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Treatment of distal radius intra-articular comminuted fractures with external fixator: Is it a good option?

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ABSTRACT

Background. In this study, it was aimed to evaluate the treatment results of distal radius intra-articular comminuted fractures treated with closed reduction and external fixation. *Material and Methods*. This study included 46 patients who underwent closed reduction and external fixation with the diagnosis of distal radius intra-articular comminuted fracture. According to the AO classification, 21 patients had type C1, and 25 patients had type C2 fractures. Patients were evaluated with the radiological criteria developed by Lindstrom and the clinical scoring system developed by Gartland and Werley. *Results*. Mean union time was 7 weeks (6-8 weeks). All patients were followed for 12 months. As a result of Lindstrom radiological-anatomical evaluation 10 (21,73%) patients were evaluated as moderate, 16 (34.7%) patients as good, and 20(43.4%) patients as excellent. When these 46 cases were evaluated according to the modified Gartland and Werley functional evaluation scheme, a satisfactory result (excellent and good) was obtained in 42 cases (91.3%), and unsatisfactory (moderate and poor) results were obtained in a total of 4 (8.7%) cases. *Conclusion*. The closed reduction and external fixator application is a treatment method that can be preferred in the treatment of unstable radius distal intra-articular comminuted fractures in the right indication and in the right patients, under appropriate conditions.

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Introduction

Radius distal fractures are the most common fracture type among all fractures [1-3]. It constitutes 75% of all forearm fractures admitted to the emergency department and 16% of fractures treated in the emergency department [2,4]. It is common in children aged 5-10 years and in people in the 6th and 7th decades of life, who have led a more sedentary life and whose bone quality is not very good. Approximately 80% of the patients in this second group are women [1,4]. While it generally occurs with low-energy traumas in elderly patients, it mostly occurs with high-energy traumas such as traffic accidents, falls from a height, and sports injuries in young patients. In treatment planning, factors such as the patient's age, physical and cognitive capacity, lifestyle, co-morbid health problems, and compliance with the treatment should be taken into account, as well as the fracture type [4,5]. The aim of treatment is to provide normal anatomy, preserve this condition and achieve functional wrist mobility as a result of treatment. 75-80% of radius distal fractures are extra-articular and stable fractures. Minimally displaced or impacted fractures can be treated with conservative methods [2,6,7]. In unstable radius distal fractures, reduction loss after non-operative treatment has been described quite frequently [8-10]. Although a wide variety of surgical intervention methods and fixation materials have been described in the treatment of unstable fractures, a standard treatment method has not been established. Surgical treatment alternatives include percutaneous pinning or external fixator application after closed reduction, pinning after limited open or open reduction, internal fixation, and combinations of all these interventions, and in addition to these interventions, grafting, arthroscopy-assisted reduction and stabilization can be counted.

In our study, we retrospectively analyzed the anatomical, radiological and clinical treatment results of distal radius fractures that we treated with an external fixator, and the effects of these results on the daily work and social life of the patients.

Materials and Methods

This study included 46 patients who underwent closed reduction and external fixation with the diagnosis of distal radius intra-articular comminuted fracture between January 2017 and January 2021. All procedures followed were in accordance with the ethical standards of the

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responsible committee on human experimentation and with the Helsinki Declaration. The Ethics Committee approval date is 17.10.2022 and the number is 298. Informed consent was obtained from patients. Twenty-six of our patients were female and twenty were male. The mean age was 47 years (26-75 years). The mechanisms of fracture were listed as traffic accidents in 5 patients, sports injury in 9 patients, and falling in 32 patients. According to the AO classification, 21 patients had type C1, 25 patients had type C2 fractures (Figures 1 and 2). Seven of the cases were open fractures (Gustillo type 1). Patients with accompanying other system injuries, patients with concomitant fractures in the ipsilateral upper extremity, patients with a previous history of wrist fracture in the same extremity, and patients who could not be followed up for 12 months were excluded from the study.

Figure 1. Preoperative Anterior-posterior X-ray
Figure 2. Preoperative Lateral X-ray

After radiological examinations, closed reduction was attempted and long-arm circular casts were applied to all of them. For type 1 open fractures, reductions were attempted after debridement, and irrigation was performed when necessary. Post-reduction radiographs were evaluated, and surgical treatment was decided if there were severe volar and/or dorsal angulation, more than 2 mm separation or stepping on the articular surfaces, and angulation of more than 10° between the fragments.

Closed reduction and external fixation were applied to the patients under general anesthesia. Two pins were applied to both the 2nd metatarsal and 10 cm proximal to the radius styloid. In order to protect the sensory branch of the radial nerve and the lateral antebrachial cutaneous nerve, pins were applied to the radius after the mini-incision. After evaluating the suitability of the reduction under the scope, the fixator was fixed in mild flexion and ulnar deviation of the wrist. Considering that excessive traction may prevent finger movements and cause claw hand deformity to develop, finger movements were controlled after the fixator was applied. Then, the stability of the distal radio-ulnar joint was checked. The pronation and supination range of motion of the forearm was checked and it was tried not to have any restrictions. Reduction, depth of the pins and intercarpal distances were checked under scope before ending the surgery (Figures 3 and 4). The increased intercarpal distance was considered a sign of excessive traction and traction was relaxed. The intercarpal joint distance may exceed the radiocarpal joint distance by up to 1 mm. The difference above this amount was considered a sign of excessive distraction.

The patients were followed up at the 2nd week, 6th week, 2nd month, 3rd month, 6th month, and 12th month. Patients were evaluated with the radiological criteria developed by Lindstrom [11] and the clinical scoring system developed by Gartland and Werley [12].

Figure 3. Postoperative Anterior-posterior X-ray
Figure 4: Postoperative Lateral X-ray

Results

The mean time from trauma to surgical intervention was 3 days (2-5 days). The mean surgical time was 48 minutes (35-60 minutes). The mean hospital stay time after surgery was 30 hours (24-48 hours). Mean union time was 7 weeks (6-8 weeks). The external fixator was removed following the union (Figures 5 and 6). Patients were evaluated according to the modified Lindström radiological-anatomical evaluation table after the removal of the fixator. As a result of the evaluations made with this scale, 10 (21,73%) patients were evaluated as moderate, 16 (34.7%) patients as good, and 20(43.4%) patients as excellent. When these 46 cases were evaluated according to the modified Gartland and Werley functional evaluation scheme, a satisfactory result (excellent and good) was obtained in 42 cases (91.3%), and unsatisfactory (moderate and poor) results were obtained in a total of 4 (8.7%) cases.

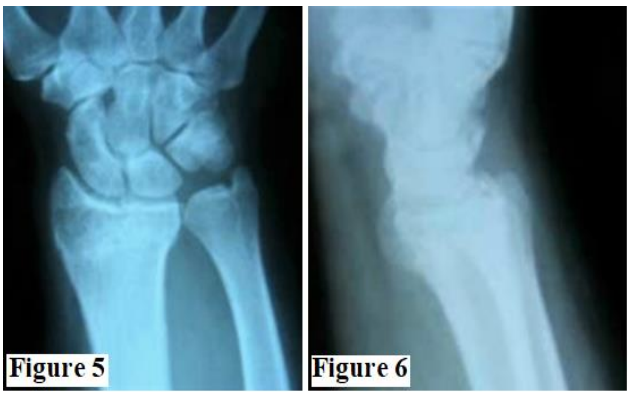

Figure 5. Postoperative Anterior-posterior X-ray at 6th month
Figure 6. Postoperative Lateral X-ray at 6th month

Superficial pin site infection was observed in 2 patients and resolved with dressing and oral antibiotic treatment (Table 1).

Table 1. Demographic data of patients

Gender (number)	26 (Female) 20 (Male)
Age (year)	47 (26-75)
Fracture type(AO)	21 (C1) 25 (C2)
Mean surgery time after fracture (day)	3(2-5)
Mean surgery time (minute)	48(35-60)
Mean hospital stay time after surgery(hour)	34(24-48)
Mean union time(week)	7(6-8)
Gartland and Werley functional evaluation (number)	42(excellent and good) 4 (moderate and poor)
Lindstrom anatomical-radiological evaluation (number)	20(excellent) 16(moderate) 10(good)

Stiffness in finger movements was observed in 5 patients. In these patients, hand and finger pain occurred due to postoperative edema and swelling, so they did their exercises less or not. These patients were subjected to regular physical therapy and rehabilitation programs after the fixator was removed, and active finger exercise was applied. As a result, all patients fully regained their normal finger movements.

Reflex sympathetic dystrophy was observed in 4 patients. After an intensive rehabilitation program, they could return to their daily activities (Table 2).

Table 2. Complications

	Number	%
Reflex sympathetic dystrophy	4	8.7
Stiffness of fingers	5	10.8
Pin site infection	2	4.3
Total	**11**	**23,9**

Discussion

There is a wide range of accepted algorithms for the treatment of distal radius fractures. Clinical and radiological findings are the main determining factors in treatment planning. Factors such as the patient's age, physical and cognitive status, occupation, bone quality, other accompanying pathologies, type and severity of the trauma, and open or closed fracture are also very important in treatment planning [13]. Many methods such as conservative treatment, external fixation, percutaneous pinning, plate, or combinations of these have been suggested for the treatment of distal radius fractures. Basically, it is aimed to restore the articular surface and balance the necessary anatomical and radiological parameters [14].

Non-displaced or minimally displaced fractures and extra-articular fractures can be successfully treated with closed reduction and casting [2,6,7]. Radius distal intra-articular fractures are generally unstable, and even if a good reduction is achieved in cast treatment, reduction loss is inevitable and this leads to malunion [6-10]. Although malunions are mostly painless, they reduce the range of motion of the joint, they can cause shortness, deformity and arthrosis in the future [13,15]. Surgical options may be preferred in order to avoid reduction loss and related complications, which are frequently encountered in casting treatment in radius distal intra-articular comminuted fractures. In this study, we evaluated the results of our patients who underwent external fixation after closed reduction. It was reported that treatment with plaster could not provide sufficient radial length and that an external fixator should be preferred for this. It was also emphasized that external fixation is an effective method for providing radial length [10,16]. In Kapoor's study, conservative treatment, external fixator, and open reduction techniques were used in similar patients and, as a result, external fixation was reported to be the most effective treatment method that can be chosen in cases with displaced and comminuted intra-articular fractures [17].

In our study, according to the Gartland and Werley Functional Scoring system evaluation, 37 (80.49%) excellent, 5 (10.86%) good, and 4 (8,69%) moderate results were obtained. There was no bad outcome evaluation in any case. Cooney reported that he achieved 87% adequate results in his study consisting of 100 cases, almost all of which were intra-articular fractures [18]. In some other similar studies, the percentages of satisfactory results were reported as 78.5%, and 54% [19,20]. Lindstrom's criteria were used in the evaluation of radiological anatomical data. As a result of the evaluations made with this scale, 10 (21,73%) patients were evaluated as moderate, 16 (34.7%) patients as good, and 20 (43.4%) patients as very good.

Complications of the treatment of distal radius fractures with external fixators were reported in a wide range of rates. Factors such as the personal characteristics of the patients selected for the operation, their compliance with the treatment, and the presence of osteoporosis are also effective in the complication rates [13,21].

Reflex sympathetic dystrophy is one of the most important complications that may occur. Cooney, Kaempffe and Güdemez respectively reported reflex sympathetic dystrophy in 5%, 11%, and 33% of the cases in their studies, and they emphasized that the amount and duration of distraction was the basis of this problem [18,22,23]. In addition, the waiting time in the preoperative period and patients' compliance with rehabilitation is also

an effective factor. Contraction of ligaments and surrounding soft tissues that develop during the waiting period causes extreme pain and limitation of movement in the postoperative period [22,24]. At the end of the 3rd postoperative week, it was reported that the relaxation of the distraction has a preventive effect on the possible complication of reflex sympathetic dystrophy [24]. In our study, this complication was detected at a rate of 8.7%. Pain and edema control and aggressive rehabilitation helped this complication to be resolved in a short time. Due to similar reasons, stiffness in the fingers developed in 10.8% (5 cases) of our cases, and pain control and rehabilitation treatment were applied. Although it does not interfere with the daily activities of adults, some stiffness remained in their fingers.

It has been reported that radial nerve sensory branch irritations occur in approximately 7% and resolve over time after fixator removal [25]. This complication was not observed in our study. We used mini-incision and guide devices when placing pins, to prevent radial nerve sensory branch injuries; no loss of reduction developed in any of our cases. This complication was reported in 4% by Cooney and 7% by Szabo [18,26].

Superficial pin site infection was observed in 2 cases (4.3%), which were treated with dressing and antibiotic therapy in our study. Complications such as pin breakage, carpal tunnel syndrome, tendon rupture, osteomyelitis, delayed union and nonunion were not observed.

The external fixator is a treatment method that has many advantages during the application and postoperative period, it does not restrict the daily activities of the patient. Delayed union, nonunion and infection problems that can be seen in open reduction applications are minimized by the use of closed reduction and external fixators. In addition, it requires short surgery and hospitalization period and provides avoidance of problems related to internal implants. Also, the external fixator can be combined with techniques such as percutaneous fixation with a K-wire or internal fixation.

Limitations of our study can be listed as a short follow-up period, a low number of cases, and not be compared with other methods.

Conclusions

The closed reduction and external fixator application is a treatment method that can be preferred in the treatment of unstable radius distal intra-articular comminuted fractures in the right indication and in the right patients, under appropriate conditions.

Conflict of interest disclosure

There are no known conflicts of interest in the publication of this article. The manuscript was read and approved by all authors.

Compliance with ethical standards

Any aspect of the work covered in this manuscript has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

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