

Case Report

Retro-lunar dislocation of carpal bones with trans-capitate, trans-lunate fractures and intact scaphoid. What if Bain was right?

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ABSTRACT

We report the case of retro-lunar dislocation of carpal bones detaching the proximal pole of the capitate with intact scaphoid, associated with lunate fracture. A rare case where the pathomechanics of the lesion has not yet been precisely identified. We present our conservative approach in the treatment of the capitate fracture and propose a theory-based explanatory pattern that combines the ligaments injuries sequences described by Mayfield from lateral to medial (corresponding to Johnson's lesser arc injuries), and the displacement of the transmitted force along Wagner's dislocation line from medial to lateral, causing bones injuries, following Johnson's greater arc injuries and Bain's translunate arc. Our management after closed reduction of the dislocation was surgical through dorsal approach and fixation of the proximal pole of the capitate. 25 months after surgery, despite the installation of early osteoarthritis, the functional outcome is satisfactory.

Introduction

Retro-lunar fractures-dislocations of carpal bones are rare injuries that usually result from high-energy trauma. When involving the capitate, they are most often associated with a fracture of the carpal scaphoid as part of the pseudo-Fenton's syndrome described by Jones [1–3]. These injuries are serious because of the threat they pose to the stability of the wrist as well as the installation of osteoarthritis which is often unavoidable and requires early surgical management. Both capitate and lunate fractures account for only 1 to 2% of all carpal bones fractures [4,5], and the association of a capitate fracture with a perilunar dislocation is even rarer, of the order of 0.4% according to Rand [6]. We present our management of an exceptional form, which has never been published before to our knowledge and we try to understand the different stages of the injury mechanism according to the concept of the three arc injuries of Johnson [7] and Bain [8].

Patient and observation

A 61-year-old male patient, right-handed, labourer, admitted on an emergency basis following a fall from an estimated height of 2 m landing on the ulnar border of the palm of his right hand, with wrist hyperextension and ulnar deviation, causing a closed trauma of the wrist. The examination reveals a total impotence with diffuse swelling of the wrist and excoriations at the level of the hypothenar region without any neurovascular involvement. X-Ray assessment of the right wrist shows a posterior perilunate dislocation of the carpal bones with transverse fracture of the capitate detaching its proximal pole, as well as a dislocation ahead the

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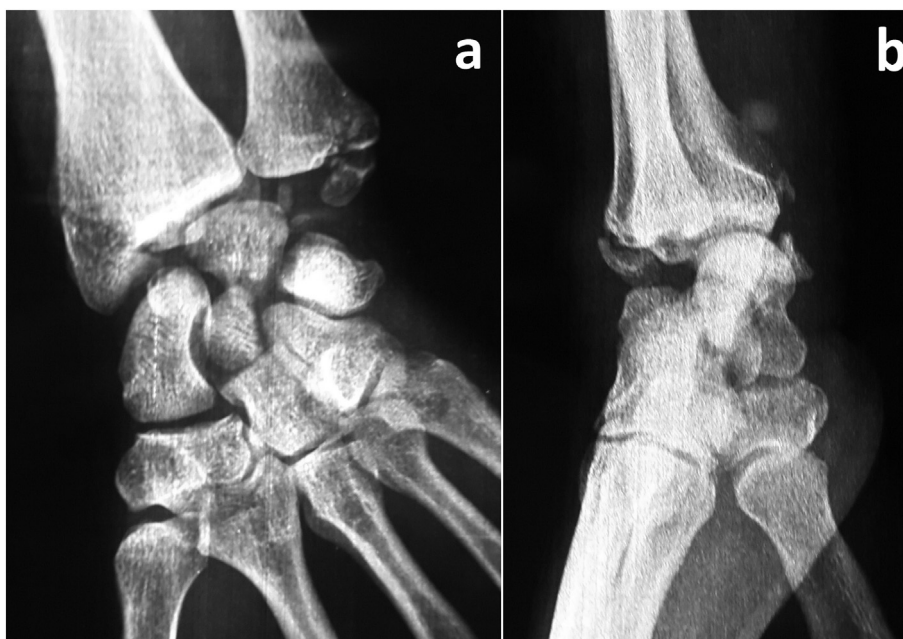


Fig. 1. Posteroanterior (a) and lateral (b) radiographs of the right wrist at admission: Retro-lunar dislocation of carpal bones with transverse fracture of the capitate, anterior displacement of the lunate with fracture-enucleation of a part of its anterior horn, radial styloid fracture and ulnar styloid fracture.

lunate classified as type IIa according to Herzberg [9] and as type 2 according to Witvoet and Alieu [10] with fracture-enucleation of a part of its anterior horn. We also notice radial styloid fracture and ulnar styloid fracture (Fig. 1). At first, we performed a closed reduction under local anaesthetic before completing our exploration with a CT scan (Fig. 2). The patient was then admitted to the operating room where we performed -under general anaesthetic and after a tourniquet was applied at the root of the limb- a dorsal approach of the carpus by longitudinal incision between 3rd and 4th compartments, extended in depth by the opening of the extensor retinaculum [11]. The extensor pollicis longus is reclined outwards while the rest of the extensors are reclined inwards to reach the capsule that we have incised laying a flap with a proximal base to expose the capitate fracture site. We note that the proximal pole of the capitate is rotated 90° transversally and that it is the seat of cartilaginous injuries with a slight loss of substance in the fracture site. We perform the reduction of the capitate fracture before its fixation with a mini-fragment screw (Fig. 3). We then perform a temporary arthrodesis of scapholunate, triquetrolunate and scaphocapitate spaces by 3 Kirschner wires (15/10th) before fixing the

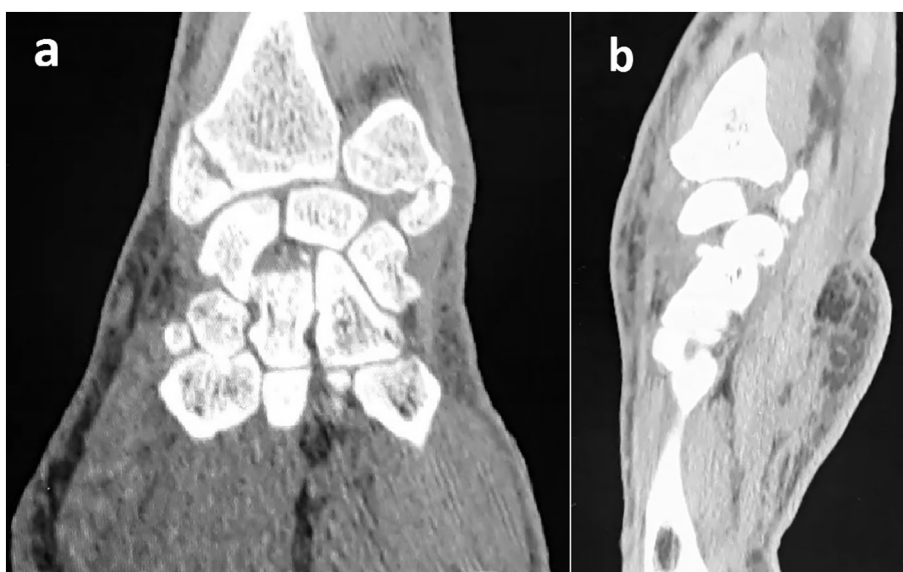


Fig. 2. CT aspects in frontal (a) and sagittal (b) sections after closed reduction.

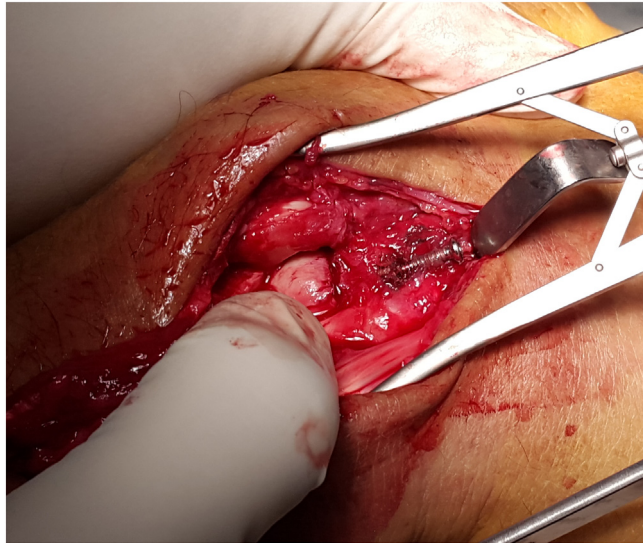


Fig. 3. Fixation of the capitate head with a mini-fragment screw.

radial styloid fracture, also by pinning (Fig. 4). Although recommended [12,13], we could not perform a direct suture of the scapholunate ligament because of the quality of the stump and the unavailability of anchors. Nevertheless, the enucleate fragment of the anterior horn of the lunate being inaccessible by this approach and the anterior approach being more likely to aggravate ligaments injuries, it was then left in place. After careful closure of the capsule, the extensor retinaculum and the skin, a short-arm cast was applied, the wrist being in neutral position.

Results

The pins were removed under local anaesthetic at 6 weeks at the same time as the removal of the plaster immobilization to allow physiotherapy. The screw was held in place until capitate consolidation which occurred around the 3rd month and it was then removed by mini-dorsal approach centred on the screw head that was identified by image intensifier. 25 months after surgery, the radiological evaluation shows the consolidation of the radial styloid fracture as well as the complete consolidation of the capitate fracture without signs of avascular necrosis of the proximal pole of the capitate. Nevertheless, signs of perilunate, scapholunate and

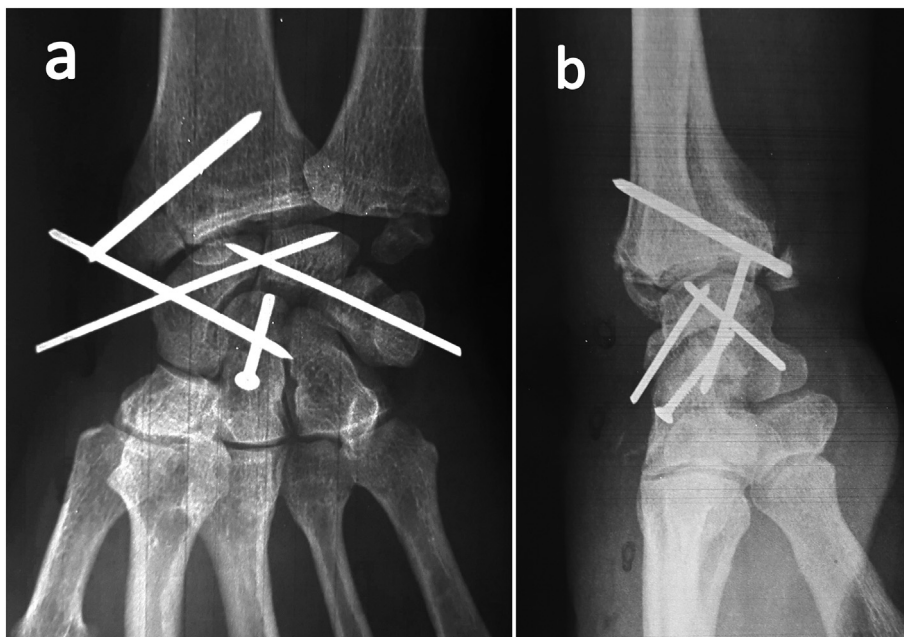


Fig. 4. Posteroanterior (a) and lateral (b) radiographs of the right wrist after surgery.

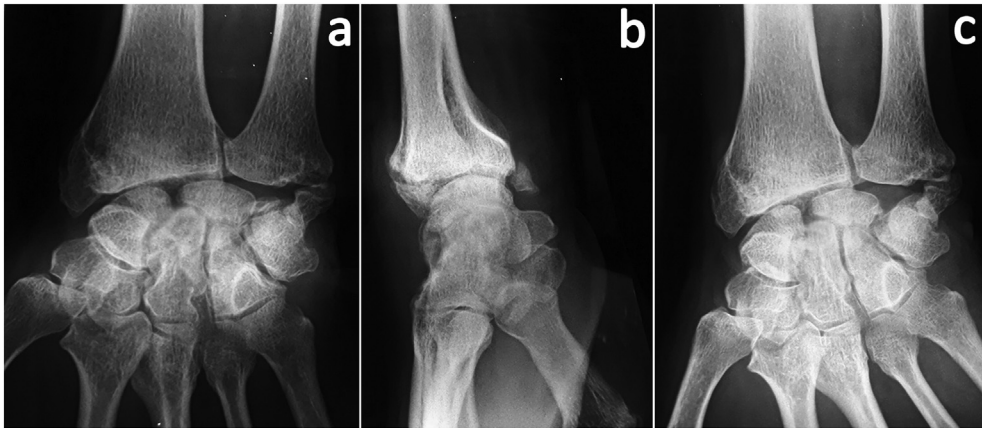


Fig. 5. Posteroanterior (a), lateral (b) and ulnar deviation (c) radiographs 25 months after surgery.

triquetrolunate instability remain present. Indeed, in the front views in neutral position of the wrist and in ulnar deviation we note a scapholunate diastasis with a displacement of the lunate which is not dorsal as we would expect but palmar in VISI. The latter, although separated from a part of its anterior horn which interferes with the interpretation, seems nevertheless flexing presenting its posterior horn. The scaphoid is also flexed revealing the sign of the ring by projection of its anterior tubercle while the wrist is not in radial deviation and that this sign is also found on the view in ulnar deviation. A lunotriquetral overlap is also patent. On the side view, palmar displacement of the lunate in VISI is obvious with a loss of collinear radius-lunate-capitate-M3 alignment. The palmar displacement of the lunate in VISI probably reflects the predominance of triquetrolunate instability over that of scapholunate (the lunate being no longer subject to the extension forces of the triquetrum), and a probable medial injury mechanism [14]. We also note the installation of midcarpal osteoarthritis (in particular scapho-capital and luno-capital) as well as osteoarthritis of the radiocarpal space (in particular radio-scaphoid). Finally, we notice the pseudoarthrosis of the avulsed fragment of the anterior horn of the lunate (Figs. 5 and 6). Clinically, our evaluation was based on Cooney's functional score [15] for an overall « Average » score of 75 out of 100 [Pain: 20/25 (Low occasional) - Function: 25/25 (Normal Work) - Mobility: 15/25 (Arc Flexion-Extension 90°–120°) - Strength: 15/25 (75–100%)], as well as on the Patient-Rate Wrist Evaluation (PRWE) [16,17] with a very good score of 8/100 (Fig. 7). The patient, a labourer, resumed his activity and did not report any signs related to a possible carpal tunnel syndrome. For the time being (25 months after surgery), there does not seem to be a significant correlation between the importance of the radiologically identified osteoarthritis and the functional status which remains satisfactory.

Discussion

We did not find in our literature review any publication presenting a case of posterior perilunate dislocation associating a fracture of the lunate and a fracture of the capitate with intact scaphoid. To our knowledge, the only approaching form was published by Bain

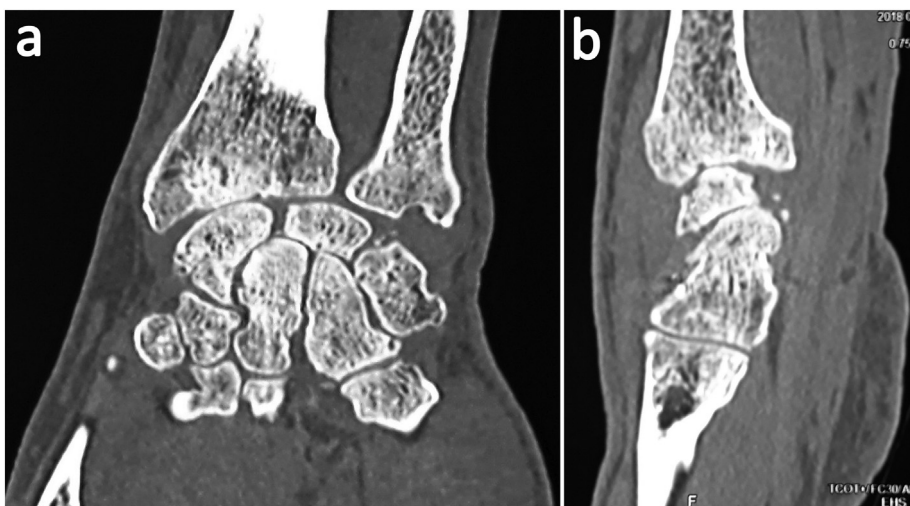


Fig. 6. CT aspects 25 months after surgery in frontal (a) and sagittal (b) sections.

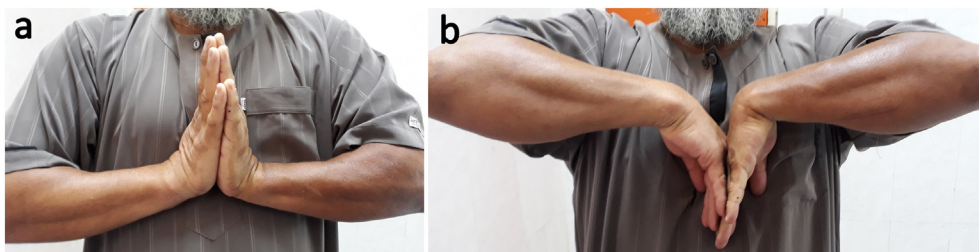


Fig. 7. Clinical results 25 months after surgery.

[8] who described a translunate fracture associated with a fracture of the capitate with subluxation of the latter without complete dislocation of carpal bones and without anterior displacement of the lunate. Located in the vulnerable area of the carpus between greater and lesser arcs of injuries described by Johnson and supplemented by Bain's translunate arc (Fig. 8), the fracture of the capitate most often falls within the nosological entity of Fenton naviculocapitate syndrome where a scaphoid fracture is systematically associated with it. The combination of lesser arc ligament injuries with greater arc bone injuries and those of the translunate arc in the context of retrolunate dislocation is an exceptional entity. Therefore, in the series of 166 cases of retro-lunar dislocations and fracture-dislocations compiled by Herzberg [18] only 6 cases of the 2nd category included an intact scaphoid without even specifying whether one of these cases presented a capitate fracture. Herzberg certainly identifies schematically the possibility in perilunar fractures-dislocations with intact scaphoid that a transcapital course of the transmitted force can occur as a variant but without giving more details on this particular entity. From an etiopathogenesis point of view, if hyperextension is a constant common to the different theories, it is however difficult to justify the fracture of the capitate and that of the lunate with intact scaphoid in the context of a retro-lunar dislocation. Indeed, Fenton argues that it is the radial styloid, in the position of hyperextension and radial

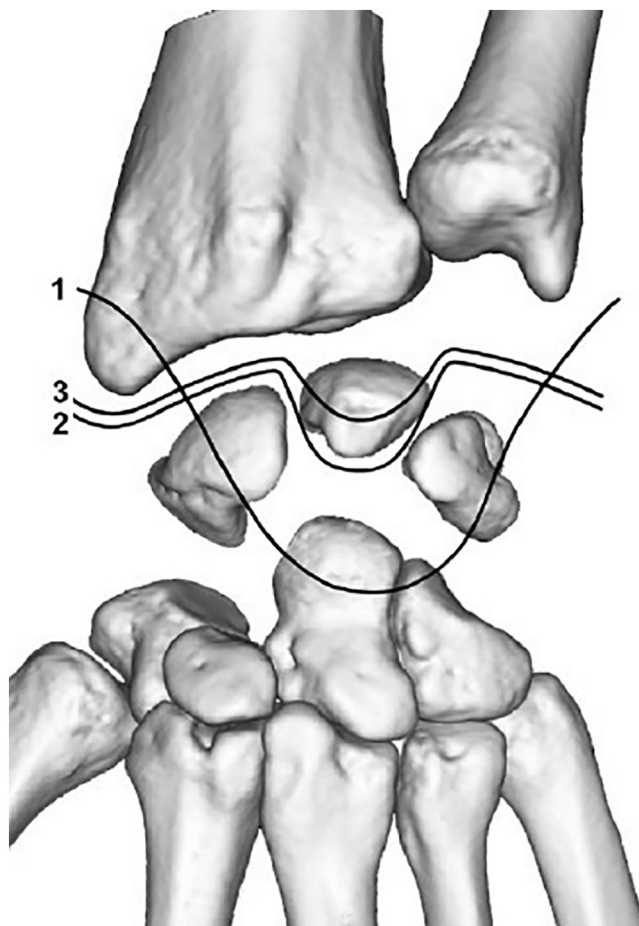


Fig. 8. Johnson's perilunate injuries pattern supplemented by Bain. Line 1 indicates greater arc injuries reaching bone structures. Line 2 indicates lesser arc injuries reaching ligament structures. Line 3 indicates translunate arc injuries.

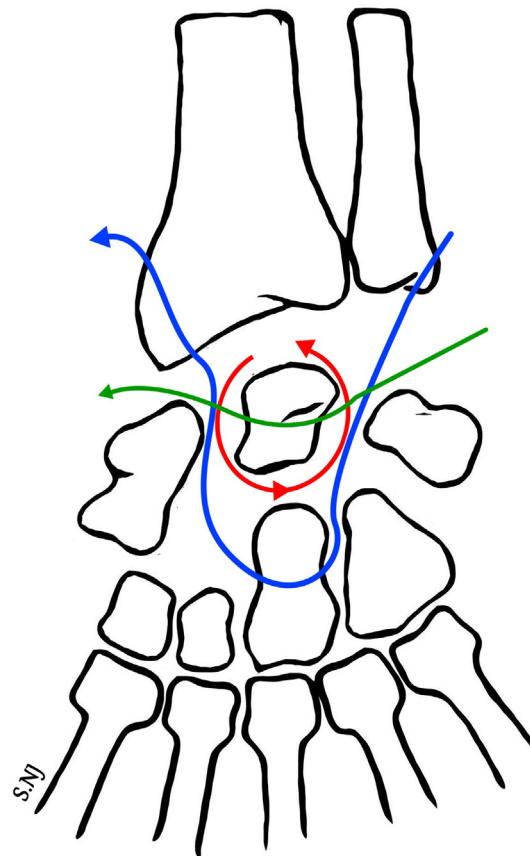


Fig. 9. Propagation of ligament injuries according to Mayfield from lateral to medial (red circle), and bones injuries from medial to lateral according to Wagner's dislocation line corresponding to Johnson's greater arc injuries (blue line) combined with Bain's translunate arc (green line).

deviation of the wrist, that fractures the scaphoid before the remaining energy fractures the capitate. Stein [19] in turn argues that compression fracture of the scaphoid releases the hyperextension which leads to the posterior margin of the radius when exposed to the capitate neck and fractures it leading to the rotation of its proximal fragment when the wrist returns to the neutral position. Finally, Johnson connects capitate fracture to the instability of the capitulum joint which, during hyperextension, allows the dislocation behind the capitate, the proximal pole of which is then struck by the posterior horn of the lunate. None of these patterns completely or systematically meets the explanation of our particular case where there is a retro-lunate dislocation of carpal bones with intact scaphoid. That is why we think that besides hyperextension there is another element that we believe is important so we can be able to explain this fracture of the capitate, namely the impact on the ulnar border of the wrist transmitting transcapsular force from medial to lateral in ulnar deviation of the wrist. This allows us to combine the Mayfield classification [20–22] of ligament injuries initiated by hyperextension and extending from lateral to medial around the lunate, from the scapholunate complex to the triquetrolunate complex, (superimposable on Johnson's lesser arc injuries), with Wagner's dislocation line [23] describing the route taken by the transmitted force propagating from medial to lateral on the route of the greater arc and fracturing the proximal pole of the capitate. This transmitted force rushes into the space created between the scaphoid and the lunate and reaches the radial styloid to fracture it in turn. An intact radio-scapho-capital ligament could explain the undisplaced fracture of the latter. A sequence associated with injuries involvement of Bain's translunate arc which, with the resistance of the anterior radiolunate ligament, allowed the fracture enucleation of a part of the anterior horn of the lunate (Fig. 9). An ulnar medial starting point of the transmitted force that seems to be supported by the circumstances of the accident with the impact on the ulnar border of the palm of the hand, as well as the palmar displacement of the lunate in VISI as a result of the importance of the triquetrolunate malalignment. Obviously, our biomechanical analysis remains hypothetical and need to be verified experimentally on anatomic portion in laboratory in order to reproduce the injury, to identify injuries sequences and whether it validates or not our anatomopathological approach correlated to Johnson's and Bain's three arcs concept. Even if the biomechanical hypothesis remains open to debate, in practice the fixation of the capitate fracture must always be performed in order to preserve the height of the carpus, limit the risk of instability and obtain a good quality carpal neocondyle allowing the performance of possible subsequent procedures in good conditions. Indeed, the good functional outcomes obtained are to be compiled with the early installation of a mediocarpal then global osteoarthritis which can be explained by the nature and the number of ligaments and bones injuries, the possible misalignments of this central bone and the presence of cartilaginous injuries. This osteoarthritis can become in the advanced stages disabling, compelling us to resort to surgical

procedures that will be adapted to the patient's situation. These operations will be greatly facilitated when the environment is favourable because of the conservative attitude that must always be adopted vis-à-vis the capitate fracture. The evolution without avascular necrosis of the proximal pole of the capitate confirms the already recognized good vascularization of the latter, especially in its distal part [24] and reinforces the conservative attitude to be systematically adopted.

Conclusion

Retrolunate dislocation with capitate and lunate fractures is a rare injury, with serious consequences on the carpal stability and the installation of an early osteoarthritis. It is therefore important when any dislocation of this type occurs to look for a fracture of the capitate and the lunate which may be unknown on standard views indicating the performance of a CT scan of the wrist. After urgent reduction of the dislocation, the treatment is surgical and strictly conservative by dorsal approach which provides an excellent access to the capitate and allows easy fixation of its proximal pole and the achievement of a good consolidation of the fracture. There is no strict and systematized correlation between the importance of the radiologically identified osteoarthritis injuries and the functional discomfort observed clinically. On the pathomechanical level, given the importance of the injuries and the diversity of the bones and ligaments structures affected, our explanatory pattern remains a hypothesis that associates the injuries sequence according to Mayfield from lateral to medial and the displacement of the transmitted force from medial to lateral according to Johnson's greater arc and Bain's trans-lunate arc to justify the dorsal dislocation of carpal bones detaching the proximal pole of the capitate with intact scaphoid, as well as the fracture and anterior displacement of the lunate. The aim is to further document this type of injuries in order to better understand the anatomopathological mechanisms.

Conflict of interest

The authors declare that they have no conflict of interest.

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