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Interest of the External Fixator in the Treatment of Fractures of the Lower Extremity of the Radius (30 Cases)

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Abstract **Original Research Article**

Comminuted fractures of the distal radius are common. A retrospective study was conducted in the department of orthopaedic trauma-A of university hospital Avicenne of Rabat on a six-year period between January 2010 and December 2016 involving 30 cases of comminuted fractures of the distal radius treated with distraction external fixator. The average age of our patients was 28 years old, all male, all of our patients had a wrist injury during a sports accident. The right side was affected in 88 % of cases. X-rays have objectified an articular fractures and/or comminuted without opening the skin, we adopted the Castaing classification stadifier for fractures of the distal radius. The treatment consisted of a bipolar distraction external fixator combined with a plug-in three patients, ablation of osteosynthesis material was carried out in 6 weeks, then physical therapy was started. After falling 21 months, our results were very satisfactory with good recovery of mobility of wrist and back of any sport.

Keywords: External fixator, lower extremity, radius.

INTRODUCTION

Fractures of the lower extremity of the radius are very frequent, most of them responding to orthopedic treatment by immobilization plaster. Some of these fractures, particularly those with articulative joint involvement and axial deflection, are unique to surgical treatment that is well suited for good functional results [1-4]. Many authors have presented alternative methods, usually more aggressive than reduction by external manipulation to maintain the reduction [5-7]. It was Boehler, in the 1920s [8], who introduced bipolar traction by percutaneous fixation using two Kirschner pins or Steinmann nails, one placed in the radius, close to the fracture and the other. other in the metacarpal. After the traction and the reduction of the fragments, a cast immobilizing the wrist and the elbow was put in place. This technique has been modified by several authors, keeping the same principle of maintaining a tension on the ligaments of the radiocarpal joint allowing a more stable and sufficient reduction avoiding an open surgery [9-11]. Several distraction methods have been used before and have several disadvantages (risk of relaxation of the distraction requiring further manipulation), which has led to the development of external fixators with the advantage of easier handling with more stable distraction. However, it is not always accepted that the distraction obtained by external fixation is sufficient to produce and maintain a reduction of a comminuted fracture with several fragments; in this case, a percutaneous fixation with Kirschner pins or an open reduction of articular cartilage with or without bone graft should be added [12-15].

METHODS

This was a retrospective study: 20 cases of articular and or comminuted fractures of the lower extremity of the radius treated within the orthopedic traumatology department of the University Hospital of Rabat for a period of six years (2010-2016). From an anatomopathological point of view and according to the Castaing classification, the fractures of our series were distributed as follows:

Sagittal T-fracture: 02 case;

- Comminuted cross fracture: 10 cases;
- Complex comminuted fracture: 02 cases;
- Anterior displacement joint fracture: 03 cases;
- External cunean fracture: 03 cases.

The average age of our patients was 28 (19-36 years old), all male. Injuries were defined as high or low energy. sports accidents, Bicycle accident , Car accidentand Motorcycle accident caused the injuries. All fractures were closed, the right side reached in 16 cases and the left side in 04 cases. Initial clinical examination revealed localized pain with wrist deformity and total functional impotence of the upper limb (Fig-1). A radiological assessment made of standard radiography of the wrist of face and profile allowed us to study the comminution of the lower extremity of the wrist (Figure-2). Surgical treatment was performed urgently under locoregional anesthesia: reduction of the fracture by traction in the axis of the forearm followed by fixation of the radiocarpal joint by external fixator bridging the wrist joint. Radiological control showed a good radiocarpal joint congruence after reduction (Fig-3) without scapholunate diastasis or inferior radioulnar diastasis. Percutaneous pinning with Kirschner wires was associated in three patients for better stability due to the association of an external cunene fracture. Additional immobilization with an anti-brachial splint was performed and maintained for six weeks. The removal of the external fixator was performed and rehabilitation was undertaken for a minimum of eight weeks.

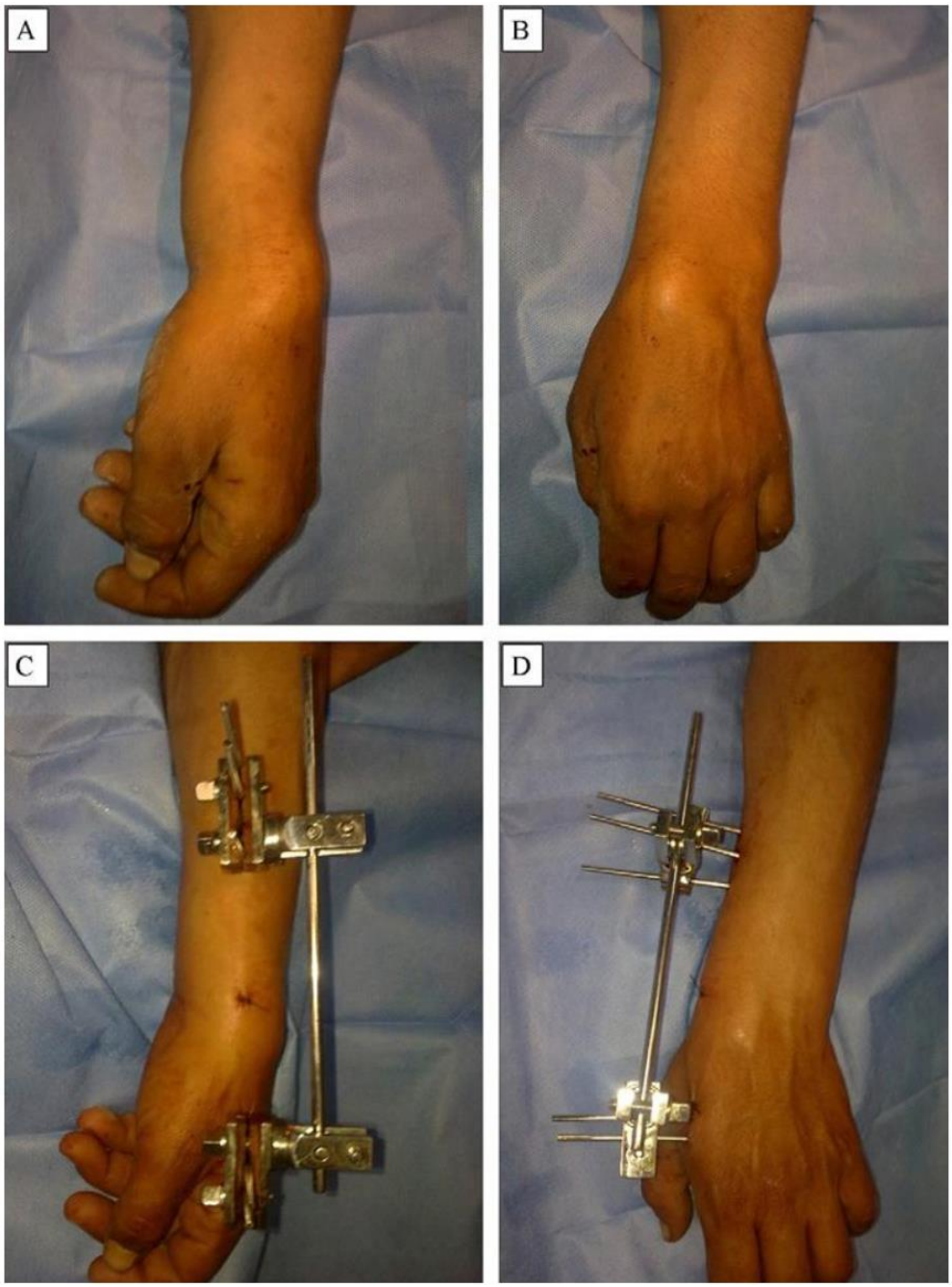

Fig-1: A. Clinical aspect of profile showing deformation of the wrist. B. Clinical aspect of the face showing wrist deformation. C. Postoperative clinical profile showing the disappearance of the deformity. D. Postoperative facial appearance showing the disappearance of the deformity

Fig-2: X-ray of the wrist of face and profile showing comminuted fractures of the articular radius

Fig-3: X-ray of the wrist of the face and profile after distraction showing the reduction of the fracture with recovery of the articular surface

RESULTS

All our patients were reviewed with a mean follow-up of 15 months. Of the 20 wrists evaluated, 18 of them were asymptomatic. The two remaining wrists had pain during the resumption of work, with moderate discomfort, both patients had developed a syndrome algodystrophique well evolved under medical treatment and physiotherapy. The range of motion was evaluated separately and in comparison with the contralateral wrist amplitudes according to normal values described in the literature [15-17]. Thus, wrist extension was equal to or greater than 95% of normal in all our patients. Bending was 95% or more of normal in 12 patients, ranging from 88% to 95% in four patients, 83% to 88% in two patients. The radial inclination was equal to or greater than 88% in 15 wrists, ranging from 83 to 88% in three wrists. The ulnar inclination was 95% or more in 16 wrists, 88-95% in both wrists. Pronation and supination were greater than 95% in all our patients. The functional results were evaluated according to the Carazatto functional criteria: the function was greater than 95% of the normal in 16 patients, equal to 90% of the normal in two patients. The gripping force of the thumb-index was analyzed in relation to the contralateral side, it was greater than 95% of normal.

The analysis of the complications showed two cases of neuroalgodystrophy having responded well to treatment, three cases of superficial sepsis compared to the well-controlled forms under antibiotic treatment and local care. There was only one small malunion with a small posterior tilt of the lower end of the radius. There was no case of osteoarthritis at the last follow-up.

DISCUSSION

Comminuted fractures of the lower extremity of the radius are usually difficult to treat by usual methods, especially comminuted fractures that have more than three fragments and are practically impossible to manipulate to obtain a good reduction. In addition, these fractures are generally unstable and the maintenance of the reduction finally obtained is very difficult using conventional immobilization methods. In addition, open reduction and internal fixation of these fractures are very difficult to achieve, especially when

the size and number of fragments are considerable, because they are generally too small to be screwed. The ligamentotaxis of the wrist by external fixator has been used for 80 years and still holds a prominent place in the therapeutic indications. The association of a plug in external fixator not only allows a better reduction of the fragments, but it also makes the assembly more solid, thus decreasing the constraints on the cards. Fractures of the distal radius are a real therapeutic challenge. The goal of the treatment is to have the best possible anatomical reconstruction, to restore the mobility as early as possible and to ensure the function without pain. These fractures have long been the preserve of the elderly. In these individuals, they occur as a result of mild trauma and therefore the immediate complications are exceptional. Osteoporosis is indisputably a factor in the genesis of this type of lesions. In addition, physiological ligament laxity in the elderly influences the results [18]. In young people, these fractures are secondary to high energy mechanisms and rarely occur in isolation. This active, male-dominated population, whose functional needs are high, requires rigorous care. Pathologically, the lesional polymorphism of the fractures of the lower extremity of the radius is at the origin of the establishment of several classifications and numerous therapeutic behaviors. The description of Abrahams Colles, published in 1814, served as a reference for almost 150 years [19, 20]. Currently, the most used classifications in the international literature are those of Older, Frykman and especially the AO system [21]. Jupiter and Fernandez [21] grouped these classifications into four categories according to the extension of comminution, the degree of displacement, the degree of joint involvement and the mechanism of injury. The classification must determine the degree of fracture stability, the energy of the lesional mechanism that provides the associated lesions and the quality of the bone [22]. X-ray analysis must study precisely four elements:

- The radial epiphysis (analysis of features, movements, articular depressions, the number of fragments, etc.)
- The lower end of the ulna
- The distal radioulnar joint;
- Associated lesions (especially those of carp).

The metaphyseal comminution must also be taken into consideration. It plays the role of a stabilizing column, decisive or not, a possible secondary angulation [22]. Many authors propose to introduce osteoporosis in the new classifications of the distal radius [23]. For the lesions of the distal radioulnar joint, Fernandez and Jupiter [24] classify them as stable, partially unstable and potentially unstable lesions. The study of these different parameters is done on the x-ray images and the use of the tomodensitometry can be useful insofar as joint depressions, superior to 2 mm, are very providers of osteoarthritis and thus indicate an imperfect initial reduction [22]. It also highlights the so-called "die-punch" lesions as an impaction of the posterior fragment of the radial glenoid [23], or a total impaction of the lunar part of the glenoid [24], or a central depression of a fragment [25]. 3D reconstructions are very useful for complex fractures [21].

Comminuted fractures of the lower end of the radius are usually difficult to treat by conventional methods [10, 16, 26, 27], particularly fractures partially unstable and potentially unstable. The study of these different parameters is done on the x-ray images and the use of the tomodensitometry can be useful insofar as joint depressions, superior to 2 mm, are very providers of osteoarthritis and thus indicate an imperfect initial reduction [22]. It also highlights the so-called "die-punch" lesions as an impaction of the posterior fragment of the radial glenoid [23], or a total impaction of the lunar part of the glenoid [24], or a central depression of a fragment [25]. 3D reconstructions are very useful for complex fractures [21].

Comminuted fractures of the lower end of the radius are usually difficult to treat by conventional methods [10, 16, 26, 27], especially comminuted fractures that have more than three fragments and are virtually impossible to manipulate to obtain good reduction. In addition, these fractures are generally unstable and the maintenance of the reduction, finally achieved, is very difficult using conventional immobilization methods. In addition, open reduction and internal fixation of these fractures are very difficult to achieve, especially when the size and number of fragments are considerable, as they are usually too small to be screwed. The combination of threads and casting as proposed by Boehler [8] and several other authors [11, 17, 28, 29] is a reasonable solution. However, this method is often linked to a number of complications, including an infection due to the impossibility of viewing and cleaning the wires. It is also not practical when it comes to a new manipulation because a loss of reduction of the fracture. The ligamentotaxis of the wrist by external fixator has been used for 80 years [20, 30] and still holds a prominent place in the therapeutic indications. Thus, the evolution of external fixators was imperative because they are lighter and more comfortable for the patient, which allows the cleaning of the skin around the cards and periodic remanipulation when needed. Nowadays, we count about thirty models of external fixator of the wrist. Although they differ in their materials, pose and design, the principles and goals are the same. Several new concepts have emerged, in particular the concept of dynamisation of the fixer and the concept of the radio-radial fixer. The latter is more and more indicated especially in extra-articular fractures or in special cases of articular fractures [22, 31]. On the other hand, it is contraindicated in osteoporotic patients or in the case where the distal fragment is too small to fit a card. At least 1 cm in height is required from the anterior cortex [20, 22, 32, 33]. Posterior comminution does not

contraindicate it for some authors [30]. It is indicated for a period of six weeks [30] provided that it has good bone density and without any lesion of the distal radioulnar joint. Active rehabilitation should not exceed a certain intensity threshold to avoid disassembly of equipment [34]. The dynamic external fixator was introduced in 1987 [35] and early mobilization is the main goal of this concept. Studies have compared the dynamic external fixative to the static fixator and this notion of dynamization has not proved its superiority [35, 36]. On the contrary, it has been shown that there is more risk of loss of reduction. Similarly, the final mobility course was better in the group of patients treated with the static fixator, at a follow-up of one year, whereas it was higher in patients treated with the dynamic fixator at one month postoperatively. Gripping force was also greater in the group treated with static fixative. The dynamic fixative did not show its superiority in comparison with the radially-radiating fixator [37]. The combination of racking with the external fixator not only allows a better reduction of the fragments, but also makes mounting more robust, thus reducing the stress on the plugs [30]. They thus make it possible to tighten the fixator in the neutral position, which reduces the distraction forces [22, 30]. They also offer the possibility of avoiding a possible collapse of the home after removal of the fixator. Biomechanical studies have shown that the results of the external fixation-racking association are greater than or equal to those of the isolated plate [30]. The indications of the external fixator associated with a racking-out may be proposed in front of [30]:

- An articular fracture with a large fragment of the radial styloid;
- An articular fracture with large fragments;
- Arthroscopic assisted reduction.

Henry [31] proposed a protocol of four weeks in association (external fixator and racking), then two weeks where the racking can be protected, or not, by a splint. In fractures with articular depression, ligamentotaxis is insufficient. In these cases, some authors have proposed reduction under arthroscopy. It allows better control of the reduction, repair of associated ligamentous lesions and extraction of intra-articular debris [19]. A randomized study comparing patients who had an open reduction with arthroscopy, found better results in those who underwent arthroscopic reduction [19]. The latter has, moreover, better functional results compared to reduction under fluoroscopic control. In fractures presenting a compression of more than 50% of the metaphyseal cancellous bone, the filling of the focus with grafts or injectable bone substitutes may be indicated in association with the external fixator. It is important to remember that adequate reduction of the fragments is obtained only by virtue of a certain degree of joint distraction, which, however, should only be maintained for about two weeks, then this traction should be lightened by allowing a good contact between the articular surfaces, without danger of losing the reduction. The external fixator was held in place for six weeks on average, as Rossillon *et al.*, [38]. In his series, Kaempffe [31] sometimes left the external fixator for up to 12 weeks and showed that the longer the duration of the distraction, the better the radiological score but the worse the functional score. Begue *et al*., [39], mobilizing the wrist under a distractor-mobilizer for two months, found 17% of reflex sympathetic dystrophy. In addition to early mobilization and to reduce the rate of dystrophy, restraint should be in neutral position and the metacarpophalangeal joints should be free. In addition, fixators should not be placed longer than eight weeks, whereas they should be removed and replaced with a thermo-malleable wrist orthosis. The radiological reassessment at the last follow-up showed a good radiocarpal joint congruence without scapholunate diastasis or inferior radioulnar diastasis. The late functional results seen in the reassessment of patients were generally very satisfactory, evaluated according to Carazatto's functional criteria: recovery was more than 95% of movements in all planes, wrist extension equal to or greater than 95% of the normal in all our patients. Flexion was 95% or more of normal in 12 patients. The radial inclination was equal to or greater than 88% in 15 wrists. The ulnar inclination was equal to or greater than 95% in 16 wrists. Pronation and supination were greater than 95% in all our patients. The gripping force of the index thumb was analyzed in relation to the contralateral side: the force was greater than 95% of normal. All our patients have resumed their sports activities without any functional discomfort or wrist pain during the various competitions.

CONCLUSION

The treatment of complex joint fractures at the distal end of the radius remains controversial. The therapeutic possibilities are multiple but none is univocal or perfect. External fixation, especially in combination with racking, gives good results.

Conflicts of Interest: The authors declare that they have no conflicts of interest in relation to this article.

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