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Original article

ARTICULAR FRACTURES OF DISTAL RADIUS: COMPARISON OF TREATMENT AND CLINICAL AND RADIOLOGICAL OUTCOMES WITH VOLAR PLATE VERSUS HOFFMANN BRIDGING EXTERNAL FIXATOR.

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ABSTRACT

The Wrist fractures are one of the most frequent traumatic pathologies. Surgery is now more commonly recommended for this type of fracture as a means to improve the outcome of patients. The objective of this study is to compare treatment with volar plate vs. external fixation in these types of fractures. A total of 158 consecutive patients who had been operated on for distal radius fractures with or without ulnar involvement, were included in this study. 109 were treated with a volar plate and 49 with Hoffmann II external fixator. The exclusion criteria were patients with a history of wrist fractures, with neurological diseases, pathological fractures and polytrauma patients. Clinical and radiographic results were evaluated in both groups of patients. Clinical parameters were: average flexion, average extension, average pronation and supination, and the average radial and ulnar deviation. The radiographic parameters that we considered were the radial tilt and ulnar variance. In both groups, we evaluated the clinical results with the DASH score and the Mayo-Wrist score. The unstable and intra-articular fractures of the distal radius can be treated with different methods, among which the most commonly used are the open reduction and internal fixation with plates or the synthesis with external fixation. Our study shows how both methods provide similar clinical and radiographic results, so the choice of which to use depends more on the surgeon's experience and the patient's compliance rather than on the type of fracture.

1. Introduction

Distal radius fractures are the most common upper limb fractures, accounting for 75% of forearm fractures [1-2], and can be defined as fractures involving the distal third of the radius. Their incidence is bimodal type, with a first group of patients between the age of 6 and 10 years old and a second group of 60 to 70 years. In the first group, these fractures are the consequence of high-energy trauma, while in the second group, they are a result of low energy trauma in a framework of bone fragility [2-3]. 2/3 of these fractures are dispalced [4] and 25% are fully articular fractures (type C according to the AO classification) [5].

Historically, the treatment for these fractures was conservative [6], but especially in recent years, surgical indications have increased with the aim of improving patient outcome and restoring articular congruity and axial alignment in order to prevent premature post-traumatic osteoarthritis [7]. Synthesis involves more plates than external fixators or the synthesis with K-wires [8].

The aim of this study is to compare the results and complications in distal radius fractures treated with volar plate vs. external fixator.

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2. Material and methods

A total of 158 patients (87 F and 71 M) who were consecutively operated on for the distal radius fracture, with or without ulnar involvement, were included in our study.

Of these, 109 were treated with volar plate (Synthes) and the remaining 49 with External Fixator (E.F.) (Hoffmann 2 Stryker). Patients ages ranged between 19 and 87 years. The exclusion criteria were: patients with previous fractures in the wrist, with infectious diseases in place and/or previous neurological trauma, and patients with pathological fractures and polytrauma.

Specifically, the two groups were divided as follows:

- In group A (treated with plate), mean age was 43.2 years (between 21 and 87 years).
- In the group B (treated with external fixation), mean age was 56.4 years (range 19-87).

There were 61 women and 48 men in group A and 30 women and 19 men in group B.

In group A, the right side was affected in 37 cases (33.9%), while in group B the right side was affected in 25 patients (51%). We used the AO Classification (23 A-B-C).

Regarding the fractures, in group A there were 27 cases of type A fractures (24.7%), 14 type B (12.8%) and 68 type C (62.3%). In group B there were 5 type A fractures (10.2%), 9 type B (18.3%) and 35 of type C (71.4%).

The average time interval between the fracture and the surgery was 3.7 days in group A and 2.9 days in group B (Table 1).

In both groups of patients surgery was performed with bi-block anesthesia, and in all cases antibiotic prophylaxis with cefazolin 1g was administered intravenously thirty minutes pre-op. The average surgical time was 65 minutes in group A vs 49 in group B (Figure 1-7).

Descriptive statistics were used to summarize the characteristics of the study group and subgroups, including means and standard deviations of all continuous variables. The t test was used to compare continuous outcomes. The Chi-square test or Fisher (in subgroups smaller than 10 patients) exact test were used to compare Categorical variables. The statistical significance was defined as $p<0.05$.

	Mean Age	AO 32-A (%)	AO 32-B (%)	AO 32-C (%)	Time between fracture and surgery	Surgery time (min)
Plate	43.2	24.7	12.8	62.3	3.7	65
E.F.	56.4	10.2	18.3	71.4	2.9	49

Table 1 - Characteristics of the two group of treatment.

Figure 1 - X-ray shows in the two projections (A AP and B LL) the intra-articular fractures of the distal radius

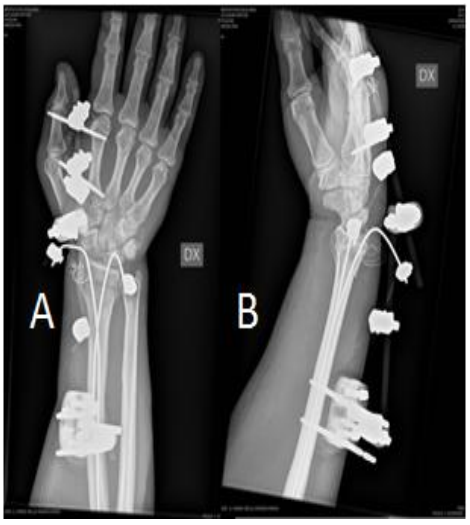

Figure 2 - X-ray (a) AP projection and (b) LL projection after the reduction and External Bridging Fixation combined with intramedullary K. wires.

Surgical treatment

In the group treated with E.F., after an initial reduction, we applied continuous traction to maintain the reduction. We then positioned two 4mm pins to the radio level through a mini incision, positioning the pins between the abductor pollicis longus and extensor pollicis brevis. Then we positioned two 3mm pins at the level of the second metacarpal, with front inclination of at least 30°, being careful not to pierce the extensor tendon. After that, we connected the pins with clamps and rods and under amplioscopic control we checked fracture reduction and added K-wires when necessary for improving stability or for better reduction of articular fragments. In our series, we added K-wires in 5 cases.

A Torniquet was used in patients treated with plate surgery and, in all cases, we used the modified Henry's approach at the distal radius in the plane between the flexor carpi radialis and the radial artery.

It therefore affects the forearm fascia id dissected, diverge ulnar flexor tendon and dissected the square pronator. The fracture was then provisionally stabilized with a K-wire while the plate and screws were positioned. The wrist was then checked under image intensifier to verify its complete motility and the presence of intra-articular screws.

In the group treated with plates, active mobilization of the wrist was started from the 1st post-operative day, while in the group treated with E.F., we suggested to begin in the first days with mobilization of the fingers, and rehabilitation of the wrist began from the sixth week at the removal of E.F.

In both groups X-rays were taken at 5, 10 and 15 weeks using the standard projections (A-P and lateral). In both groups the first dressing was performed after 7 days, and at 15 days the stitches were removed. The patients with external fixation were invited to perform daily cleansing of the pin with Amukina. At every visit, each patient was evaluated for any post-operative complications, including infection, neuropathy, tendon injuries, loss of reduction, and loosening of screws or pins. The follow-up lasted at least 1 year in both groups, on average it was 16 months (12-21). All patients were evaluated clinically with DASH-score and Mayo-wrist score.

Figure 3 - X-ray after the removal of external and internal devices showing the complete union of fractures

Figure 4 - Clinical results and range of motion of the right wrist compared with the left.

Figure 5 - X-ray in AP (A) and LL (B) shows the metaepiphyseal fracture of left wrist.

Figure 6 - X-ray after ORIF with volar angular plate.

Figure 7 - At the second month of follow-up, clinical results and range of motion of right wrist compared with the left.

3. Results

Clinical and radiographic results were evaluated in both groups of patients. The functional results in patients where plates were used were: mean flexion 75 ° (40-85°); average extension 72 ° (30-80°); average pronation: 84 ° (70-90°); average supination: 80° (65-90°); average radial deviation: 11° (8-15°); average ulnar deviation: 20° (15-25) (p >0.05). The functional results in patients where external fixators were used were: mean flexion: 80° (40-85°); average extension: 75° (30-80°); average pronation: 85° (70-90°); average supination: 83° (65-90°); average radial deviation: 10° (8-15 °); ulnar deviation: 21° (15-25°). (p >0.05). (Figure 8).

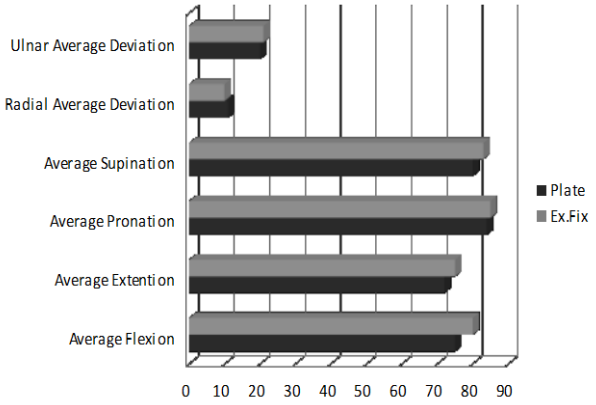

Figure 8 - The functional results in patients of the two groups (p>0.05)

Regarding the radiographic parameters, the radial inclination was on average 20° in both groups and the ulnar variance 0.7mm in both groups. (p >0.05).

In patients treated with a volar plate, the clinical results obtained in accordance with the DASH score was 18 points on average, while the Mayo-Wrist score was 82.5 points on average. The results obtained in patients treated with external fixation were 16 points on average for the DASH score, while 88.5 points on average for the Mayo-Wrist score (p >0.05) (Figure 9).

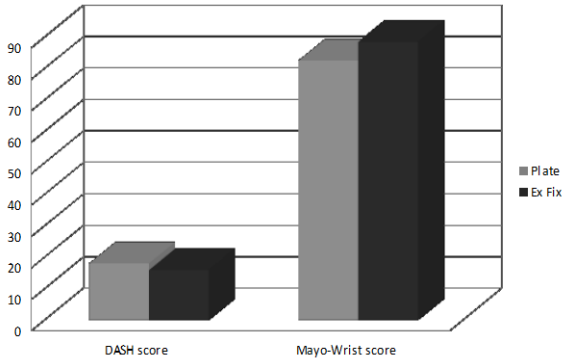

Figure 9 - Results of Dash Score and Mayo-Wrist score in the Ex Fix group and Plate group (p>0.05).

Regarding complications, in group A the plate was removed from 2 patients after 6 and 8 months with release of the carpal tunnel for carpal tunnel syndrome; 9 patients suffered from transient neuropathy of the median nerve which resolved spontaneously, 2 patients had a superficial tenosynovitis of the extensor tendons and 5 patients wanted to remove the plate after one year. In the external fixator group, 9 patients had pin-tract infections, which resolved with oral antibiotic therapy with amoxiclavulanic 1 gr/day for 7 days, 2 patients suffered complex regional pain syndrome and there were 5 cases of minor sensitivity disorders related to superficial branches of the radial nerve. There was no need to remove any of the external fixators before 6 weeks due to patient intolerance.

4. Discussion

Intra-articular and unstable fractures of the distal radius can be treated with different methods, among which the most commonly used are the open reduction and internal fixation with plates or the synthesis with E.F.

The advantages of external fixation are the need for its application for a short period of time, its low invasiveness, and its ability to protect the reduction until healing has occcured [9]. With this technique, the reduction of the fracture is by ligamentotaxis, but when the reduction is not satisfactory, it is possible to create a mini-incision and lift the sunked part of the joint using a mini-scalpel [10].

A percutaneous pin may also be utilized together with external fixation to improve the reduction and increase the stability of the construction [9]. The E.F. complication rate varies from 6 to 60% [11,12,13].The most frequent complications are injuries to the superficial branches of the radial nerve, pin tract infections, over-distraction, and complex regional pain syndrome. Among these, over-distraction is a cause of reduced motility of the fingers and of poor functional results [14].

In our study, there were 9 superficial infections of the pins (grade 1 sec. the Chan's scale)[15]. 2 patients suffered from complex regional pain syndrome and in 5 cases minor sensitivity disorders related to superficial branches of the radial nerve were reported, which resolved spontaneously.

In some intra-articular fractures, despite excessive forces being applied to the external fixator, it may be impossible to maintain an appropriate reduction. In these cases, a mini- incision is required and further stabilization with K-wires. In our study, this additional procedure was necessary in 5 cases.

The internal fixation has the advantage of direct visualization and manipulation of the fracture, a stable synthesis and the possibility to immediately begin active mobilization. Additionally, recent plates with angular stability reduce the risk of loosening of the screws, shortening, and angular displacement of the fracture. They can also be used in osteoporotic patients [16,17,18]. With regards to the entry access, palmar approach seems to guarantee better clinical outcomes, early recovery, and a reduction in complications such as tenosynovitis, rigidity and fracture collapse. [2,19]

Complications of the internal fixation include the rupture of the flexor pollicis longus (FPL) [20], carpal tunnel syndrome and neuropathy of the median nerve. For this reason, some authors suggest the release of the carpal canal during surgery with the intent to reduce the incidence of this complication [21]. In our study, there were 2 cases of carpal tunnel syndrome and 11 cases of transient neuropathy of the median nerve. There were no statistically significant differences between the 2 groups with regard to the clinical and radiographic results.

5. Conclusion

In the management of articular fractures of the distal radius, both methods provide similar findings. The medium-term clinical and radiographic results are the same, so the choice of either one of the methods depends on the experience of the surgeon and patient compliance. Among the advantages of external fixation are reduced operative time and no need to remove the means of synthesis.

6. Conflict of interest

All authors disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential conflicts of interest include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding.

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