



Original Article

Perilunate carpal dislocation. Clinical evaluation of patients operated with reduction and percutaneous fixation without capsular-ligament repair[☆]



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ABSTRACT

Objective: To qualitatively assess surgeries performed in patients with perilunate dislocations without associated fractures, who were operated using the closed reduction and percutaneous fixation method. The follow-up time ranged from one to seven years.

Methods: 628 patient records with traumatic wrist injuries, operated by the same group of Hand Surgeons between 2008 and 2014 due to acute trauma were collected, with a mean follow-up of 3.2 years. Of these, 51 were cases of perilunate fracture-dislocations, and 38 were pure perilunate dislocations without associated fractures; of these, only 32 underwent percutaneous fixation without ligamentous repair, thus meeting the inclusion criteria. Of the nine patients with perilunate dislocations who were treated using the closed reduction and percutaneous fixation method, whose mean age was 38 years (range 26–49 years), the dominant side was the left in two-thirds of the cases, and the predominant trauma mechanism was direct trauma.

Results: This study is in agreement with the literature, showing that cases treated early present good results.

Conclusion: 88% of patients who were treated by closed reduction and percutaneous fixation method maintained their daily activities and were assessed as excellent or good by the Clinical Scoring Chart.

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Luxação perilunar do carpo. Avaliação clínica de casos operados com redução e fixação percutânea, sem reparo cápsulo-ligamentar

R E S U M O

Palavras-chave:

Ossos do carpo/lesões
Ossos do carpo/cirurgia
Fixação interna de fraturas
Traumatismos do punho

Objetivo: Fazer uma avaliação qualitativa das cirurgias feitas em pacientes que sofreram luxações perilunares, sem fraturas associadas, que foram operados com o método de redução incruenta e fixação percutânea. O tempo de seguimento variou entre um e sete anos.

Métodos: Foram levantados prontuários de 628 pacientes, sob a denominação de lesões traumáticas no punho, operados pelo mesmo grupo de cirurgiões de mão, entre 2008 a 2014, com seguimento médio de 3,2 anos, devido a traumas agudos. Desses, 51 foram casos de fraturas-luxações perilunares, 38 eram luxações perilunares puras, sem fraturas associadas; dessas, apenas 32 tiveram fixação percutânea, sem reparo ligamentar, contemplaram assim os requisitos da pesquisa. Dos nove pacientes com luxações perilunares que foram tratados pelo método de redução fechada e fixação percutânea, com média de 38 anos (26 a 49), o lado dominante foi o esquerdo em 2/3 dos casos, o mecanismo de trauma predominante foi o direto.

Resultados: Este estudo convergiu com outros trabalhos na literatura, mostrou que os casos tratados precocemente apresentam bons resultados.

Conclusão: Mantiveram suas atividades de vida diária e foram avaliados como excelentes ou bons pelo Clinical Scoring Chart 88% dos pacientes que foram tratados pelo método de redução fechada e fixação percutânea.

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Introduction

Carpal instability still challenges specialists, not only because there are aspects of its pathophysiology that still need to be clarified, but also because when not properly treated, such problems can have substantial adverse social consequences in terms of disability.¹

The kinematics of carpal bones are complex, and their movements are predominantly guided by the contact of bones and by the action of ligaments and joints rather than the direct action of muscular forces. Therefore, it is difficult to predict the movement of carpal bones after ligament lesions with imaging studies and clinical tests alone.²

The wrist is a complex structure, composed of bones, ligaments, and tendons that together and harmoniously allows movements in the coronal and sagittal planes. Due to its positioning and its movement arc, the wrist is susceptible to constant axial forces and deformation vectors.³

Carpal stability is defined as the ability of the wrist to maintain static and dynamic balance of the joints under physiological loads and movements. In turn, carpal instability is the disturbance of that balance associated with bone and/or ligament injuries, resulting in failure to maintain the articular anatomical relationships and resulting in biomechanical performance deficit, pain, and carpal collapse.³

It is believed that carpal instability is more common than previously thought and that degenerative disease is the end result of undiagnosed instability.²

Perilunate dislocations are uncommon and serious injuries; 61%–65% of the cases are associated with scaphoid

fractures, referred to as “major arch injuries;” these are outside the scope of this article, which addresses only pure ligament injuries (“minor arch injuries”).⁴

The scapholunate (SL) and lunotriquetal (LT) ligaments are the most important, responsible for stabilizing the proximal row. They fixate the proximal margin of the scaphoid to the lunate, and the proximal lunate to the pyramidal, respectively.³

Previous studies have investigated the dynamic and static aspects of scapholunate instability (defined as a radiographic increase in space between the scaphoid and the lunate) and the consequences for the wrist.²

Perilunate dislocations of the carpus are rare lesions, which may go unnoticed in 15%–50% of cases, generally resulting from shock or high-energy trauma. They are responsible for severe osteochondral and capsuloligamentous lesions, which may leave important functional sequelae, dominated by chronic instability of the wrist and, in the long term, osteoarthritis.⁵

Perilunate dislocations are relatively uncommon. They are serious carpal lesions that occur after high-energy trauma or when the victim falls on the outstretched hand. They produce a variable interruption of carpal anatomy, but its constant and defining characteristic is a dislocation of the head of the capitate, distal to the surface of the lunate, most often dorsal and sometimes volar. These are a form of progressive ligament and bone damage.⁶

The main problem with carpal ligament injuries is their high tendency for medium- or long-term arthritis, which begins in the radiocarpal joint and later expands to the intercarpal joint.⁷

Mayfield described four stages of pure ligament injuries⁷:

- I: scapholunate injury or dissociation
- II: rupture or displacement between the lunate and the capitate
- III: lunotriquetral injury or dislocation
- IV: severe radiolunate injury with lunate enucleation and risk of necrosis

Injury mechanism involves abrupt wrist extension, associated with ulnar deviation and supination of the intercarpal joint. The most serious of these injuries are Mayfield types III and IV, which result from high-energy trauma.⁸

Anatomic reduction of intercarpal relationships is the key to avoiding avascular necrosis or carpal instability and, ultimately, chronic scapholunate advanced collapse (SLAC) and osteoarthritis.⁸

In addition, while spontaneous reductions are possible, they may underestimate the severity of injury and ligament damage.⁶

Three types of treatment have been described: closed reduction and cast immobilization; closed reduction and percutaneous fixation, associated with immobilization; and, open ligament and bone repair with fixation and postoperative immobilization. Currently, the results of closed reductions without fixation are unsatisfactory and do not allow the reestablishment of the capsuloligamentous apparatus and, therefore, carpal stability.⁵

The current "gold standard" treatment of these lesions is reduction, fixation, and reconstruction (mainly of the scapholunate ligament), but it is observed in clinical practice that in many of the cases in which the gold standard is not performed, reconstructions or primary suture of the intercarpal ligaments progress well, and patients remain without significant complaints for long periods of time.

Although the literature presents great variation in the results of perilunate carpal dislocations, long-term experience and prognosis are not necessarily satisfactory. Wrist movement is impaired, and arthrosis of the mediocarpal joint is common.⁹

A study demonstrated that the reflexes originating from the musculoskeletal system, which involves the wrist, play a role in protecting the joint and preventing excessive excursion of the carpal bones, having a protective effect on the development of post-traumatic osteoarthritis.¹⁰

The results of surgical treatment for perilunate dislocations and fractures-dislocations remained below ideal in patients who were treated within four weeks of injury using similar reduction and fixation principles in a specialized center.¹¹

Median nerve lesions may be present at the time of initial care due to compression of the nerve; it usually regresses after reduction. The literature reports persistence of symptoms up to six months after the reduction.¹²

A study on fractures of the distal end of the radius, focusing on carpal instabilities, demonstrated that carpal instabilities due to misalignment of the radial-lunate-capitate axis should be corrected, as in the long term they will be responsible for degenerative wrist alterations.¹³

Some factors that affect prognosis are still being discussed; this study aimed to collect qualitative data, both clinical and

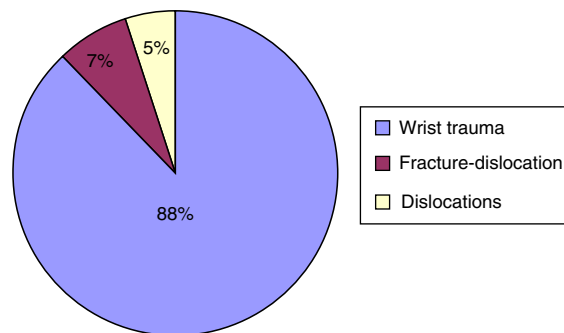


Fig. 1 – Total percentage of medical records, according to pathologies.

radiographic, in order to assess the outcome of patients who were operated for perilunate lesions of the carpus using closed reduction and percutaneous fixation.

Patients and methods

A total of 628 medical records of patients diagnosed with traumatic wrist injuries due to acute trauma, operated by the same group of hand surgeons between 2008 and 2014, with a follow-up between one and seven years were selected. Of these, 51 were cases of perilunate fracture-dislocations; 38 were pure perilunate dislocations, without associated fractures, and of these, only 32 had been treated with percutaneous fixation, without ligament repair, meeting inclusion criteria (Fig. 1).

The 628 records were divided into three groups: wrist trauma (distal radius fractures, physeal injuries, and carpometacarpal lesions), fracture-dislocations (trans styloid perilunate fractures, transscaphoid-perilunate and transcapitate fractures, or combinations of these); and perilunate dislocations or minor carpal arch injury.

Of the 38 patients with perilunate dislocations without associated fracture, those who underwent surgery after over seven days of injury or who underwent capsuloligament repair or reconstruction (including the scapholunate ligament) and patients under 18 years of age at time of injury were excluded from the study; 32 cases remained.

There was some difficulty in locating patients, since the telephone number registered in the medical records was no longer valid in many cases. In other cases, even when contact was achieved, many reported that they were well and thus did not cooperate, because participation in the study required a return to the clinic. In some cases there was loss to follow-up, change of address, or refusal to collaborate with the research. Thus, this study included nine patients.

Methods

The selected patients were those submitted to closed reduction and percutaneous fixation between the scaphoid and the lunate, scaphoid and capitate, pyramidal and lunate, and between the radius and lunate, with some variations, as will be shown. Mean time for K-wires removal was 10 weeks, as was also demonstrated in other studies,^{2,9,14} but K-wires between the radius and lunate were removed at six weeks.



Fig. 2 – Saehan dynamometer, used in the research.

For all patients, clinical and radiographic evaluation was made using the Clinical Scoring Chart,⁶ and epidemiological profile was assessed (age, sex, occupation, associated trauma); the study was approved by the Ethics Committee (No. 999,765), CAAE: 4310631580005225, and patients signed an informed consent form.

The Jamar dynamometer is an instrument for manual grip strength validation, having been the most accepted instrument since 1954, and is recommended by the American Society of Hand Therapists (ASHT) to measure grip strength in patients with various disorders that compromise the upper limbs. One article showed the validity and

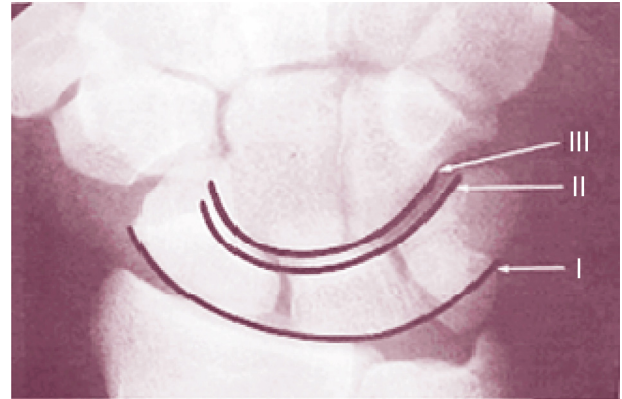


Fig. 4 – Gilula's arcs.¹⁵

reliability of the Saehan dynamometer, based on comparative and force tests between the Jamar and Saehan models. The Saehan dynamometer was used in the present study (Fig. 2).¹⁴

Patients were evaluated in a seated position, with their arms resting on their thighs, as recommended by the ASHT. Three grip strength measurements were made on each side, alternating sides; patients were instructed to perform maximal contraction for three seconds and at 30-second intervals between each test (Fig. 3). Mean values of the three tests, for each hand, were used for data analysis.¹⁴

The radiographic assessment included was composed by the analysis of Gilula's arcs (Fig. 4), posteroanterior (PA) radiographs, and the scapholunate angle, measured through profile radiography.

On the PA radiographs, the following can be observed:

Arc I – articular surface proximal to the first row of the carpus;

Arc II – articular surface distal to the first row of the carpus;



Fig. 3 – Position of the patient during hand grip test.

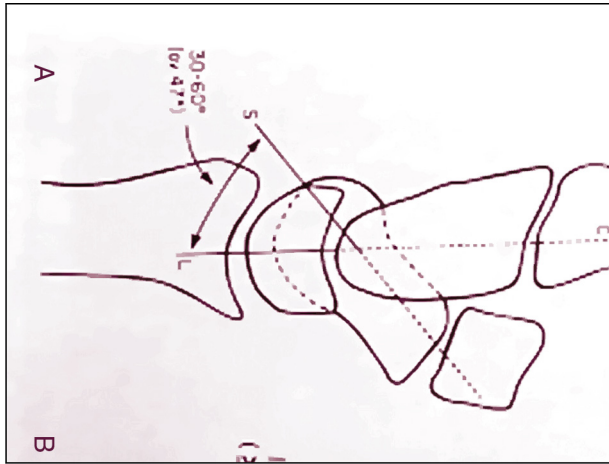


Fig. 5 – Schematic drawing.¹⁵

Arc III – articular surface proximal to the second row of the carpus.¹⁵

The scapholunate angle is measured at the profile radiographs, and is considered normal when between 30° and 60°.

Fig. 5 shows a representation of how the scapholunate angle was evaluated in profile radiographs.

Current radiographic assessment

- Maintenance of Gilula’s arcs.
- Scapholunate angle, in degrees (profile radiograph).
- Scapholunate interval: less than or equal to 3 mm or larger than 3 mm (comparative radiographs with the contralateral side).

Evaluation parameters of carpal perilunate dislocations:

Clinical Scoring Chart⁶

Pain:

- No pain..... 25 points.
- Occasional pain..... 20 points.
- Severe pain..... 10 points.
- Constant pain..... 0 point.

ROM: sum of the degrees of wrist flexion and extension.

- Greater than 140°..... 25 points.
- Between 100° and 140°..... 20 points.
- Between 70° and 99°..... 15 points.
- Between 40° and 69°..... 10 points.
- Less than 40°..... 0 points.

Grip strength: assessed through a dynamometer (the healthy side was used as a reference).

- Normal..... 25 points.
- Decreased, but greater than 50% from normal..... 15 points.
- Less than 50% of normal..... 0 points.

Table 1 – First part of patient outcomes.

Demographics			
Patient	Sex	Month/year	Trauma mechanism
1	M	Nov/13	Crushing
2	M	Jul/13	Direct trauma
3	M	Oct/13	Direct trauma
4	M	Sept/13	Direct trauma
5	M	May/13	Direct trauma
6	M	Jun/14	Direct trauma
7	M	Sept/12	Direct trauma
8	M	Feb/12	Direct trauma
9	M	Apr/08	Direct trauma

Activity

- Performed the same activities..... 25 points.
- Restricted activities due to injury..... 15 points.
- Change of work or sport due to injury..... 0 points.

Final score of the patient: the sum of the previous questions.

- Excellent: greater than or equal to 95 points.
- Good: greater than or equal to 75 points.
- Regular: greater than or equal to 60 points.
- Poor: less than 60 points.

Clinical and radiographic evaluations were performed comparatively. The contralateral side, normal and injury-free, was used as a parameter of normality for each patient.

After completion of the Clinical Scoring Chart,⁶ each patient’s result was classified according to the criteria described above (excellent, good, fair, or poor).

Fig. 6 shows a radiograph of a case of perilunate dislocation or minor arch injury.

Fig. 7 shows an example of a patient’s radiograph after closed reduction and percutaneous fixation. In this case, the scaphoid was fixated percutaneously with the lunate, the scaphoid with the capitate, the pyramidal with the lunate, and the pyramidal with the capitate.

Results

All nine patients evaluated were male, with a mean age of 38 years (26–49) and a mean follow-up of 3.2 years (1.5–7 years); left side was the dominant side in two-thirds of the cases, and direct trauma was the predominant mechanism of trauma.

Gilula’s arcs were maintained in the radiographic evaluation of 88% of patients (Table 1).

The mean scapholunate angle was 54° (35°–70°); 67% of cases were within normal limits.

Although the scapholunate interval was not an evaluation criteria of this study, it was observed that in 77% of the cases this interval was greater than 3 mm when compared with the contralateral side, despite the fact that the literature mentions diastase greater than 3 mm, with poor prognosis if not corrected,¹⁴ and values above 4 mm as predictors.¹⁵



Fig. 6 – Radiograph of a case of carpal perilunate dislocation.



Fig. 7 – Radiograph of a case treated by closed reduction and percutaneous fixation.

Of the patients evaluated, four continued to practice physical activities with minor adaptations or limitations (44% of the total).

The result of the Score Chart showed that 88% of patients presented good or excellent results, and only one patient presented poor outcome (Table 2).

Fig. 8 shows the radiograph of a case of perilunate dislocation of the carpus, treated by closed reduction and percutaneous fixation, seven years after injury.

Excellent or good results were observed in 88% of patients (Fig. 9).

Table 2 – Second part of patient outcomes.

Patient	Search results			Radiographic and clinical results		
	SL interval	SL angle	Score Chart results	Removal of the KW, weeks	Fixated joints	Maintenance of Gilula's arc
1	Greater than 3 mm	50°	Poor	8 w	RL/SL	Yes
2	Greater than 3 mm	50°	Excellent	8 w	RL/SL/SC	Yes
3	Greater than 3 mm	50°	Excellent	10 w	SL/PL	Yes
4	Greater than 3 mm	70°	Excellent	10 w	RL/SL/SC	Yes
5	Greater than 3 mm	56°	Good	8 w	RL/SL/SC	Yes
6	Less than 3 mm	70°	Good	10 w	RL/SL/SC/PL	No
7	Greater than 3 mm	40°	Good	10 w	RL/SL/SC/PL	Yes
8	Greater than 3 mm	35°	Excellent	12 w	RL/SL/SC/PL	Yes
9	Less than 3 mm	67°	Good	10 w	SL/SC/PL	Yes

SC, fixation between the scaphoid and capitate; SL, fixation between scaphoid and lunate; KW, Kirschner wire; PL, fixation between pyramidal and lunate; RL, fixation of the joint between the radio-lunate; w, weeks.



Fig. 8 – Radiograph after seven years of injury.

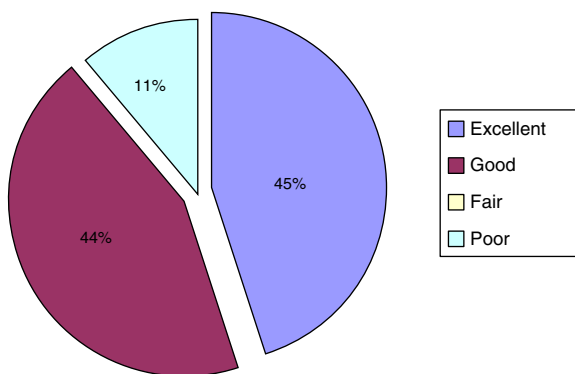


Fig. 9 – Assessed patients and results of Clinical Scoring Chart.

Discussion

Main problem of carpal ligament injuries is their potential to develop arthritis over time⁷; perilunate dislocations are complex and, due to their inherent instability, are surgically treated.¹

Clinical practice sometimes shows a divergence between clinical status of the patient's wrist and its radiographic evaluation, so this type of study has become important.

Of the medical charts with traumatic wrist injuries retrieved, most presented carpal fracture-dislocation (lesions of the major arch); the scaphoid was the main fractured bone. Pure ligament dislocations (minor arch injuries), the basis of the present study, were minority, following the proportion reported in other studies in the literature.⁶

Despite the small number of patients evaluated, this study aimed to qualitatively evaluate cases operated due to carpal perilunate dislocations treated acutely, in up to seven days, by the same team of surgeons. Patients, with a mean follow-up of 3.2 years (1.5–7), underwent non-invasive reduction and percutaneous fixation without repair of the scapholunate ligament, with a 10-week mean interval until removal of K-wires. The literature indicates a similar interval for removal of the K-wires, ranging from 8 to 12 weeks.^{1,6,9}

Regarding demographic characteristics, there was a predominance of physically active young men and lesions due to high-energy trauma (most of which were motorcycle accidents). In 77% of the patients, the radius was fixated to the lunate, which is also suggested by some studies as a way of avoiding loss of reduction.⁷

Maintenance of Gilula's arcs was observed in 88% of the cases in the present study, and the scapholunate angle in lateral view was within the normal range (30°–60°) in 67% of cases.¹⁵

Of the nine patients evaluated, four practiced physical activity (two are in the military, one is an amateur athlete, and one is a martial arts teacher). They continued to perform their exercise activities, with minor changes or adaptations.

Only one patient had a poor score, having to discontinue his physical activities (motocross) in favor of lighter activities, due to wrist ROM limitations.

Conclusion

Results of the present study are in agreement with the literature, showing that cases treated early have good results.⁶

The study demonstrated that 88% of patients who were treated by closed reduction and percutaneous fixation were able to maintain their daily activities and were assessed as excellent or good by the Clinical Scoring Chart.

Conflicts of interest

The authors declare no conflicts of interest.

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