reduction as follows: Under satisfactory anesthesia and muscle relaxation, a finger trap traction is applied and continued for several minutes before manipulation is tried. The reduction of the dorsally shifted lunate is attempted by direct pressure from the dorsum (the lunate is more readily palpable than in volar dislocations), while at the same time the hand is palmarflexed and rotated into supination around an imaginary pivot point passing through the triquetrum. The author claimed that volar perilunate dislocations are more difficult to reduce than the dorsal variety, and when reduced they are more likely to recur. He recommended that immobilization is more effective with the wrist in neutral or slight dorsiflexion. Green and O'Brien [17] also suggested that the manipulation of closed reduction could be accomplished with supination of the hand and distal row on the fixed forearm and proximal row.

Fernandes et al. [9] supported that closed reduction achieved in a case of trans-scaphoid volar perilunate fracture dislocation was very unstable except in position of extreme dorsiflexion, while Niazi [16] claimed that the closed reduction achieved of a perilunate dislocation, was found to be unstable in neutral or extension positions.

Although successful treatment has been reported with closed reduction alone [9, 16], in trans-scaphoid volar perilunate fracture-dislocations, closed reduction has been applied as initial


**Fig. 6.3** Male, 28-years old. A polytrauma patient (fracture of *left* femur and left forearm, dislocation of the *right* elbow, ligamentous injuries at both knees). Same day, the fractures of the femur and forearm were operatively treated. Initial X-rays of the fractured forearm, where the wrist joint is also indicated (**a**, **b**); next day, changing the forearm wound, wrist deformity and crepitation were discovered (**c**); wrist X-rays revealed a trans-scaphoid volar perilunate fracture-dislocation (**d**, **e**); with a dorsal approach, except for the fractured scaphoid, an oblique fracture of the capitate head was found (*arrows*), while the SL and LT ligaments were intact (**f**, **g**); Postoperative X-rays (**h**, **i**); final appearance 3 months postinjury. (*R* Radius, *S* Scaphoid, *L* Lunate, *C* Capitate). (Comments: **a**) although careful evaluation of the initial forearm X-rays reveal the fractured scaphoid, obviously a spontaneous reduction concealed the magnitude of the injury, **b**) since the LT joint was intact, probably the case constitutes an incomplete type of injury). With permission from [42]

treatment, but it was soon followed by open reduction and fixation of the scaphoid due to the unstable character of the injury [6, 10, 13, 26, 32, 37].

Whenever closed reduction was the definitive treatment, it resulted in malunion [2, 9] or nonunion of the scaphoid. Conversely, open reduction and stable fixation of the fractured scaphoid usually rendered good results [2, 27, 28, 40], even in delayed treatment [14].

Several authors [6, 17, 23, 26, 32] prefer to internally fix the scaphoid through a volar incision, and percutaneously pinning the reduced joints. Others [36], prefer to use a dorsal approach for its versatility and better exposure (Fig. 6.3a–k).

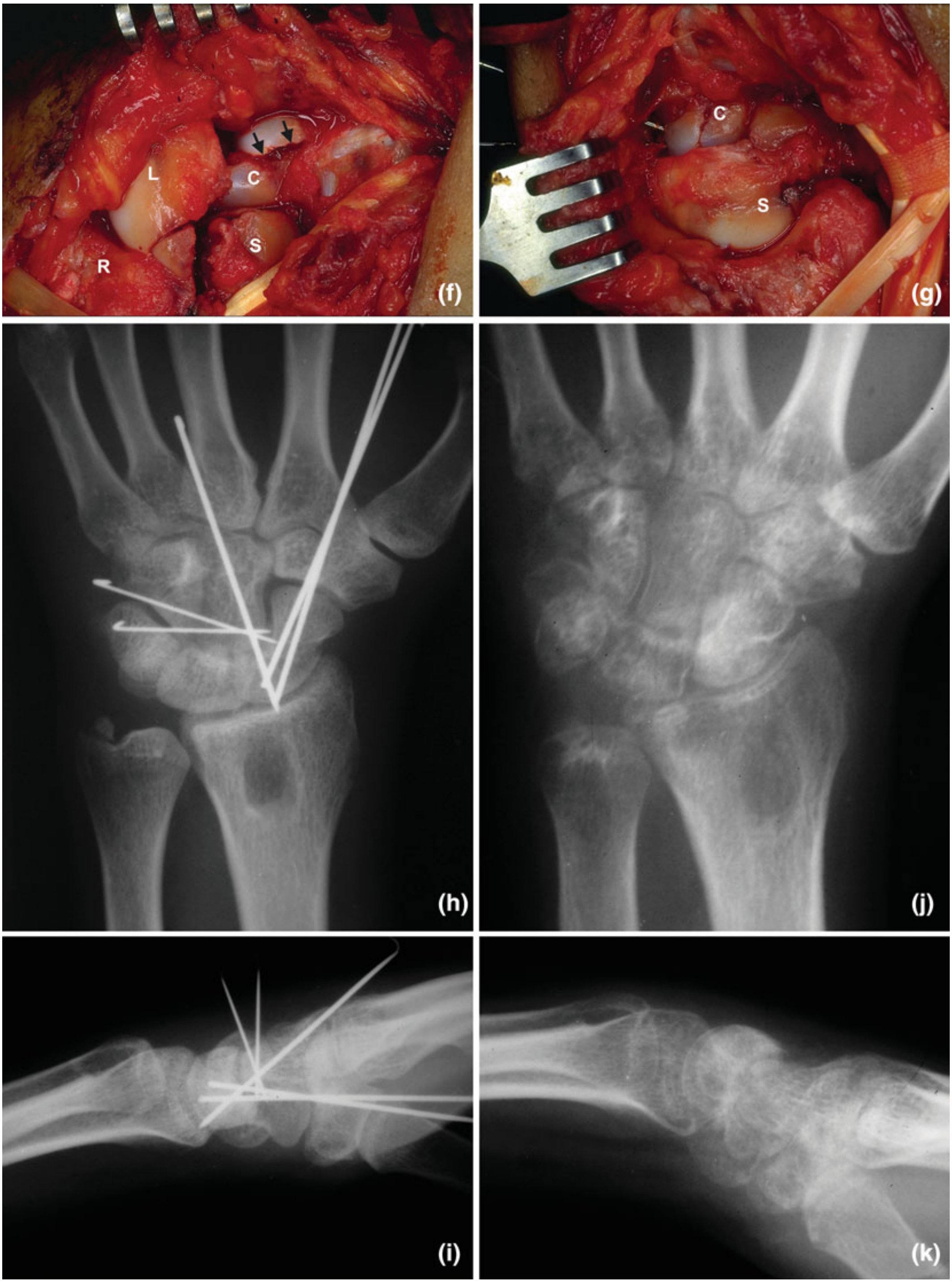


**Fig. 6.3** (continued)

Green and O'Brien [17] in cases of volar perilunate dislocations, recommended closed reduction and percutaneous K-wires for 8 weeks, whereas any residual scaphoid subluxation should be corrected via a dorsal approach.

Similarly, in cases of lunate fracture stable fixation with a headless screw or K-wires is mandatory [13].

Various authors [6, 10, 18, 32, 36], have suggested that purely ligamentous volar perilunate dislocations when treated with closed reduction and cast immobilization are more likely to give satisfactory results than does the fracture dislocation counterpart.

Proximal row carpectomy has been applied in an acute trans-scaphoid, translunate volar perilunate fracture-dislocation, with the distal scaphoid pole free of any tissue attachment located just under the extensor retinaculum [11].

The outcome was considered significantly worse for those patients who underwent surgical treatment much later after the initial injury [4].

Post-traumatic instability of the wrist, avascular necrosis of the proximal pole of the scaphoid, and intracarpal osteoarthritis are possible complications when the progression of such an injury is not satisfactory [6, 41].

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