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Intra-Articular Distal Radius Fracture with Lunate Fossa Rotated and Associated Lesions: Radiologic Analysis

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Abstract

Introduction: Intra-articular distal radial fractures in young patients occur in high energy trauma which can lead to a combination of bone and ligaments lesions. An articular step superior to 2 mm is pejorative, for that an adequate radiologic analysis is necessary accessing to the best surgical treatment. The purpose of our study was to investigate this type of fracture and expose radiologic analysis (radiograph and CT-scan) of bone and ligamentous associated lesions of this specific twisted lunate facet fracture for recognizing it and accessing to the best surgical treatment. **Patients and Methods:** Seven patients with severely displaced type 4 articular fractures of the distal radius whose wrists had been exposed to violent compression are reported in our series, they are required open treatment for the reduction and fixation of disrupted articular surfaces by using an antero-medial approach which allows direct access to the fragment of the lunate facet and easier visualization of the distal radio-ulnar joint. **Results:** All the patients were clinically examined with antero-posterior and lateral X ray, completed by a CT scan, all the fractures were type IV according to Melone classification. In all of our seven cases there was a lesion of the distal radioulnar joint (DRUJ) identified in the CT scan. The CT scan allowed us to individualize well the void of the lunate fossa and calculate his exact degree of rotation, which is very important for planning therapeutic management. **Discussion:** In all of our cases the CT scan was to expose all of the osseous and ligamentous injuries; in the sagittal reconstruction we were able to objectify and calculate the exact degree of the rotation of the lunate fossa fragment; in the frontal reconstruction the void of the lunate fossa is visible and in the axial reconstruction we can determine the incongruence of the distal radio-ulnar joint (DRUJ). Intra-articular involvement has long been recognized as a poor prognostic factor in fractures of the

distal radius. However, despite early studies reporting poor results with non operative treatment for these injuries, most authors opposed operative intervention, due to lack of a good radiological analysis and the CT scan; knowledge that a number of studies have shown that inadequate reduction of intra-articular distal radius fractures leads to the development of arthritis.

Keywords

Articular Fracture, Lunate Facet, Distal Radio-Ulnar Joint, Wrist, Radiograph, CT-Scan

1. Introduction

Intra-articular distal radial fractures in young patients occur in high energy trauma which can lead to a combination of bone and ligaments lesions. Articular reduction should be anatomic because an articular step superior to 2 mm is pejorative, for that an adequate radiologic analysis is necessary accessing to the best surgical treatment. Some authors have reported distinctive features for complex articular fractures with fragments of 90˚ ou 180˚ twisted lunate facet (Melone, halbrecht, takami, Panagopoulos, uzel) Highlighted by our 7 cases and the cases of the literature. The main goal was to expose radiologic analysis (radiograph and CT-scan) of bone and ligaments injuries associated with this specific twisted lunate facet fracture in order to recognize it and have access to the best ORIF.

2. Patients and Methods

Patients

The initial clinical analyses of the cases are presented in Table 1.

Radiological analysis

In Table 2 we have to present all of the osseous and ligamentous injuries which we were able to highlight of our cases.

Table 1. Clinical analysis of the cases.

	Age	Sex	Side	Dominant limb	Date of trauma	Mechanism of trauma	Skin condition	Melone Classification
Case 1	19	M	R	L	21/02/00	Ejected from his car	Closed fracture	type IV
Case 2	22	M	L	R	14/06/00	Traffic accident motorcycle	Closed fracture	type IV
Case 3	43	M	R	R	11/02/07	Fall from a balcony 6 m	Closed fracture	type IV
Case 4	23	M	L	R	03/08/07	Fall from a roof 4 m	Closed fracture	type IV
Case 5	45	M	L	R	02/06/09	Traffic accident motorcycle	Closed fracture	type IV
Case 6	56	M	L	R	11/09/15	Traffic accident motorcycle	Closed fracture	type IV
Case 7	57	M	R	R	26/12/15	Fall from a scale 4 m	Closed fracture	Type IV

Table 2. Radiological analysis of the cases.

	Degree of Rotation of the lunate fossa fragment	Fracture of the radial styloid process	Dorsal subluxation of the carpus	Fracture of the ulna	Scapholunate instability	Radio-ulnar dislocation	Others injuries out side the wrist
Case 1	90˚	Important Displacement	yes	no	no	Yes	no
Case 2	180˚	Important Displacement	yes	Base of the styloid process	no	yes	no
Case 3	90˚	Minimal Displacement	yes	no	no	yes	no
Case 4	180˚	Important Displacement	yes	Distal part of diaphysis	yes	yes	Skull-facial trauma Coma 15 days
Case 5	90˚	Important Displacement	yes	no	no	Yes	no
Case 6	90˚	Important Displacement	yes	no	no	yes	Rolondo fracture of the first metacarpal bone
Case 7	90˚	Important Displacement	yes	Tip of the styloid process	no	yes	no

3. Results

All the patients were clinically examined with antero-posterior and lateral X ray, completed by a CT scan, they are exposed in Table 2. All the fractures were type IV according to Melone classification, combined with fractures and rotation of the lunate fossa fragment at 90˚ in 4 cases and 180˚ in 3 cases. Important displacement of the radial styloid process and dorsal dislocations of the radio-carpal joints in 5 cases. Furthermore the case 2 presented fracture of the base ulnar process type B according to Fernandez classification (whose treatment was direct pining with posteromedial approach), whereas the seven case presented fracture of the tip (Figure 1); the case 4 has a fracture of the lower part of the ulnar diaphysis with scapholunate diastasis at 4 mm without DISI. In all of our seven cases there was a lesion of the distal radioulnar joint (DRUJ) identified in the CT scan. The CT scan allowed us to individualize well the void of the lunate fossa and calculate his exact degree of rotation (Figure 2, Figure 3).

4. Discussion

Imaging with conventional radiograph is insufficient and sometimes initially not interpretable due to the difficulty to realizing Orthogonal Radiography because it's painful (Figure 4). It is for this reason that is necessary to complete with a CT scan of the wrist and post reducionnal peroperative radiography realised in the operating room. In all of our cases the CT scan was to expose all of the osseous and ligamentous injuries; in the sagittal reconstruction we were able to objectify and calculate the exact degree of the rotation of the lunate fossa fragment

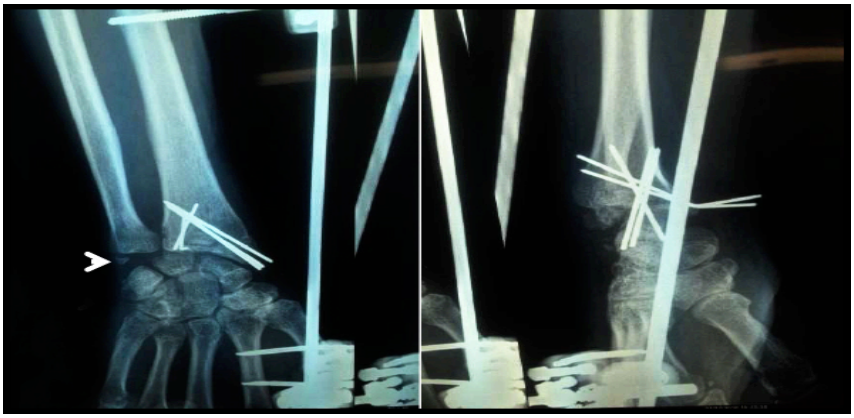

Figure 1. Postoperative radiography showing reduction and fixation of articular fragment with Kirschner wires and neutralization with external fixation. We noted a displacement of the fracture of the tip ulnar process (white arrow). In all of our cases we have used anantero-medial approach which allows direct access to the fragment of the lunate facet and easier visualization of the distal radio-ulnar joint compared to the Henry approach.

Figure 2. Different views of CT reconstruction image demonstrating in 3 D the rotation of the lunate fossa fragment at 90˚ and the different s injuries of the wrist.

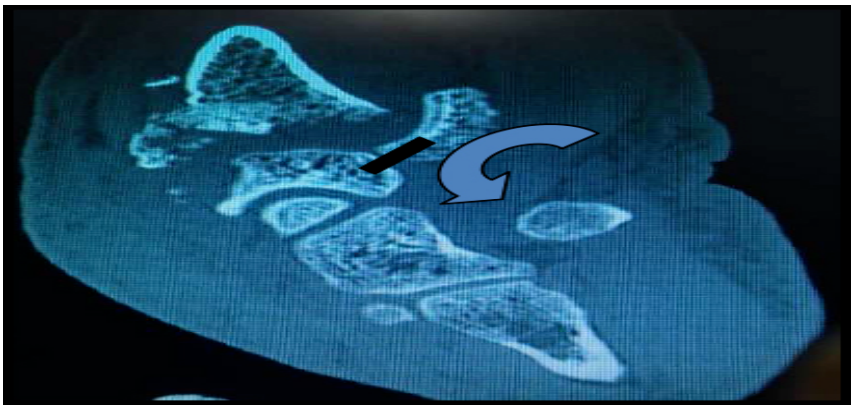

Figure 3. Blue arrow showing the rotation path of the lunate fossa fragment; the black straight line shows the route of the short radio-lunar ligament.

(**Figure 2**, **Figure 3**); in the frontal reconstruction the void of the lunate fossa is visible and in the axial reconstruction we can determine the incongruence of the

distal radio-ulnar joint (DRUJ) (Figure 5). Melone has formulated a classification of intra-articular distal radius fractures with specific operative indications [1]. Fractures with significant rotation of the lunate fossa fragment (type four) are considered unstable and require open treatment (Figure 6). In Melone's series, he reported on 15 patients with type four injuries two cases of fracture with rotation of the palmar medial fragment [1]. Halbrecht and stuchin reported a case of distal radius fracture with unusual fragment displacement with rotation at 180 degree and suggested that type four injury was rare [2], Hiroshi and Takami presented two same cases with subluxation of the carpus one dorsal and one volar and presente that this injury appears to be a variant of Barton's fracture [3]; Panagopoulos AM and al has presented one case report of comminuted distal radial fracture with 180˚ rotation of lunate fossa [4]. Fracture of the styloid process was present in all of our cases; It is almost always the case in this type of fractures Thing that we noticed in all the literatures [1] [2] [3] [4] [5]. A degree

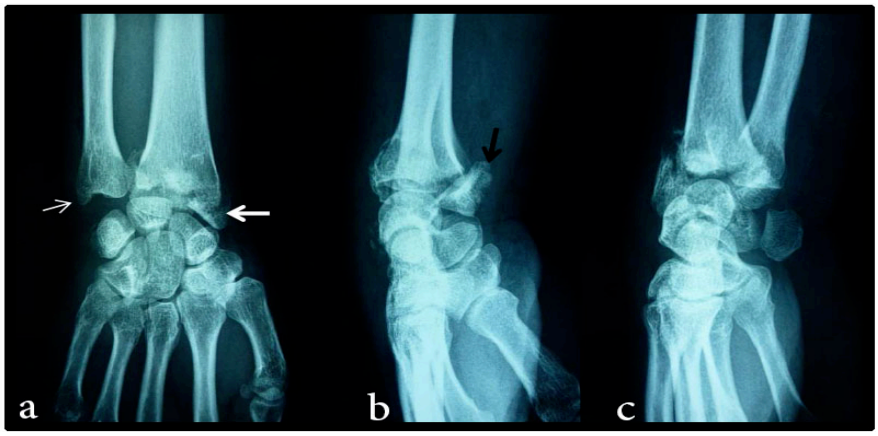

Figure 4. (a) Antero-posterior radiograph showing a Melone type 4 fracture of the distal radius and a displacement of the styloid process (white arrow) with fracture of the tip ulnar process (white small arrow); (b) Lateral radiograph showing 90˚ rotation of the lunate facet (black arrow). (c) The oblique view is not contributory.

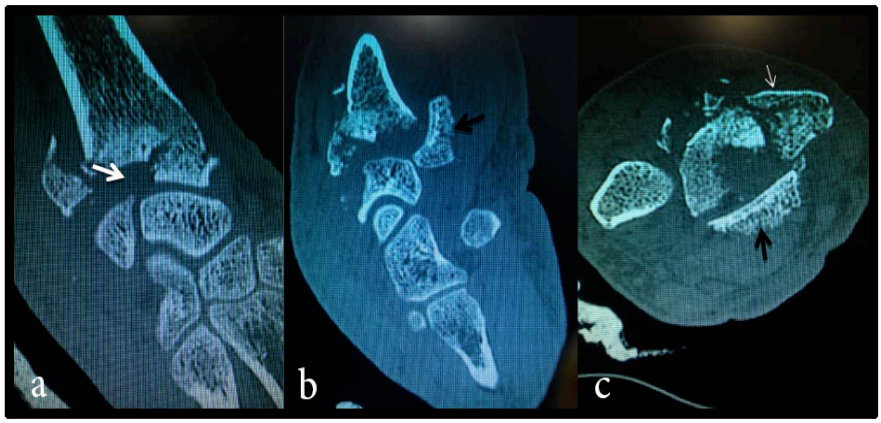

Figure 5. The importance of the T.D.M which allows to analyze well the rotation of the lunate fossa fragment at 90˚ (black arrow), the void of the lunate fossa (white arrow) and the important displacement of the radial styloid process (white small arrow).

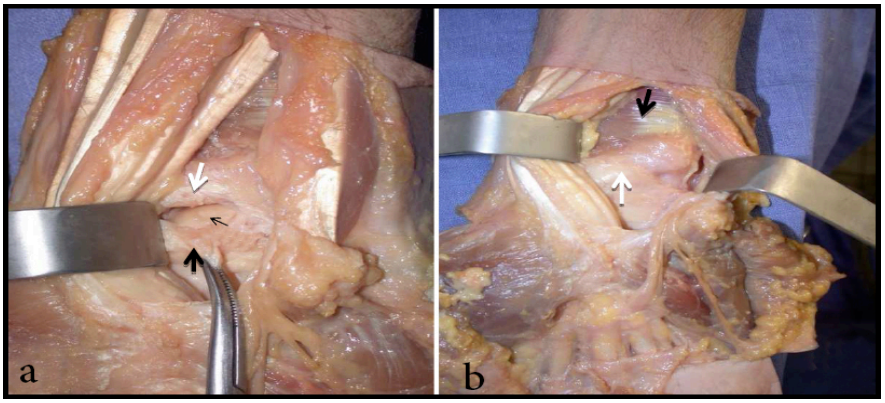

Figure 6. (a) Cadaver dissections view showing the short radio lunar ligament (black arrow), the lunate fossa (white arrow) and the lunatum (black small arrow). (b) Dissections view showing the pronator quadratus (black arrow) the lunatum (white arrow) and demonstrating the anantero-medial approach which allows direct access to the fragment of the lunate facet and easier visualization of the distal radio-ulnar joint.

of rotation of the lunate fossa fragment was at 90˚or 180˚, the mechanism of injury are understood to be caused by a combination of hyperextension and compression (carpal impact) which leads to avulsion of the lunate fossa by traction of the short radio-lunar ligament. An experimental cadaveric study showed that The presence of associated injuries in the fracture of the distal radius was evaluated at 63% which 43% a destabilization of the triangular fibrocartilaginous complex (TFCC) and 32% lesion of the scapho lunar ligament [6].

In all of our seven cases there was a lesion of the distal radioulnar joint identified in the CT scan, Standard postero-anterior (PA) and lateral views of the wrist help in the diagnosis of DRUJ subluxation/dislocation but must be taken with the forearm in neutral rotation, this is where the need for the CT scan which allows to mesure the radio-ulnar ratio (RUR) which considered us a musure of DRUJ congruence using transverse CT slides of the wrist and an interactive computer programme to mesure RUR in a standardised digital version. The per operatory exploration showed a lesion more or less important of the TFCC which is attached to the fragment of the lunate fossa rotated without any effect of stability of The distal radioulnar joint (because it persists others elements of stability like interosseous membrane and pronator quadratus); The case 2 has then a bipolar lesion of the TFCC because there was a fracture of the base styloid process of the ulna. The TFCC is a major stabilizer of the DRUJ and injury to this structure may lead to DRUJ instability, However many TFCC injuries produce no instability but can still cause pain [7]. The most recognized scheme is the PALMER classification (type 1 is traumatic TFCC lesions); surgical treatment for TFCC tears should be considered when there persistent pain from mechanical irritation or synovitis, DRUJ instability or associated fractures [8]. The CT arthrography and MRI arthrography are both the best methods to evaluate the TFCC and all of the others intrinsic ligaments of the wrist, the retinaculum and the flexor carpi ulnaris tendon [9]. The case 4 presented a scapho lunate di-

astasis at 4 mm without DISI (dorsal intercalaled segmental instability); the point is that lesion of this ligament may cause a scapholunate instability which can responsable to rotatory subluxation of the lunate and horizontalisation of the scaphoid and then SLAC (wrist scapho-lunate advanced collapse) [8]. The early diagnosis of this lesion is very important before producing any complications; this diagnosis is based on the opacification of the wrist coupled to the CT scan or MRI without forgetting the advent of the arthroscopy which plays a valuable role in the management of scapholunate instability [10]. Intra-articular involvement has long been recognized as a poor prognostic factor in fractures of the distal radius. However despite early studies reporting poor results with non operative treatment for these injuries, most authors opposed operative intervention, due to lack of a good radiological analysis and the CT scan; knowledge that a number of studies have shown that inadequate reduction of intra-articular distal radius fractures leads to the development of arthritis.

5. Conclusion

Intra-articular fractures of the distal end of the radius with rotation of the lunate fossa in young adults constitute a distinct and complex subgroup of injuries. These injuries are difficult to treat and tend to have a high incidence of post-traumatic arthritis with lesions of intrinsic ligaments. It is therefore very important to make a lesional analysis with a CT scan for an adequate treatment of all the lesional associations. Then the CT arthrography and MRI arthrography are both the best methods to evaluate the lesion of intrinsic ligaments. Future studies with a larger number of patients and a longer follow-up are needed to clarify whether the bony changes will have clinical implications, and if treatment algorithms have to be modified.

Conflicts of Interest

The authors do not declare any conflict of interest.

Author Contributions

All the authors contributed to the conduct of this work, all the authors read and approved the final version of the manuscript.

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