MÆDICA - a Journal of Clinical Medicine

ORIGINAL PAPERS: CLINICAL OR BASIC RESEARCH

The value of the external fixator in distal radius fractures

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ABSTRACT

The articular fractures of the distal radius represent nowadays a very difficult therapeutic problem. During the last two decades, the development of the external fixation technique for the fractures of the distal radius significantly improved the results.

The authors are reviewing the most well known classifications and highlight their advantages and limitations. These are useful to identify the unstable fractures and the optimal therapeutic indications.

***Material and method:** 36 patients treated by external fixation (EF) between 2000 and 2004 were studied. For 24 of them, the EF was the unique method of treatment, and for other 12, the EF was associated with another type of osteosintesis.*

The results were appreciated by Lidstrom and Frykman's criteria. According to these, we obtained 88% of very good results and 10% of good results.

We highlight the fact that the premature extraction of the external fixator will make possible the dorsal angulation of the distal fragment.

The complications (malunion, carpal tunnel syndrome, pain dysfunction syndrome) appeared for a reduced number of cases and, finally, didn't affect the wrist function.

***Conclusions:** For the unstable, cominuted fractures of the distal radius, the EF alone or in association with an additional fixation (K wires, or screws) make a good alignment, maintain the length of the radius and create the anatomical conditions for full functional recovery.*

Keywords: radius, external fixator, unstable fractures, osteosynthesis

Different orthopedics procedures and techniques have been imagined along the years for treating the distal radius fractures (D.R.F.). The most well-known method, still largely used nowadays as well, is represented by the orthopedic reduction by traction combined with flexion and ulnar deviation.

Percutaneous K-wire fixation through different techniques after the orthopedic reduction became a procedure largely used in the unstable fractures. It allowed the immobilization of the wrist in a position closer to the physiological one, thus avoiding excessive traction of the capsulo-ligamentary structures and median nerve neuritis or algoneurodystrophy.

Introducing the external fixation (EF) in the therapeutic arsenal, for treating the unstable fractures, represented a step forward. The procedure can be used as such, or associated with the internal fixation. Using EF in treating the D.R.F. fractures is connected to ANDERSON's name (quoted by McQUEEN and JUPITER) and VIDAL's (1,2). The latter described the principle of tensioning the capsule and ligaments by the

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means of which the fracture is reduced. VIDAL also introduces the,,ligamentary taxis'' term.

Using the external fixator for the complex fractures of D.R.F became a routine practice. It is recommended both in the unstable cominutive fractures, fracture-dislocations, open fractures, and in osteotomies for mal union.

FRACTURE CLASSIFICATION

As in several other segments, there are multiple classifications which aim at systematizing the different fracture routes, involving radio – carpal joint (R-C), the degree of displacement and even at making prognosis on the functional future of the wrist.

Some of these classifications are only historically important; some others preserve their practical value.

Frykman's classification takes into consideration the involvement of the radio-carpal joint, radio-ulnar joint (R-U) and distal ulnar fracture (3).

Frykman classification of distal radius fractures		
Distal Ulnar Fracture:	No	Yes
Extraarticulary	**I**	**II**
Intraarticular into RC Joint	**III**	**IV**
Intraarticular into RU Joint	**V**	**VI**
Intraarticular into RC + RU Joints	**VII**	**VIII**

D.R.F. with volar displacement is difficult to reduce and more difficult to maintain. It is an unstable fracture with an important degree of failures by secondary displacement. **Thomas** paid a special attention to these types of fractures and drafted the following classification:

Type 1 extraarticulary fractures with palmar deviation;

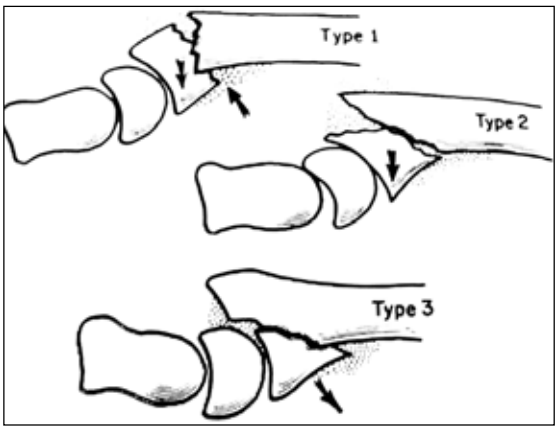


FIGURE 1. Thomas's Classification (by Rockwood)

Type 2 intraarticulary fractures with volar deviation of the distal fragment along with the carp bone;

Type 3 intraarticulary fractures with volar fragment proximally and anteriorly dislocated along with the carpal bones – similar to Barton's fracture;

Melone's Classification

In 1984, Melone observed that in the R-C articular fracture there are 4 main fragments: shaft, radial styloid, dorsal medial and palmar medial (4).

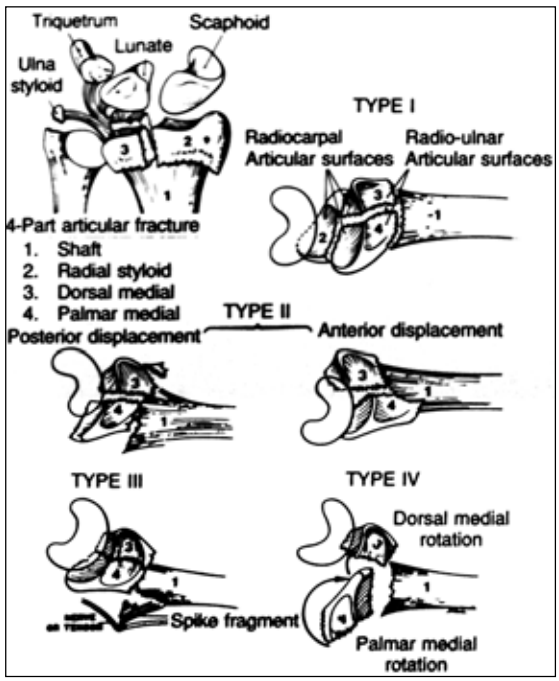


FIGURE 2. Melone's Classification (by Rockwood)

Type. I stable fracture, no displacement or with variable displacement of the medial complex as a hole. It is stable after a closed reduction;

Type. II unstable with moderate or severe displacement of the medial complex associated with comminuted anterior and posterior cortical bone;

Type. III unstable; imply an additional fracture line from the radius shaft to the flexors compartment;

Type. IV unstable; the medial complex comminuted; severe comminution and rotation of the distal fragments;

Type. V exploded fracture; comminution of:

diaphysis segment, radius styloid process; dorso-medial and palmar-medial fragments.

The notion of „ medial complex" includes the medial fragments and the ligaments which connect them to the ulnar styloid process.

The AO classification is the most comprehensive one including both the intra- and extraarticulary fractures. There are 3 main types (A,B,C), each type has 3 main groups (A1,A2,A3, B1....) and each group has 3 subgroups.

Type A: extraarticulary fractures;

Type B: fractures which interest a part of the radio-carpian joint, with methaphysis and epiphysis continuity preserved;

Type C: complex intraarticular fracture.

We also shortly mention **Fernandez'** classification, who considers that the path of the distal radius fracture reflects the action manner of the traumatic force (5). The following fractures are described in the next figure.

MATERIAL AND METHOD

We studied the anatomical and functional results of the treatment of DRE fractures with EF. To this end we studied a number of 36 patients who underwent surgery during 2000-2004. The average age is of 54 years.

Indications for using EF (6,2):

- comminuted fractures extended intra-articulary, with or without radius styloid process fracture; (FRYKMAN III or IV)
- radio-ulnar intraarticulary fractures (FRYKMAN V sau VI);
- comminuted fractures into radio-carpal and radio-ulnar joint (FRYKMAN VII sau VIII);

Fernandez' Classification		
1	Bending	One cortex of the metaphysis fails due to tensile stress (Colles and Smith fractures), and the opposite cortex undergoes some comminution.
2	Shearing	Fracture of the joint surface: Barton's; reversed Barton's styloid process fracture, simple articular fracture.
3	Compression	Fracture of the surface of the joint with impaction of subchondral and metaphyseal bone (die-punch); intraarticular comminuted fracture.
4	Avulsion	Fracture of the ligament attachments to ulnar and radial styloid process; radio carpal fracture-dislocation.
5	Combinations	Combination of types; high energy injuries.

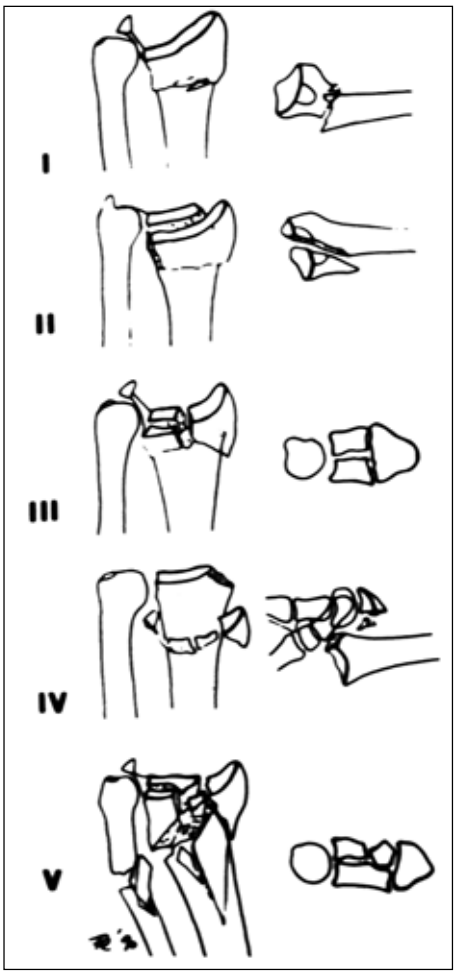


FIGURE 3. Fernandez' classification (by Graff and Jupiter)

- loose of reduction after cast immobilization;
- bilateral distal radius fractures;
- opened fractures.

Out of the total number of patients, 78% were women.

In order to systematize, we used Frykman's classification. According to this classification, 75% out of our cases were fractures of type VII and VIII.

The average period of follow-up was of 2, 5 years.

Most of the fractures were results of falls on the hand (76%), the remaining percentage representing car crushes, sport or work accidents.

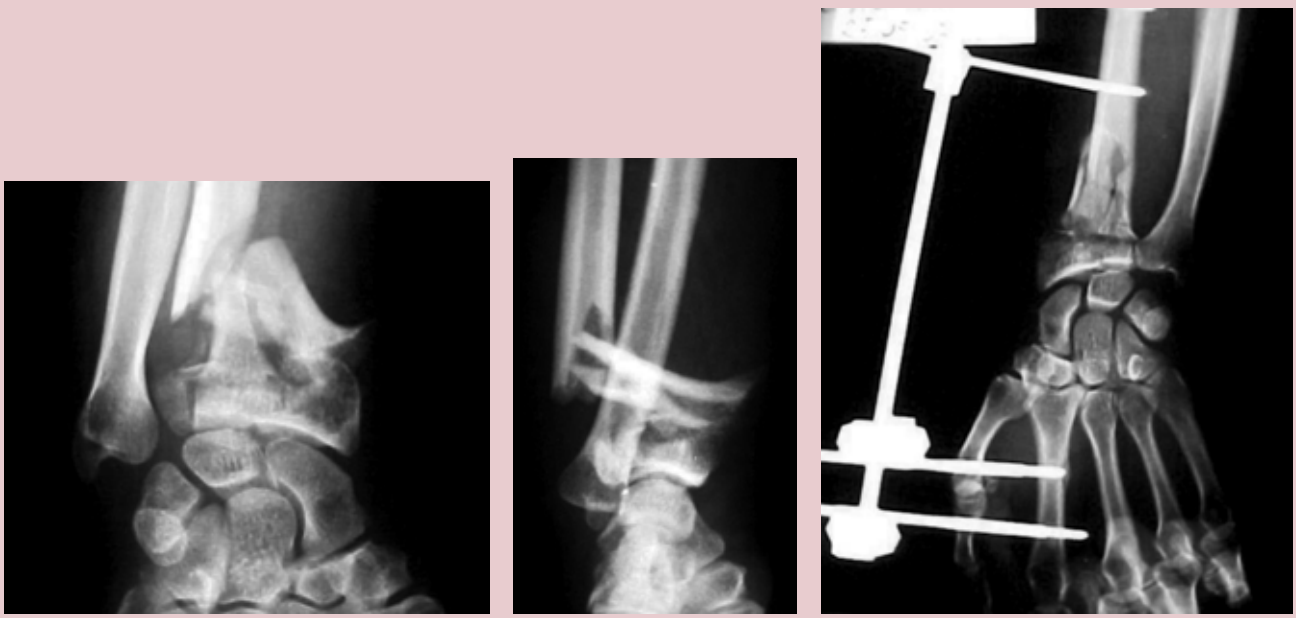
The bilateral fracture was signaled in three cases.

For the 24 patients EF was the only treatment. For the rest of 12 cases, EF was associated with another type of osteosynthesis.

In 8 cases the DR fracture was opened.

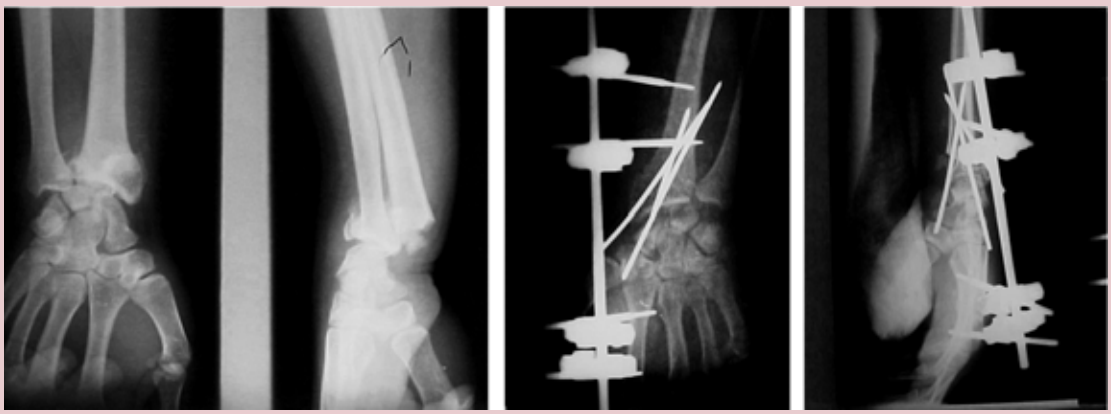
A B

FIGURE 4 (A, B). Bilateral distal radius fracture



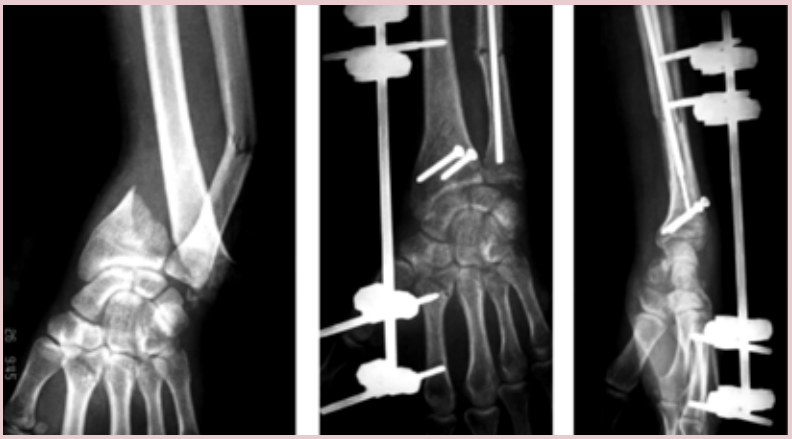
A B C

FIGURE 5 (A,B,C). External fixator – as a unique treatment



1 2 3

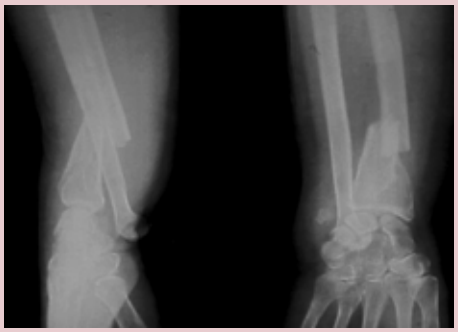
A



1 2 3

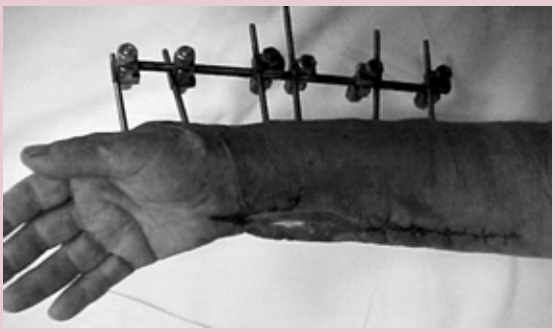
B

FIGURE 6. External fixator associated with K wires (6A – 1,2,3) or screws (6B – 1,2,3) osteosynthesis.

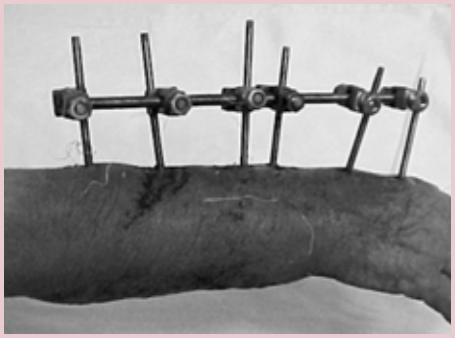


A

B



C



D

FIGURE 7. Open distal radius fracture type III: 7A – preop. Rx; 7B – postop. Rx; 7 C, D – clinical aspect

In case of the patients who underwent surgery with additional K wires, the material was ablated after 4 weeks.

In some of the cases, EF was taken out after 4 weeks; the patients were immobilized with an antebrachial-palmar plaster cast in physiological position. In most of the cases, EF was kept for 6 weeks without plaster cast immobilization afterwards.

Associated lesions: such as elbow dislocation, scaphoid fracture, humeral condyle fracture, radial head fracture.

RESULTS

The results were considered from the clinical and radiological point of view. Clinically, one kept under observation the pain, the movement of the wrist joint, grasping power, and aesthetical aspect.

The range of motion of the interested joint was compared to the counter-lateral joint.

The range of motion of the palmary and dorsal flexion was examined in comparison at the two wrists, and then the amplitude of the prone-supine movement. A flexion-extension diminished of 5° up to maximum 10° degree was observed, without affecting the wrist functioning. Regarding the pronosupination, the loss exceeded 10° in some cases, aspect which led to the diminishing of the prehension capacity.

The anatomical result was determined through post-op X-ray measurements, then after removing the ostheosynthesis material.

The normal inclination of the radial surface is between 4 and 22° (7).

The radial shortening is measured on the anterior-posterior X-Rays.

The results were systematized according to LIDSTROM criteria (8):

- 1st degree – without deformities: dorsal angulation is absent in a shortening smaller then 3 mm
- 2nd degree – slight deformity: dorsal angulation under 10° in a 3-6 mm shortening
- 3rd degree – moderate deformity: dorsal angulation of 11-14° in a 7-11 mm shortening
- 4th degree – severe deformity: dorsal angulation > 15° more than 12 mm shortening

According to these X-Ray criteria, as well as to the clinical ones, we appreciated our results as very good in 88% (32), good in 10% (3), and medium in 2% (1).

The length of the radius was re-established at approx. 90% of the patients that underwent surgery. We observed a significant decrease of the squeezing force in the patients with an unsatisfactory reduction and in those who initially had a good reduction, but because of different causes they lost the reduction progressively. In this category of patients, we found a reduced flexion – extension of approx. 10° and of the pronosupination that exceeded 10°. The radial inclination was well reconstructed and we didn't notice a loss of the inclination not even after taking out the osteosynthesis material.

The dorsal inclination was corrected during the surgery, but afterwards there was a loss of approx. 5° in 1/3 patients.

Although followed by plaster immobilization, the precocious ablation of EF (4 weeks) favored the dorsal movement of the epiphysis fragment in 6 cases with a loss of the normal inclination of approx. 10°, yet without being a functional success.

COMPLICATIONS

Misalignment is a frequent complication of the orthopedic treatment (8). After the treatment through EF, misalignment appears either as a consequence of an insufficient initial reduction, or as a consequence of the loss of the initial reduction favored by the posterior bony defect and the elasticity of the fixator.

We came over this complication in 4 cases in which EF was suppressed after 30 days.

- the carpal tunnel syndrome was present in 2 cases with a big dorsal movement of the distal radius fragment, but it gave in progressively and a surgical intervention was not necessary.
- the algodystrophy appeared in 3 young patients and imposed a complex treatment with vasodilators, anabolics, physiotherapy.
- tendon lesions were not signaled in our cases.
- superficial infections at the wire level (5 cases) gave in after the suppression of EF. There were no deep infections (radius osteitis, or second metacarpal).

DISCUSSION

The plan for the treatment of the patients with fracture of the distal radius is based not only on the anatomy of the fracture, but also on the local factors, such as bone quality, associated comminution, the fracture movement amplitude, the lesions of soft tissues.

As the requirement for maintaining the anatomy became widely accepted, there are some treatment options available for the unstable fractures: percutaneous osteosynthesis with Kirschner wires, immobilization of the wrist in plaster cast and wires, EF, open reduction and internal fixation with or without bone grafts, open reduction with dorsal approach and internal fixation (9,10).

A more careful investigation of the manner the external support is applied, such as the metallic external fixator, showed that a great deal of the limited wrist movement that was supposed to be the result of the device application is in reality related to the complexity of the fractures that take this type of treatment.

External fixation became more popular as a method for treating complex fractures of distal radius.

Partly due to the fact that the problems associated to wire introduction and plaster cast immobilization, as well as thanks to the improvements brought to the external fixator design and Schanz screws introduction. When there is instability, maintaining the length and the alignment is very important, especially in the case of important lesions of soft tissues, the external fixator is recommended, either alone, or with additional fixation with K-wires.

Conclusion

In comminuted, unstable fractures, EF alone or associated with an additional fixations with K-wires (screws) ensure the maintenance of the radius length, bone alignment and creates the anatomical conditions of a complete functional recovery.

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