






The Treatment of Comminuted Fractures of the Distal Extremity of the Radius by External Fixator: About 12 Cases

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Abstract:

Comminuted fractures of the distal radius are common. A retrospective study was conducted in the Department of Orthopaedic and Traumatology of Ibn Sina Hospital in Rabat on a period of two years between February 2021 and January 2023 involving 12 cases of comminuted fractures of the distal radius treated with external fixator distraction. The average age of our patients, all males, was 37 years old. The right side was affected in 66 % of cases. X-rays have objectified an articular fractures and/or comminuted without opening the skin. We adopted the Castaing classification to characterize fractures of the distal radius. The treatment consisted on an external fixation. Ablation of osteosynthesis material was done after 45 days, then reeducation was started. After a window of 13 months, our results were very satisfactory with good recovery of mobility of wrist and practice of normal activities.

Keywords: *radius, fracture, pain, fixator, ligamentotaxis.*

Introduction

Fractures of the lower extremity of the radius are very frequent, most of them responding to orthopedic treatment by cast immobilization (David, 2002). Some of these fractures especially those with comminution with joint damage and an axial deviation, are the prerogative of a surgical treatment well adapted to obtain good functional results (Ledoux, Ravis & Vanderghinst, 1973). Many authors have presented alternative methods, usually more aggressive than reduction by external manipulation aimed at maintaining the reduction (Seitz, et al., 1991). It was Boehler in the 1920s who introduced bipolar traction by percutaneous fixation using two Kirschner wires

or Steinmann nails, one placed in the radius, close to the fracture and the other in the metacarpal (Scheck, 1962); Barbieri, Mazzer & Santiago, 1994). After traction and reduction of the fragments, a cast immobilizing the wrist and the elbow was put in place.

Several authors keeping the same principle of maintaining tension on the ligaments of the radio-carpal joint allowing a more stable reduction and sufficient to avoid open surgery have modified this technique (Hoppenfeld, 1987).

Several methods for distractions have been used before and had several disadvantages (risk of loosening distraction requiring further manipulation), which led to the development of



external fixators having the easier advantage handling with more stable distraction (Rauis et al., 1979; Nakata et al., 1995; Gausepohl, Pennig & Mader, 2000). Nevertheless, 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, it is advisable to add a percutaneous fixation by Kirschner wires, or after an open reduction of the articular cartilage with or without bone graft (Leung et al., 1989; Leung et al., 1990; Müller et al., 1991).

Materiel and Methods

Our study is retrospective on 12 cases of articular fractures and/or comminuted joints of the lower extremity of the radius, treated in the Orthopedic and Traumatological Surgery Department of the CHU Ibn Sina in Rabat for a period of two years between February 2021 and January 2023.

From an anatomopathologic point of view and according to the classification of

Castaing, the fractures in our series were distributed as follows:

- Sagittal T-fracture: one case;
- Comminuted cross fracture: six cases;
- Comminuted complex fracture: two cases;
- Articular fracture with anterior displacement: two cases;
- External cunean fracture: one case.

The average age of our patients, all males, was 37 years (28–43 years). Violent trauma following accidents work or during sporting activities caused the fractures. All fractures were closed, the right side reached in eight cases and the left side in four cases. The initial clinical examination found localized pain with wrist deformity and fully functional impotence upper limb. A radiological assessment made of standard x-ray of the wrist of face and profile allowed us to study the comminution of the lower end of the wrist. Surgical treatment was performed urgently under locoregional anesthesia: reduction of the fracture with a traction in the axis of the forearm followed by fixation of the radiocarpal joint by bridging external fixator the wrist joint.

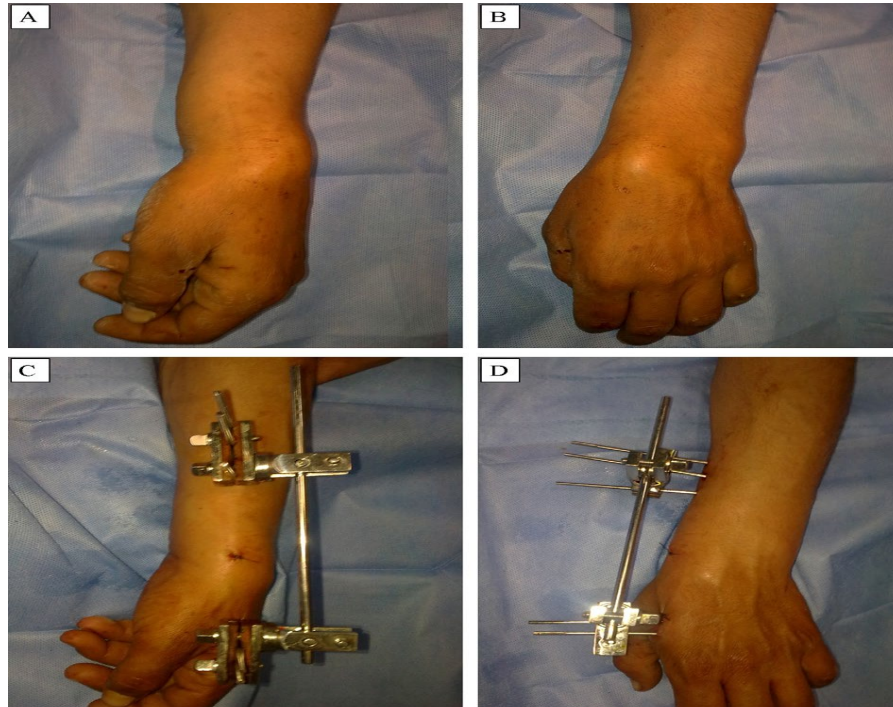


Figure 1. Clinical Aspect of a Deformed Hand with Distal Radius Fracture and the External Fixator Used

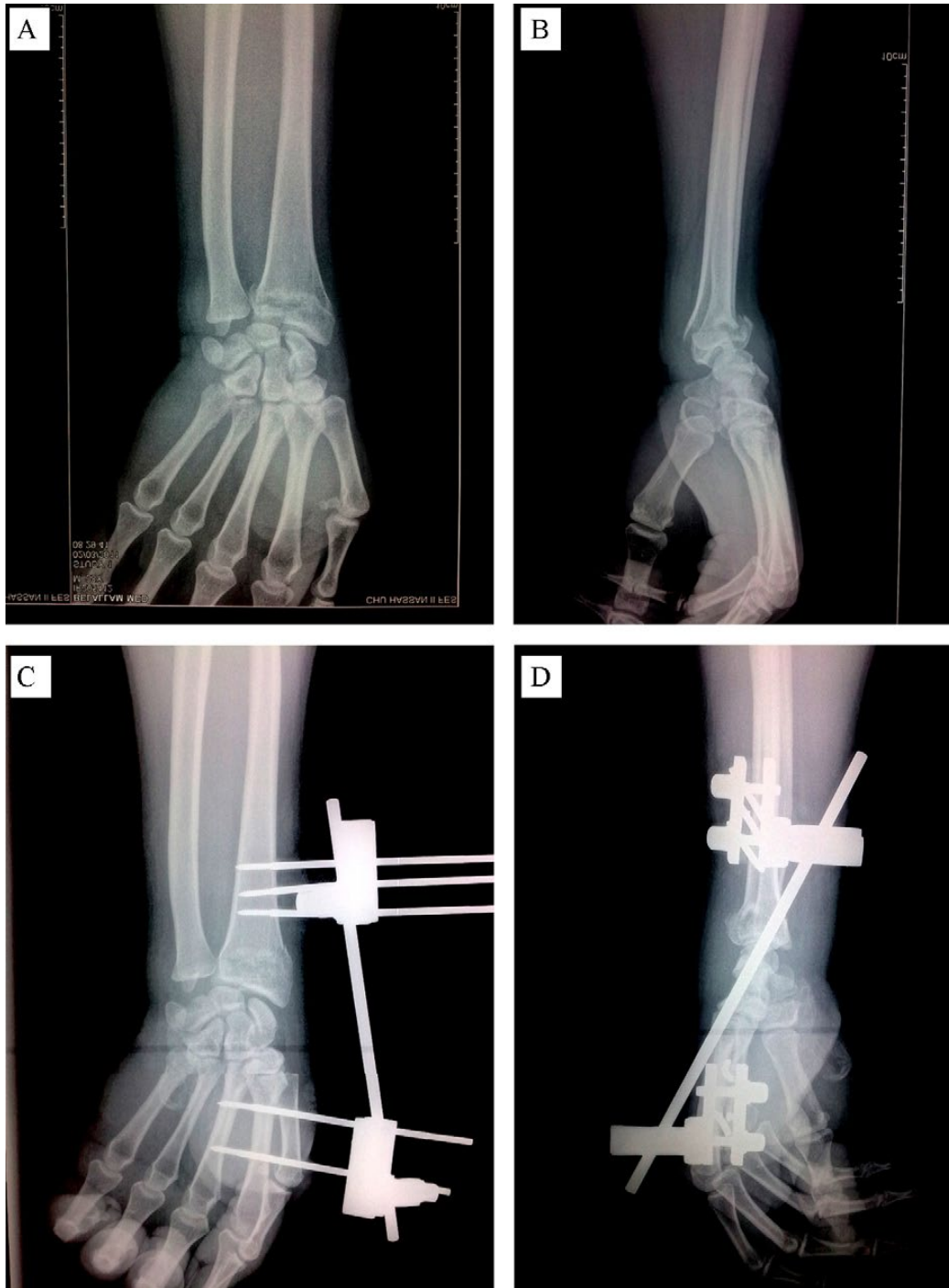


Figure 2. X-Ray Showing Aspect of a Deformed Hand with Distal Radius Fracture and the External Fixator Used

The radiological control has objectified good radiocarpal joint congruence after reduction without scapholunate or radio-ulnar diastasis lower. Percutaneous pinning with Kirschner wires was associated in three patients for better stability given the association of an external cuneal fracture (Cooney, Dobyns & Linscheid,

1991). An additional immobilization with an anti-brachial splint was performed and maintained for six weeks. From then on, external fixator ablation was performed and rehabilitation was practised for a minimum of eight weeks.

Results

All our patients were reviewed with an average follow-up of 13 months. Of the 12 wrists assessed, 10 showed complete recovery.

The two remaining wrists had pain when resuming competition, with feeling of moderate

discomfort, these two patients had developed an algodystrophic syndrome which progressed well under medical treatment and physiotherapy. Range of motion was assessed separately and in comparison with the amplitudes of the controlateral wrist according to normal values described in the literature (Jupiter & Fernandez, 1997).



Figure 3. X-Rays Showing the Aspect of a Deformed Hand with Distal Radius Fracture and the External Fixator Used

Thus, the extension of the wrists was equal or greater than 90% of normal in all our patients. There flexion was equal to or greater than 93% of normal in 11 patients, ranging from 80% to 93% in four patients, 85% to 92% in two patients. The radial inclination was equal or higher than 92% for nine wrists, ranging from 83 to 88% for four wrists. The ulnar inclination was equal to or greater than 95% for 10 wrists, between 88 and 95% for the two remaining wrists. Overhand and supination were greater than 95% in all our patients.

The functional results were assessed according to the Carazatto functional criteria: function was superior to 95% of normal in seven patients, equal to 90% of normal in five patients.

Thumb-index grip strength was analyzed in relation to the contralateral side, it was superior 95% of normal.

The analysis of the complications objectified two cases of neuroalgodystrophy.

Responding well to treatment, three cases of superficial sepsis next to cards that have been suppressed well under antibiotic treatment and local care.

We noted an only minimal malunion with a small posterior tilt of the lower end of the radius. There were no cases of osteoarthritis at the last retreat.

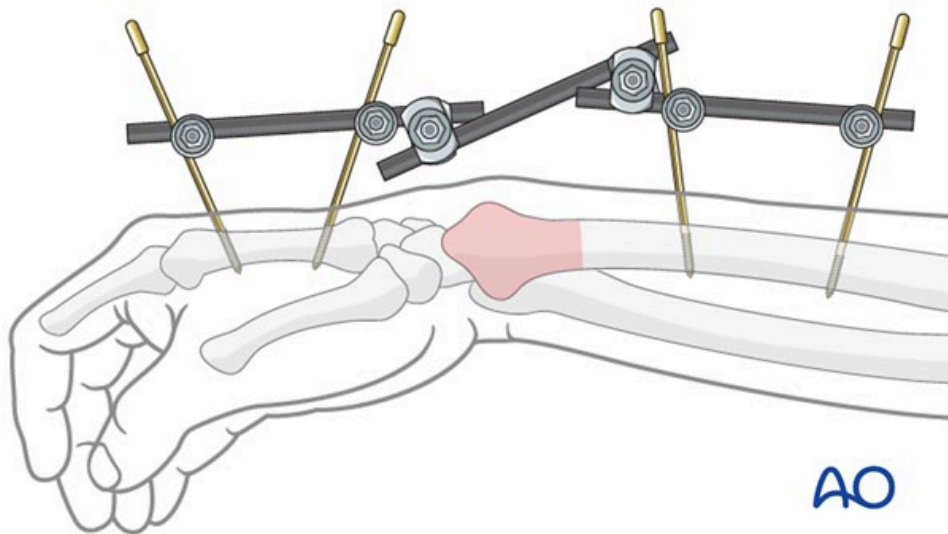


Figure 4. Joint-Spanning External Fixation (Temporary or Definitive) for Extraarticular Comminutive Fracture

Discussion

Fractures of the distal end of the radius are a real therapeutic challenge (Roux, 2009). The aim of the treatment is to have the best possible anatomical reconstruction, to restore mobility as early as possible and to ensure the function

without pain. These fractures have long been the prerogative of the subject age. In these people, they occur as a result of a mild trauma and therefore complications immediate are exceptional. Osteoporosis is undoubtedly a factor intervening in the genesis of this type of lesions. In addition, physiological ligament laxity

in the elderly influences the results. At the house of the young subject, these fractures are secondary to mechanisms of high energy and rarely see each other isolated. This working population, predominantly male and whose functional needs are high, involve a rigorous care. From an anatomic-pathological point of view, polymorphism lesion of extremity fractures lower radius is at the origin of the establishment of several classifications and numerous therapeutic behaviors (Frykman, 1967).

The description of Abrahams Colles, published in 1814, served as reference for almost 150 years (Sarmiento et al., 1975). Currently, the most used classifications in the international literature are those of Older, Frykman and especially the AO system.

Jupiter and Fernandez grouped these classifications into four categories according to the extension of the comminution, the degree of movement, the degree of joint involvement and the lesion mechanism. Classification should determine the degree of stability of the fracture, the energy of the lesion mechanism, which is the provider of associated lesions and bone quality.

The radiographic analysis must study precisely four elements:

- the radial epiphysis (analysis of features, displacements, joint depressions, the number of fragments, etc.);
- the lower end of the ulna;
- the distal radioulnar joint;
- associated lesions (especially those of the carpus) (Shin & Jupiter, 2007).

Metaphyseal comminution must also be taken into consideration. It plays the role of a stabilizing column determining or not, a possible secondary angulation.

Many authors propose to establish osteoporosis in the new classifications of the distal end of the radius.

Regarding lesions of the distal radio-ulnar joint, Fernandez and Jupiter classify them as stable lesions, partially unstable and potentially

unstable. The study of these different parameters is done on the radiological images and the use of computed tomography can be useful insofar as where joint depressions, greater than 2 mm, are very providers of osteoarthritis and thus indicate an initial imperfect reduction. It also highlights so-called lesions "die-punch" as being an impaction of the posterointernal fragment of the radial glenoid, or total impaction of the lunar part of the glenoid, or a central depression of a fragment. 3D reconstructions are very useful for complex fractures.

Comminuted fractures of the lower extremity of the radius are usually difficult to treat by usual methods, especially comminuted fractures which have more than three fragments and which are virtually impossible to manipulate to obtain a good reduction. Also, these fractures are usually unstable and the maintenance of the reduction, finally obtained, is very difficult using conventional immobilization methods. However, open reduction and internal fixation of these fractures are very difficult to achieve, especially when the size and the number of the fragments are considerable, as they are usually too small to be screwed. The combination of yarn and casting as proposed by Boehler and several other authors is a reasonable solution. Nevertheless, this method is often linked to a number of complications, including infection due to inability viewing and cleaning wires. She is also not handy when it comes to a new manipulation due to loss of the fracture reduction. Wrist ligamentotaxis by external fixator has been used for 80 years and keeps still a preponderant 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 cleaning of the skin around the pins and remanipulation periodically as needed. Nowadays, we count a thirty models of external wrist fixator. Although they differ in their materials, their way of laying and their design, the principles and goals are the same. Several new concepts have emerged, in particular the notion of dynamization of the fixator and the concept of the radio-radial fixator. The latter is

of increasingly indicated especially in extra-articular fractures or in special cases joint fractures.

However, it is contraindicated in osteoporotic patients. In the case that the distal fragment is too small to be able to put a plug in it. It needs at least 1 cm in height of the anterior cortex.

The posterior comminution does not contraindicate it for some authors. It is indicated for a provided period of six weeks to have a good bone density and without any lesion of the distal radioulnar joint. Active rehabilitation should not

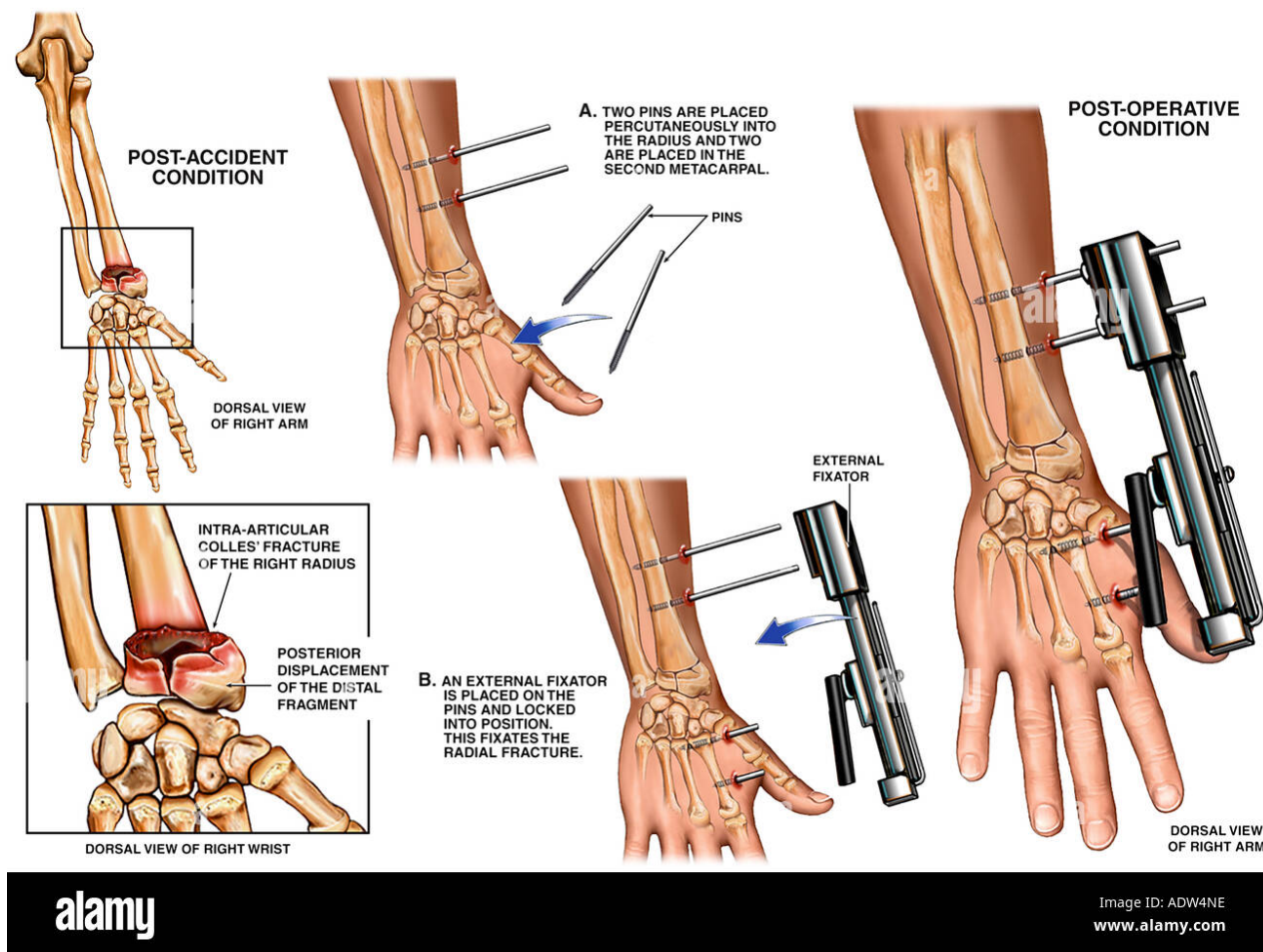


Figure 5. Principles of the External Fixation

exceed a certain intensity threshold so as not to cause a disassembly of equipment. The dynamic external fixator was introduced in 1987 and early mobilization represents the main purpose of this concept. Studies have compared dynamic external fixator to the static fixer and this notion of dynamisation did not prove its superiority. On the contrary, it was shown to be more likely to lose the reduction.

Similarly, the final mobility run was better in the group of patients treated with the static fixator, at a follow-up one year, whereas it was higher in patients treated by the dynamic fixator one month postoperatively. The strength of grip was also greater in the group treated with the static fixer. The dynamic fixator did not show as its superiority in comparison with the radio-radial fixator.



Figure 6. Communitive Radius Fracture

The association of a pinning with the external fixator does not allow not only better fragment reduction, but it also makes the assembly more solid, thus reducing the constraints on the files. They thus make it possible to tighten the

fixator in neutral position, which reduces distraction forces. They also offer the possibility of avoiding a possible collapse of the focus after removal of the fixator.

Biomechanical studies have shown that the results of the fixative combination

is greater than or equal to those of the isolated plate. Indications for the external fixator associated with a plug-in can be proposed in front of:

- a joint fracture with a large fragment of the styloid radial;
- a large-fragment joint fracture
- reduction assisted by arthroscopy.

Henry proposed a four-week protocol in combination (external fixator and racking), then two weeks when racking-in may or may not be protected by a

splint. In fractures with joint depression, the ligamentotaxis is insufficient. In these cases, some authors proposed arthroscopic reduction. It permits better control of reduction, repair of associated ligament injuries and extraction of intra-articular debris (Trumble et al., 1990).

A randomized study comparing patients having had an open reduction to others by arthroscopy, found better results in those who had arthroscopic reduction.

The latter has, moreover, better functional results compared to the reduction under radioscopic control. In the fractures presenting a settlement of more than 50% of the cancellous metaphyseal, the filling of the hearth by grafts or injectable bone substitutes may be indicated in combination with the external fixator. It is important to remember that adequate fragment reduction is achieved only by virtue of a certain degree of articular distraction, which, however, should only be kept for about two weeks, and then this traction must be lightened by allowing good contact between the articular surfaces, without danger of losing the reduction.

The external fixator was kept in place for six weeks on average, as Rossillon et al. In his series, Kaempffe sometimes left the external fixator on until 12 weeks and showed that the longer the duration of the distraction important, the better the radiological score but less good was the functional score. Begue et al, by mobilizing the wrist under a distractor-mobilizer for two months, encountered 17% algodystrophy. In addition to early mobilization and in order to reduce the rate of algodystrophy, compression should be in a neutral position and the metacarpophalangeal joints must be free. In addition, fixators should not be placed for more than eight weeks, while they should be removed and replaced with a wrist brace thermo-malleable. Radiological reassessment at the last follow-up demonstrated good radio-carpal joint congruence without scapholunate diastasis, nor inferior radio-ulnar. The late functional results seen in the reassessment of patients were generally very satisfactory, assessed according to the Carazatto functional criteria: recovery was more than 95% of movements in all planes, wrist extension equal to or greater than 95% of normal in all our patients. Flexion was at or above 83 % of normal in patients. The radial inclination was equal to or greater than 88% in 11 wrists. The ulnar inclination was equal or greater than 95% in 10 wrists. Pronation and supination were greater than 95% in all our patients. Strength grip of the index thumb was analyzed in relation to the contralateral side: strength was greater than 95% of normal. All our patients resumed their sports activities without any discomfort functional, nor pain in the wrists during the different competitions and activities.

Conclusion

Considering the seriousness of most of the fractures studied,

the final results observed (good clinical, anatomical and functional results in 98% of the wrists) and the absence of severe complications, the authors conclude that the method of external fixation for the treatment of comminuted fractures of the lower end of the radius always

restores the bone anatomy, and also allows sufficient functional recovery.

It remains the ideal technique for the treatment of this type of fractures.

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