Chapter 3

Tips and Tricks in Perilunate Carpal Fracture-Dislocations

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Summary

Perilunate dislocations and fracture-dislocations are much less frequent than fractures of the distal radius, but they are a serious condition that can definitely alter the biomechanics of the wrist, due to some associated irreparable injuries and the difficulty of treatment.

The most important thing is to make an early diagnosis of all affected structures (bone, cartilage and ligament) and to this end, in addition to conventional radiography of the wrist, it is useful the traction X-Ray.

Treatment should never start without classifying injuries according to the Larsen et al. criteria [1] which must be evaluated: chronicity, constancy or severity, etiology, anatomic location, direction, and pattern.

The current criteria are inclined surgical treatment by dorsal, palmar or double approach, depend on the injury requirements. Suture or ligament reattachment, pref-
erably scaphoid screw compression osteosynthesis and K-wires in the other bone fractures. There will also use K-wires between different bones to keep the anatomical reduction relations while ligamentous injuries heal (8 to 12 weeks). Only a few very special cases of transscaphoid perilunar fracture-dislocations may be susceptible to orthopedic treatment.

Anatomical reduction of these lesions does not guarantee a perfect final result, but the overall outcomes were published in the most representative series, are directly related to the degree of achieved reduction maintained during the period of healing. Clinical result is better than radiographic one but not generally exceed 50% of good and excellent results. The conditions of the injury seems to be the major influence on the result that the treatment performed.

Carpal instability, scaphoid nonunion and radiocarpal and intercarpal posttraumatic osteoarthritis are common complications affecting more than 50% of patients who have suffered these injuries, although they have been treated in specialized centres. It should further research into new forms of treatment by the orthopedic surgeon and rehabilitation physician.

Introduction

Carpal stability, in which the proximal row represents an inherently unstable intercalated segment, is given by a complex osteo-ligamentous system. The scaphoid is a link between the two carpal rows, interacting with the two arcs of radiocarpal oblique palmar and dorsal ligaments, primarily the radio-capitate one.

This complex arrangement allows synchronous movement of the proximal and distal rows by angulation including when flexion and extension, and adaptive geometric changes in the radial or ulnar inclination [2] are made.

Classifications

The most common mechanism in which injuries occur is carpal hyperextension and wrist ulnar deviation [3]. These injuries can lead to a series of bone, ligament or osteo-ligamentous injuries, which physiopahtology was described perfectly by Mayfield [4]. He describes the sequence of ligamentous injuries occurring: in the first degree connections between the scaphoid and lunate, starting in the volar side; in grade II, a complete or partial breakdown of radio-capitate ligament occurs, avulsed of the radial styloid, which entails opening up the space of Poirier on the volar side, and dorsal dislocation of the head of the capitate bone; in grade III, once unions between scaphoid and lunate with capitate bone have broken, the lunotriquetral bonds are broken, the rupture or avulsion of the volar radiotriquetral ligament and dorsal radio-carpal ligaments; in grade IV, the lunate is pressed by the rest of the carpus returning from the back and regains its relations with the radio, radio-carpal ligaments are torn dorsal completely and lunate rotates supported in...
its ligamentous volar attachments palm, to a volar dislocation.

Because of the complexity and diversity of perilunate fracture-dislocations, it has not yet disclosed a definitive classification, although the most handled are those of Green and O’Brien [5] and Cooney et al [6] without consensus. Larsen et al [1] advised that to make a good diagnosis, treatment and prognosis of any carpal instability must always consider six categories of factors:

**Chronicity**

The lesions may be: acute, when they have less than a week of evolution, in them there is a maximum potential for primary healing of damaged structures. Subacute: one to six weeks of evolution, there is still some possibility of primary healing. Chronic: more than six weeks of evolution, the outlook darkens and surgery is need to repair it.

**Constancy or Severity**

Carpal instability can be: static, when instability is seen in a conventional X-Ray study (AP and L), they are the most serious. They can be subdivided into reducible and irreducible. When instability is not observed in a conventional radiographic study and to do X-rays in awkward positions, it is called dynamic instability. Predynamic ones show some cases for potential instability or anatomical changes which are not associated with radiographic findings.

**Etiology**

It is generally accepted that most of the carpal instabilities are secondary to trauma (especially serious instabilities are due to falls from heights and open injuries); however, also rheumatism; infections; Kienböck disease; osteonecrosis of the large bone; neurological diseases; iatrogenic ... can cause instability.

**Anatomic location**

It is essential for treatment identified by radiographic diagnosis, the location of the lesion or lesions in the radiocarpal; midcarpal; carpometacarpal or specific bones or ligaments. Combinations of traumatic injuries suit certain patterns, of which the best known is the perilunar instability, but may be other independent respond to injury.

**Direction**

Carpal deformities that often exist in instabilities are of two types: Translocation or angulation. The translocations represent a carpal deviation dorsally, palmar, radial or ulnar. The angles are reflected as a volar or dorsiflexion of the lunate or entire proximal row and are known by the acronym VISI or DISI.

**Pattern of instability**

They described four basic types of instability:

The CID (carpal instability dissociative; Cooney et al,
[7]) is an instability or ligament injury between bones in the same row; eg rotatory subluxation of the carpal scaphoid.

The CIND (carpal instability non dissociative; Dobyns, [8]) is the instability between the two rows, being in good relationship bones of each; for example, the midcarpal instability.

The CIC (carpal instability complex; Amadio, [9]) is a combination of the two previous; no alteration of the relationship between the bones of the same row (CID) and also no change in relations between the two rows (CIND). Except for pure radiocarpal dislocations, which are classified as non-dissociative instabilities. The rest of the perilunate dislocations and fracture-dislocations are complex and meet the criteria of CIC.

The CIA (carpal instability adaptive; Taleisnik [10], is an adaptation of normal carpal to some external evil alignment, such as a vicious callus of the distal radius fracture.

It is necessary to differ within the category of complex carpal instability (CIC), Garcia-Elias [11]:

1. Dorsal perilunate dislocations (lower arch).
2. Dorsal perilunate fracture-dislocations (high arch).
3. Volar perilunate dislocations (higher or lower arch).
5. Dislocations isolated of the carpal bones.

The first two groups have in common the presence of a carpal injury around the lunate -the first is a pure ligamentous injury and the second includes the presence of associated fractures in the adjacent bones. The third, although it also occurs in the perilunar area, produces the volar displacement of the distal carpal row apart from the lunate. The fourth and fifth groups are a variety of non perilunate dislocations, usually associated with very high energy trauma.

For all the above, transscaphoid perilunar fracture-dislocations, which are the subject of this study, are included in a homogeneous group; therefore, we will refer to the entire group of perilunate dislocations (lower arch) and perilunate fracture-dislocations (high arch). We include anterior dislocations of the lunate between the lower arch, thus coinciding with Elias Garcia [11]; we believe that perilunate and lunate dislocations are pathologically equivalent injuries with similar treatment.

**Epidemiology and Diagnosis**

Perilunate dislocations and fracture-dislocations represent about 5% of the significant post-traumatic wrist injuries [12].

Frequently, they are young male patients, around 30 years old; dominant side; the most common cause is the
casual fall during sports accidents or work, also fall from height and traffic accidents, specially motorcycle or bicycle. It is usually blunt trauma, with a small percentage of open lesions that evolve worse [13]. The pure dislocations account from 25% to 40% in different published series and fracture-dislocations the rest.

They are much more frequent dislocations and fracture-dislocations in which the distal carpal row is positioned dorsally with respect to the lunate, while the volar represent around 5% of them. When a fracture-dislocation exists scaphoid used to be the most affected bone, followed at a distance by the triquetrum and capitate. Scaphoid fractures are transverse and located in the middle third in 70% of cases. In over 50% of patients, there are associated fractures, radial and ulnar fractures [13].

The most frequent injuries are generally associated with multiple trauma and fractures in the same limb [14]. There are irritative syndromes in the median nerve up to 30% of patients [7].

The diagnosis should be suspected by clinical -great inflammation, pain and functional dissability of the wrist- and confirmed by radiology. It should assess the normal balance by checking the alignment of radio, lunate, capitate and third metacarpal, so that scapholunate angle (30-60°), radiolunate one (> 15°) and the ratio of the carpal height (> 0.5), evidence objectively the injury. In the AP X-ray a loss of carpal Gilula’s arches [15] will be displayed.

The scaphoid and lunate fall into a flexed position and a sign of cortical ring will be considered as a scapholunate ligament injury and / or lunatetriquetral injury. Lunate appears triangular, which is offset relative to the measure of the energy imparted. They may also be present the loss of joint alignment, overlapping the carpal bones and fractures. The lateral X-ray shows altered alignment of radio, lunate, and capitate. The capitate bone is commonly dorsally displaced and lunate volarly. Lunate can be rotated 90 or 180 degrees [15], (Figure 1).

Figure 1: X-ray and MRI of perilunate fracture-dislocation, overlapping the carpal bones and fractures, which show an altered alignment. The capitate bone is dorsally displaced, and lunate volarly.
It is also convenient to use traction X-ray to check the existence of small bone fragments and to detect some ligament [16] injuries. The presence of these small fractures should not be enough to consider the injury as a fracture-dislocation [17] criteria. Conversely, the presence of bone fractures of the scaphoid specifically, does not rule out the existence of ligamentous injuries to this bone and neighbors, for example scapholunate ligament [18].

**Treatment**

Treatment of carpal instability cannot start without having classified each particular case in one of the six categories of carpal instability, defined Larsen et al [1].

There are two goals of treatment in these lesions [19]. The first intention is to restore the alignment between the radius, lunate and capitate bone. Then, the restoration of the broken mechanism that has allowed the dislocation. The indications for open treatment appear immediately after an attempt to manipulate or after having done so. These absolute indications are: irreducible dislocation of the lunate, persistent displacement of some bone fragments, and rotatory subluxation of the navicular or other persistent carpal instabilities.

**Treatment of Doral Perilunate Dislocations**

**Acute Dislocations**

We must reduce the acute moment before deface the anatomy inflammation and make the handling more difficult. To minimize the median nerve injury it is recommended that closed reduction is performed atraumatic under anesthesia and muscle relaxation [20].

It consists on continuous axial traction under adequate anesthesia for 10 minutes to relax the tight muscles. Later, we extend the patient’s wrist, maintaining traction with our hands while the thumb of the other hand stabilizes the lunate on the volar side of the wrist pushing it back; we gradually give the wrist palmar flexion, allowing the capitate bone moves the concavity of the lunate. Once reduced the luno-capitate joint and hold the axial traction, we give extension to the wrist so that the complete reduction of dislocation [11] is achieved. Reduced after injury, placed in plaster immobilization.

In more than two thirds of cases, a loss of reduction will occur in the cast, with consequent residual instability [31].

Closed reduction under scopia and percutaneous osteosynthesis, placing two Kirschner wires one between the scaphoid and the capitate bone and another between the scaphoid and lunate, can be an excellent method of bone support. The k-wires are maintained, with a cast immobilization, for 8 weeks, which is the time for ligamentous injuries healing [13].

Trumble and Verheyden [22] believed that when perilunate or lunate dislocations were treated, the key to success was to make a strong scapholunate interosseous liga-
ment repair, and consider that the fixation with Kirschner wires after ligamentous repair did not give the scapholunate compression that these bone needed to heal in good condition; therefore they recommend the use of a wire cerclage between the scaphoid and lunate after the ligament sutured. In the space between the lunate and triquetrum, these authors thought that it was enough contention with two Kirschner wires after suture that ligament.

Figure 2: Open dorsal approach to reduce a perilunate fracture-dislocation when closed reduction is insufficient.

When there are unreduced one fragments of the radial styloid bone or a large piece of the triquetrum, they may be displaced after handling or interfere with the reduction. In most cases it is necessary to do open reduction and fixation with Kirschner wires, never removal of those fragments (Figure 2).

Currently it is possible to perform an arthroscopic treatment of this injury, allowing internal fracture fixation and stabilization with Kirschner wires of the carpal bones [23-26]. Arthroscopic reduction can limit associated soft tissue injury of open surgical reduction and it may allow healing with less secondary stiffness [27].

Chronic Dislocations

We must try to reduce the dislocation and make repairs in the scapholunate ligamentous-lunar region and lunotriquetral. The double dorsal and palmar approach has been proven safe. The dorsal approach follows the path of the extensor pollicis longus in the third extensor compartment, and the palmar one, the path of extended carpal tunnel volar approach [28].

When the dislocation is irreducible, the surgical option may be a proximal carpal row excision, or midcarpal [29] arthrodesis. The panarthrodesis is reserved for very advanced cases, osteoarthritis, or failures of the proximal carppectomy or the intercarpal arthrodesis.

Treatment of Anterior Lunate Dislocation

Immediate treatment of this lesion is an attempt of reduction by traction and handling. Avascular necrosis of the lunate is very rare complication after this injury [30]. When the dislocation is discovered three weeks after, we must make an attempt at manipulation and then ligamentous repair. If manipulation fails, the approach os choice is...
anterior one, releasing the bone adhesions and returning to its place, to avoid damaging the volar radiolunate liga-
ment.

Chronic anterior dislocation: This injury is not un-
common diagnosis due to failure or lack of reduction in the first moment, as mentioned before. The current trend is to replace the bone and make ligament repair with or without reinforcements [31]. Other authors have proposed the resection of the first row of the carpus; intercar-
pal partial or radiocarpal arthrodesis, when degenerative changes have been developed.

Treatment of Dorsal Transscaphoid Perilunar Fracture-Dislocations

In acute injuries, the initial treatment consists of axial traction continued for 10 minutes, with adequate anesthe-
sia, and closed manipulation. If after satisfactory reduc-
tion, stable relations between the carpal bones, a well-
padded, brachial-forearm plaster cast is placed in light palmar flexion and radial deviation which includes the first digit. During the first three weeks, it should make a weekly radiographic control and if the reduction is main-
tained, the patient takes the cast for a period between 12 and 16 weeks. Any change in the position of the scaphoid or fragments thereof, or scapholunate angle, or radiolunar angle, however small, should make us change to surgical treatment [32].

The following method of treatment would be the re-
duction under image intensifier and percutaneous place-
ment of K-wires. It is useful for patients who refuse open treatment [33]. It involves placing two or more percutaneous K-wires, in the scaphoid fracture and two additional blocking scapholunate and lunotriquetral joints. In our study [14], we selected this treatment method because it was with the best results were obtained, done under image intensifier to detect existing lesions.

Figure 3: X-ray postoperative control; bone screws and K-wires to reduce and fix the transscaphoid perilunar fracture-dislocations.

Surgical treatment is the most reasonable method to make an anatomical reduction and reconstruction of all
structures [33]; it is advisable to complete an open reduction, practicing osteosynthesis of fractured bones (cannulated screw in the scaphoid) and suturing injured ligaments (Figure 3). The same dorsal pathway that in pure perilunate dislocations is used [21] and, when it is necessary a volar approach, we agree with Garcia-Elias, that the right one can be Russe device [11]. This pathway is used to release the fracture of the interposition of soft tissue, to provide bone graft if necessary and to repair the anterior capsular gap that matches the area of the scaphoid fracture. It is also a good way for compression screw osteosynthesis of the scaphoid fractures [21].

In the ligamentous sutures, it must be borne in mind that, although difficult, we must be taken to preserve the innervation which is very close to the bone insertion of ligaments. This may allows improvements in postoperative course, to preserve some of proprioception recovery [34].

Temporarily stabilized with Kirschner wires of ligamentous repair, helps ease it [35]. And they can be anatomically reconstructed through the use of bone anchors that help reproduce the primary ligament insertions [36].

In the absence of any detectable difference in radiographic or clinical results, the temporary fixation with a screw is an attractive alternative for the temporary K-wires fixing, since it allows the start of wrist movement before and without the possibility of complications related with mobilization or infection of wires [37].

Treatment of Complex or Infrequent Lesions

There are variants of dorsal transscaphoid perilunar fracture-dislocations with associated fractures in other bones. Jonson [38] classified these dislocations major arc in three grades: grade I when only affect the scaphoid; grade II, when they affect the scaphoid and capitate bone, and grade III, scaphoid, capitate and triquetrum. A variant of grade II is the Fenton’s syndrome. The injury is a fracture of the scaphoid bone and capitate, which suffers a rotation of the proximal pole of 90 or 180 degrees. The radiological interpretation is quite difficult, but this is specially showed on traction X-ray. The indicated treatment [39] is the open reduction, placing first capitate head so that the scaphoid could be reduced and fixed with K-wires.

Results

The overall results are very difficult to evaluate because it is an uncommon condition, in which the published series of personal experiences rarely surpass the 30 patients. In addition to this lack of cases, the large variety of types of injuries means their homogeneity, and abundance of treatment possibilities further diversifies variables.

Nor is there agreement on the review criteria. Therefore, most authors divide the clinical and radiographic results [40]. Clinical outcomes were evaluated most consulted series according to criteria of pain, mobility, strength and ability to perform some activities with the injured wrist [34].
Radiographic analysis is performed by measuring the scapholunate angle to see if there is DISI (greater than 70 degrees) or VISI (less than 30°); the carpus and ulnar translation are measured following criteria Youm et al [41].

In the series published by us [14], in which 41 patients were reviewed, from two general hospitals, with an average follow-up of 3 years. Clinical results were: 30% very good, 30% good, 20% regular and 20% bad. Radiographic outcomes: very good in 10%, good in 30%, fair in 25% and 35% bad. It is observed that the clinical outcome is better than radiographic one [33], but as Herzberg said [16], good clinical tolerance of bad radiographic results disappear when more years of evolution pass.

In more specialized treatment centers and when reconstruction of ligamentous injuries is performed, results improve [32,36]. However, the average of the range of movement of flexion-extension and lateral deviations of the wrist does not exceed 60% of normal; grip strength is 73% and the radiographic measurements show an increase scapholunate angle, decreased carpal height and osteoarthritis in 50% of patients [36]. Patients with initial sleazy reduction tend to have worse clinical outcomes [35].

The perilunate injuries are potentially devastating and disabling if the diagnosis is delayed or the reduction and fixation is inadequate [32]. Careful attention should be take to the restoration of normal carpal alignment. Despite this, due to the high energy of the initial injury and damage associated chondral dislocation, eventually radiographic progression towards osteoarthritis is common. With early recognition, appropriate surgical and anatomical reduction protected with robust fixing, can achieve satisfactory long-term clinical outcomes [37].

**Complications**

Avascular necrosis of the scaphoid or lunate may reach 20%, and resolve spontaneously in half of cases [30]. This has been proven in our series although in cases of necrosis results were fair or poor [14].

Pseudoarthrosis or malunion of the scaphoid, is a frequent long-term complication, but its exact percentage is not well in different publications referenced; in our series [14] has been 25%.

Posttraumatic carpal instability occurs most frequently in DISI, with or without translation or ulnar carpal collapse. The scapholunate angle and carpal height worsen over time, influenced by the loss of cartilage thickness in midcarpal joint [33].

Posttraumatic osteoarthritis affects to 18% -22% of patients in some series [13]. In other publications [34], 50% and affected mainly midcarpal joint. Eight of the 10 patients in our series [14], which had more than 10 years of evolution had osteoarthritis. In publications with longer follow-up [33] it can reach 100%. It seems related to the intensity of the initial trauma [14].
Prognosis Factors

The poor prognostic factors existing in perilunate dislocations and fractures-dislocations are [42]: open injuries; the volar fracture-dislocations; dislocations that occur after falls from height with more severe injuries of bones and soft tissue; high energy trauma in radial styloid fractures; delay in treating the injury above 4 weeks; anatomical reduction obtained with treatment does not guarantee the end result, but if the achieved reduction is better, results improve.

Conclusion

We conclude with precedents authors [42] that the prognosis of perilunate dislocations and fracture-dislocations is bad, even in the best conditions of diagnosis, being treated in the first 4 weeks and in a specialized center. The clinical outcome depends mainly on the initial trauma and the existence, or not recognized cartilaginous and ligamentous injuries [20,12].

References


