

External Fixator versus Pin and Plaster: The Approach to Distal Radius Fractures

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Abstract: distal radius fracture is the most common fracture of the long bones in adults and is quite prevalent amongst orthopedic patients. **Methods:** This is a randomized clinical trial conducted with recruiting 70 patients suffered from comminuted distal radius fractures. The study was carried out in Imam Khomeini Hospital, Sari, Iran, in 2011 and 2012. **Results:** All patients in the external fixator group (37 patients) showed the radiographic features of the union while only 29 patients in the pin & plaster group (93.5%) manifested evidence of union ($p= 0.117$). Only 4 patients (10.8%) in the external fixator group and 7 patients in the pin and plaster group had mal-union ($p= 0.189$). Eight patients (11.8%) had infection of the pin site, 2 patients (5.4%) in the external fixator and 6 patients (19.4%) in the pin and plaster group. **Conclusion:** According to the results of this study, external fixator had fewer side effects in comparison to the pin and plasters surgery and is a preferred treatment for comminuted distal radius fractures. Moreover, this technique is associated with better clinical and functional outcome.

Key words: *distal radius fracture, external fixator, pin and plaster*

1. Introduction

Distal radius fracture is the most common fracture of the long bones in adults and is quite common among orthopedic patients (1,2). It contributes to 75% of fractures in the forearm and 16% of all fractures encountered in the emergency room (3). Distal radius fractures are mainly a result of motor accidents. It is also increased with age over 30 years, may be as a result of osteopenia process (4). The mechanism of this type of fracture is usually fall with outstretched hand. The yearly incidence of distal radius fractures in England is 910000 and 3710000 cases in male and female above 35 years old, respectively. The life time chance of distal radius fracture among women is 13% to 15% while only 2% among men (5). Distal radius fractures were described by Colles in 1814 for the first time. Until then, the usual practice for the treatment of this fracture was conservative. However, because of movement of the bone segments, the need for recurrent casting, and increased expenditures the external fixator was developed and used worldwide (6).

Until few decades ago, most of the distal radius fractures in adults were managed conservatively. Surgical techniques involve open reduction and internal fixation (ORIF), external fixation, close reduction, percutaneous pin casting or a constellation of these techniques (7-10).

There are many factors affecting the choice of treatment in distal radius fractures including the force of the damage, radiographic pattern of the fracture, crushing of the bone, displacement of the bone segments and the quality of the bone (11-14).

Despite various therapeutic techniques for the treatment of fractures, there are few studies demonstrating their role comprehensively (15). Considering the contradictions in the choice of the treatment for distal radius fractures and the relative prevalence of this clinical event, we designed the current study in order to compare the external fixator versus the pin and plaster techniques in terms of union, postoperative complications, and postoperative function.

2. Material and Methods

This is a randomized clinical trial conducted with recruiting 68 cases suffered from crushed distal radius fractures. The study was conducted in Imam Khomeini Hospital, Sari, Iran in 2011 and 2012. All patients between 18 and 75 years of age with the distal radius fractures and no any systemic disease were recruited. On the other hand, patients were excluded from the study if they had any neural dysfunction before surgical operation or if a history of previous distal fracture in the same radius was

obtained. The informed consent was documented and patients could freely choose to withdraw from the study after full disclosure of the treatments and their complications. The patients were randomly distributed using table of random numbers into two groups: one group (31 patients) received pin and plaster treatment and another group (37 patients) received external fixator treatment. All the external fixator procedures were done under general anesthesia with the AO-ASIF (Association for Osteosynthesis/Association for the Study of Internal Fixation) type using four pins. The distal pin was inserted in the second metacarpus. All the fractures were reduced with the ligamentotaxis mechanism. All patients received similar antimicrobial treatment (Cephalotin 1g, four times a day) up to one week after the surgical operation.

In the pin and plaster group, the patients operated under general anesthesia. The position was supine with the involved hand in vertical traction with a finger trap through the index finger, and provided 8 to 10 lbs of countertraction with a water bottle. While the arm is in traction, a closed reduction that is the first step in the treatment is performed and verified by image intensification. A neutral position of the wrist was desirable. The proximal is inserted in the radius between the muscles of the first and second compartments and other smooth pin is placed across the second and the third metacarpal bone. The pins are incorporated in below elbow plaster cast. Follow-up period at our outpatient orthopaedic clinic at 2-week intervals following hospital discharge was done. In our study fracture healing was assessed both clinically and radiographically at each follow-up. It is preferable to leave the pins and plaster in place for 6-8 weeks and removed after this time on without local anesthesia. The use of the splint was not needed after 4 to 6 weeks (16).

Demographic features including age, gender, power of wrist muscles, restriction of the wrist movements,

the rate of postoperative infection, union, and malunion following operation were documented and followed for four months. The X-ray was performed before and during the study in order to evaluate the extent of crushing, dislocation, and Frykman classification.

The data were collected using a questionnaire containing the above mentioned parameters. SPSS 16 was used for statistical analysis. The descriptive analysis is presented as mean \pm standard deviation and analytical analysis was done by Chi-square and student t test. The probability value was selected less than 0.05.

3. Results

Sixty-eight patients finished the study. Patients were follow-up for 16 months (range=10–27 months). The mean age of participants was 42.09 ± 14.91 years. Our study included 40 men (58.8%) and 28 women (41.2%). The external fixator group contained 37 patients (54.4%) [22 males (55%) and 15 females (53.6%)] with the mean age of 41.78 ± 13.74 years and the pin and plaster group included 31 patients (45.6%) [18 males (45%) and 13 females (46.4%)] with the mean age of 43.9 ± 17.91 years old. We excluded Frykman types I, II, and III fractures at the outset because these could be successfully treated conservatively. The prevalence of each Frykman's class is presented in Table 1.

Union is proliferative physiological process in which the body facilitates the repair of a bone fracture (16). In the external fixator group, the radiographic features of the union were evident in all patients. In contrast, only 29 patients (93.5%) in the pin and plaster group showed evidence of union while the rest (6.5%) had non-union. The analysis yielded no significant difference between groups in terms of the rate of union ($P=0.117$).

Table 1. The Frykman classification and the type of treatment in the study population

Frykman typing	External fixator	Pin and plaster	Total	p value
Type I	0	0	0	0.115
Type II	0	0	0	
Type III	0	0	0	
Type IV	17 (46%)	14 (45.1%)	31 (45.6%)	
Type V	8 (21.6%)	11 (35.5%)	19 (27.9%)	
Type VI	9 (24.3%)	5 (16.1%)	14 (20.6%)	
Type VII	2 (5.4%)	1 (3.3%)	3 (4.4%)	
Type VIII	1 (2.7%)	0	1 (1.5%)	
Total	37	31	68	

Table 2. The prevalence of extension and flexion restriction, the extension and flexion power of wrist in the wrist in each treatment group

	ROM	External fixator	Pin and plaster	Total	χ^2
extension restriction in the wrist	Extension restriction	0	5 (16.1%)	5 (7.4%)	0.011
	Normal extension	0	26 (83.9%)	63 (92.6%)	
flexion restriction in the wrist	Flexion restriction	3 (8.1%)	9 (29%)	12 (17.6%)	0.024
	Normal flexion	34 (91.9%)	22 (71%)	56 (82.4%)	
The extension power of wrist	+	0	0	0	0.0006
	++	0	0	0	
	+++	0	3 (9.7%)	3 (4.4%)	
	++++	2 (5.4%)	8 (25.8%)	10 (14.7%)	
	+++++	35 (94.6%)	20 (64.5%)	55 (80.9%)	
The flexion power of wrist	+	0	0	0	0.048
	++	2 (5.4%)	1 (3.2%)	3 (4.4%)	
	+++	1 (2.7%)	6 (19.4%)	7 (10.3%)	
	++++	3 (8.1%)	6 (19.4%)	9 (13.2%)	

Radial mal-union diagnosis in our study was based on the loss of palmar tilt and the loss of radial inclination. First caused the carpus shifts distally on the radius and the second results in increased stress at the radiolunate articulation (16,17).

Of total 68 patients, 11 (16.2%) showed radiographic evidence of mal-union. Of 37 patients in the external fixator group, only 4 cases (10.8%) had mal-union. On the other hand, the evidence of mal-union was observed in 7 cases (22.6%) of the pin and plaster group. This difference, however, was statically insignificant ($P=0.189$).

Pin site infection was observed in 8 patients (11.8%); 2 patients (5.4%) in external fixator group and 6 patients (19.4%) in pin and plaster group ($P=0.075$). There was no significant association was seen for gender between the two treatment groups ($\chi^2=0.9$). Moreover, patients treated with the pin and plaster significantly differed from those with the external fixator in terms of restricted extension ($\chi^2=0.011$) and flexion ($\chi^2=0.024$) in their wrist (Tables 2).

When the two groups were analyzed in relation to extension ($\chi^2=0.0006$) and flexion ($\chi^2=0.048$) power of wrist, the results were statistically significant. Tables 2 depict the extension and flexion power of wrist in each treatment group, respectively.

4. Discussions

Distal radius fracture, not only is prevalent among emergent orthopedic population, but also is potentially disabling event which should be prevented by employment of an appropriate

therapeutic approach. Despite various approaches to distal radius fracture, appropriate treatment plan has changed dramatically. The recurrent displacement of the fractured segments demanded repeated casting with serious personal and public financial burden. Hence, the external fixator has become an appropriate treatment choice for these patients (17-31). The age of this technique is now 50 years and in 80% to 90% of patients brings about very good anatomical and clinical results (32-35). This technique is sometimes considered first choice though it may be used as an alternative to the previously failed treatment. Despite complications that may afflict the results of this approach, the functional status of the patient is not significantly affected except if deformities, non-union, and mal-union occur. It is of value to mention that in crushed fractures of the distal radius the risk of mal-union is more with older techniques such as closed reduction and casting. Thus, the external fixator has become a minimally invasive method in this type of fractures. There are numerous studies comparing the external fixator and the pin and plaster techniques in the treatment of distal radius fractures. Considering higher incidence of complications (mainly mal-union) in the pin and plaster technique, it seems that alternative techniques such as external fixator has gained more proponents. Nonetheless, the internal fixation is not recommended instead of external fixation in the distal radius fractures (36, 37). Considering higher incidence of complications (mainly mal-union) in the pin and plaster technique,

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Mehboob and Arora reported that the most common complication in patients treated with external fixator was infection of the pin site (4 out of 30 and 6 out of 27 respectively) followed by mal-union (22, 38). In contrast, the most common complication in our study was mal-union. In general, only 11 patients of the total 68 patients in our study had evidence of mal-union.

Of the 37 patients in the external fixator group only four (10.8%) had mal-union. This finding was similar to a study done by Anderson et al. who reported complications of the external fixator in 24 patients as the following: mal-union in two (8.3%), non-union in one (4.2%), and infection of the pin site in nine cases (37.5%) (32). In the Ismatullah's study the prevalence of mal-union was similar to our study and mal-union was observed in two (13.3%) and infection of the pin site in two (13.3%) out of 15 patients (28). The prevalence of this complication was less in the Kakaretals' study who reported only one in seven patients (14.2%) treated with pin and plaster had mal-union (39). However, we did not detect any statistical significance with respect to the type of surgery and the occurrence of mal-union ($P= 0.189$). Our results were congruent with the study done by Ismatullah who stated that classical treatments of the distal radius fracture increase the risk of mal-union but external fixator bears minimal invasiveness and effectively stabilizes the fracture segments with less prevalent complications (28).

Hertel et.al proposed that non-union is a random quality of fracture which may extend to the metaphysis or even diaphysis of the bone in osteoporotic patients (40). We observed non-union in only two patients. These women were 58 and 61 years old and probably had low bone density. In the Anderson's study, non-union was also seen in one osteoporotic woman aged 64 years old. It appears that this complication is not common following distal radius fracture because we did not find any non-union in the external fixator group and only found two (6.5%) patients in the pin and plaster group with non-union. The correlation between the type of treatment and the union was not significant which is in accordance with the Hertel and Anderson studies (32, 40).

Contrary to our study, Anderson et.al reported infection of the pin site as the most common complication of the external fixator treatment (nine out of 24 [37.5%]) (39). Our results were more in agreement with the studies conducted by Mehboob (22), Ismatullah (38) and Dienst (33) who reported infection had complicated up to 13.3% of their studies' population. We found that in the external

fixator group only two (5.4%) and in the pin and plaster group only six (19.4%) had infection of the pin site.

Harley and Hatchinson reported no significant difference between the external fixator and the pin and plaster groups in terms of wrist power (23, 24). In other words, Harley and colleagues reported that although there was no statistical difference between groups in terms of surgical complications and the external fixator is an appropriate method for unstable distal radius fracture, but the pin and plaster method was also effective in fractures with minimal displacement. However, the pin and plaster was not as successful as external fixator (23). Santiago et.al reported no significant difference between groups in terms of surgical outcome and the wrist power (19). However, Diaz et.al and Grewal et.al reported similar results to ours. Grewal reported that the wrist power is relatively less reduced in the external fixator technique (18). Diaz et.al reported that there was a significant difference between external fixator and pin and casting. In fact, our results are in accordance with Grewal's and Diaz's studies because we also found a significant correlation between the extension power and the type of treatment (18, 41). Furthermore, we detected a significant correlation between the flexion power of the two groups, similar to the Diaz and Grewal studies (18, 41). However, this finding was in contrast to the results reported by Santiago (19), Harley (23), and Hatchinson (24) studies. Our study was deficient in the assessment of variables such as tendon rupture, degenerative arthritis, reflex sympathetic dystrophy, and pin break. The evaluation of these variables need a more comprehensive study in order to better compare the external fixator versus the pin and plaster techniques.

5. Conclusion

According to the results of our study, external fixator is a preferred treatment for comminuted distal radius fractures because this approach results in fewer side effects (mainly restricted movements and reduced power) in comparison to the pin and plaster surgery. Moreover, this approach is associated with better clinical and functional results.

6. Recommendations

We recommend that a more comprehensive study is done in order to compare various external fixator techniques with respect to their prognosis and complications. We also recommend that other important variables such as neuropathy, reflex sympathetic dystrophy, and the classification of fractures according to AO classification be considered in a larger study in order to derive the best therapeutic approach for each disease state and to

compare the convalescent period, radial tilting, and the clinical evaluation according to Green and O'Brien scoring system. In this way the best approach with the least complication would become clear for each type of fracture.

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