

ORIGINAL ARTICLE

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Comparison of volar plate screw fixation with k-wire fixation by closed technique in instable distal radius fractures **Ismail Guzel**,  **Serkan Akpınar***Malatya Training and Research Hospital, Department of Family Orthopedics and Traumatology, Malatya, Turkey*

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**Abstract**

The aim of the present study was to compare the clinical outcomes of volar plate screw fixation with the K-wire fixation with external fixator applied with closed technique in instable distal radius fractures extending to the joint in elderly patients. The study included 60 patients who were treated for AO type C distal radius fracture in our clinic between January 2016 and January 2019. The patients were divided into two groups: Group External fixator (EF) with 30 patients who underwent multiple K-wires using closed technique and Group Volar Plate (VP) with 30 patients who underwent volar plate and screw fixation using open technique. Wrist range of motion (ROM), disabilities of the arm, shoulder and hand (DASH) score and grip strength values, radiologic parameters were compared between groups. After 12 months of follow-up, there was no significant difference in DASH score and grip strength values between the two groups ($p = 0.263$ and 0.085 , respectively). The mean duration of surgery was found to be shorter in the EF group ($p < 0.001$). There was no significant difference between radiologic parameters. Significantly fewer fluoroscopy applications were needed in the VP group than in the EF group ($p < 0.001$). Both VP and EF treatments had similar functional outcomes in patients over 65 years of age. Considering its shorter duration of surgery and less invasive nature, EF treatment was concluded to be more applicable in patients over 65 years of age.

Keywords: Radius, Fracture, plate, screw, fixation**Introduction**

Radius distal end fractures are the most common fractures in Turkey and in the world [1, 2]. These fractures are caused by high-energy traumas such as falls, bumps and traffic accidents in young patients, but they can also originate from lower traumas due to osteoporosis in elderly patients [2, 3]. Extra-articular simple fractures are treated with methods such as closed plaster splints, while intra-articular multi-fragmented fractures are surgically treated [4-8].

Today, many treatment methods have been defined in the treatment of these fractures. Among the most preferred methods are screw-plate fixations carried out with various incisions and techniques, K-wire method applied with closed technique and external fixator method. There are many studies on these techniques in the literature. These studies mentioned the advantages and disadvantages of

these techniques. Despite the good results in most patients, poor outcomes were also reported in some patients [4-9].

Due to increased life expectancy and osteoporosis in geriatric patients, clinicians often encounter distal radius fractures in this age group. Today, despite technological advances, increased experience in surgical techniques and anesthesia applications, treatment of these fractures remains to be associated with high mortality and morbidity. Stable fixation is difficult in multi-fragmented fractures and fractures extending to joint especially in this age group due to the decrease in bone quality, resulting in poor clinical outcomes [9].

K-wire fixation applied with closed technique and volar plate screw fixation are among the most successful methods mentioned in the literature. Both advantages and disadvantages of the two methods were described in previous studies. However, there have been only a limited number of studies directly comparing these two methods [4-9]. There were limited number of studies according to treatment of geriatric radius distal fractures which require more sensitivity than the other age groups.

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The aim of the present study was to compare the clinical results

from volar plate screw fixation with the K-wire fixation applied with closed technique in instable distal radius fractures extending to the joint in elderly patients. The hypothesis of this study is EF treatments will shorter duration of surgery therefore less anesthesia risk in the higher comorbid patients.

Materials and Methods

The study was planned as a retrospective cohort study. A total of 60 patients who were treated in our clinic due to AO type C distal radius fracture using K-wire fixation with external fixator or volar plate screw fixation between January 2016 and January 2019 were included. Written consent was obtained from the patients in the study.

Inclusion criteria for the study

- Patients between the ages of 65 and 90 years
- Intra-articular fragmented AO type C (10) radius distal end fractures
- Minimum follow-up period of 12 months

Exclusion criteria for the study

- Open fractures
- Pregnant patients
- Pathologic fractures
- Refractures

The patients were homogenized based on demographic characteristics such as age, gender and fracture type, side, and were divided into two groups. Group EF consisted of 30 patients who were treated using multiple K-wires with closed technique while Group VP was constituted by 30 patients who underwent volar plate and screw fixation with open technique. One of the important outcomes of the treatment methods examined in the present study was the grip strength value. In EF group in which multiple K wires were applied with the closed technique, the mean grip strength value was 49.7 ± 20.4 . The mean grip strength value in Group VP where the patients were treated with volar plate and screw fixation with open technique was 35.1 ± 18.7 . Based on the theoretical power analysis considering a Type I (α) error rate of 0.5 and a test power of 0.8 ($1 - \beta$), effect size of 0.75, alternative hypothesis (H1), two-tailed, two-variable independent sample t test, the necessary minimum sample size was calculated to be 30 patients in each group and a total of 60 patients in the study (15,16). The results of 60 patients were evaluated in the study (Group EF: 30 patients and Group VP: 30 patients). There was no difference between the two groups in terms of age, gender, fracture side and fracture classification ($p > 0.05$) (Table 1). Local ethical authority was approved all the study protocols.

Surgical Method

After achieving fracture reduction and joint surface smoothness in the patients included in the group EF, fixation was performed using two or three K-wires based on stabilization status. Effective

reduction and stabilization were confirmed with scopy.

In patients in the VP group, skin was cut with an average skin incision of 4 cm from the wrist volar using the modified Henry approach. Flexor carpi radialis tendon sheath was cut longitudinally and taken to the tendon ulnar side. After the flexor longus muscle was separated, incision was made to the pronator quadratus muscles, and the fracture line in the radius bone was exposed. After the joint restoration was achieved by reducing the broken parts, the locked volar radius plate (Gold, Turkey) was fixed with locked screws under fluoroscopic control. After reduction and fixation, the pronator muscle was repaired and the skin was closed appropriately.

Post-Operative Evaluation

In group EF, wrist movements were started in the fourth post-operative week. In the sixth week, K-wires were removed and exercises were given to ensure full joint mobility of the wrist. For the patients in VP group, splints were used for two weeks after surgery. In the second week, the stitches were removed, and exercises were given to ensure full joint mobility in a gradual increase.

Clinical evaluation was performed by the same observer in the 1st year after surgery. Active wrist range of motion (ROM) was measured using a standard angle meter as flexion-extension and radial-ulnar deviation movements. Functional evaluation was performed based on disabilities of the arm, shoulder and hand (DASH) score. According to this evaluation, patients were given scores between 0 (no disability) and 100 (most severe disability). Grip strength was measured in kilograms using a hydraulic hand dynamometer (Saehan Hydraulic Hand Dynamometer; Saehan Corporation, Changwon, South Korea). Postoperative complications, number of fluoroscopy and revision surgeries were recorded and compared.

IBM SPSS 19 software (IBM SPSS Statistics 19, SPSS Inc., an IBM Co., Somers, NY) was used for statistical analyses. Clinical data were expressed as numbers, percentages or mean $\pm$ SD. The two-way chi-square (χ^2) test was used to evaluate the relationship between two categorical variables. Student's t test was used for continuous variables. $p \leq 0.05$ was considered statistically significant.

Results

After 12 months of follow-up, there was no significant difference in DASH score and grip strength values between the two groups ($p = 0.263$ and 0.085 , respectively). The mean duration of surgery was found to be shorter in the EF group ($p < 0.001$). The average number of fluoroscopy applications was smaller in the VP group than in the EF group ($p < 0.001$). Three patients in the VP group developed superficial infection that was healed with a one-week oral antibiotic therapy while two patients developed median nerve entrapments. We did not encounter these problems in the patients treated with EF. In the EF group, a patient underwent plate-screw fixation as revision surgery. Radiologic parameters were similar (Table 2 and Table 3)

Table 1. General characteristics of the study groups

	Group		p
	EF	VP	
GENDER (Male/Female)	14/ 16	13/ 17	0.399
SIDE (Right/Left)	15/ 15	17/ 13	0.305
AGE (years)	75.5±9.3	71.9±9.0	0.067
AO Classification C1/C2/C3	5 / 13 / 7	6 / 11 / 8	

Data are shown as mean ± standard deviation / Median / Minimum-Maximum or frequency, percentage p: Independent samples t test or chi-square test were used.

Table 2. General characteristics of the study groups

	Group		p
	EF	VP	
DASH scores	16.5±5.7	15.5±6.4	0.263
Grip strength (kg)	33.9±7.2	36.6.0±7.8	0.085
Scopy shots	8.3±0.9	6.2±0.8	<0.001
Flexion (°)	48.4±12.0	52.5±12.7	0.103
Extension (°)	45.7±10.7	47.8±9.5	0.217
Ulnar deviation (°)	16.5±2.8	17.7±4.5	0.116
Radial deviation (°)	12.9±1.8	13.6±2.5	0.126
Duration of surgery	17.6±2.6	39.4±7.3	<0.001
Reoperation	1	none	

Data are shown as mean ± standard deviation / Median / Minimum-Maximum or frequency, percentage p: Independent samples t test or chi-square test were used. p: Between-subject comparison

Table 3. Radiological Parameters

Groups	VP	EF	p value
	(n=30)	(n=30)	
Radial inclination (degr)	18.5±3.3	19.8±4.6	0.116
Volar tilt (degr)	6.5±4.6	6.3±5.4	0.419
Articular Stepping (mm)	0.7±0.6	0.86±0.7	0.117

Discussion

Instable distal radius fractures that extend to joints are very common in elderly patients, and constitute a significant problem for physicians especially in this population due to the risks associated with osteoporosis and anesthesia. In the present study, we compared the two most commonly used methods for treating these fractures. The results showed that clinical outcomes were similar in elderly patients. Although the EF treatment was disadvantageous in terms of scopy exposure, we observed that it was advantageous in terms of duration of surgery.

Many studies and methods have been defined in the treatment of distal radius fractures. A literature evaluation especially on EF and VP methods revealed that Shukla et al. (8) achieved excellent results in the group treated with EF in their study in patients under 50 years of age. In addition, Roh et al. [4] observed that in

patients under the age of 54 with AO type C2 and C3 distal radius fractures, functional results were better in patients treated with VP compared to those treated with EF in short term while the first-year results were similar in both groups. Similarly, several other studies showed that the three-month clinical outcomes were better in the patients treated with VP, but one-year clinical outcomes were similar [12,13]. In terms of age of the patients, these studies argued that VP treatment was more advantageous in young patients. In the present study, we compared these two methods in patients over 65 years of age. We did not come across a study in the literature that specifically examined elderly patients. In the present study, we found that the clinical outcomes were similar in both groups, and that the duration of surgery was shorter in the EF group compared to the VP group. Considering the increased comorbid conditions due to advanced age and higher risk of anesthesia in elderly patients, shorter surgical time could be a very important advantage

in elderly patients.

Roh et al. compared volar plate and external fixator therapy for the treatment of distal radius fractures. The functional DASH score was similar in these treatment groups, which was consistent with the present study. There was no difference between the treatment methods for the postoperative mean radial inclination, volar tilt and Articular Stepping (mm) findings [4]. Grip strength and joint mobility were evaluated in most studies in the literature, and different results were reported. In their study, Jeudy et al. [12] stated that grip strength in VP group was better than that in EF group, while extension-flexion angles were similar in both groups. [13] Grewal et al. [13] reported that grip strength and joint's range of movement in early post-operative period were better in VP group, but the first-year outcomes were similar in both treatment modalities. Kumbaracı et al. [14] stated that the pronation and flexion angles were better in the VP group compared to EF group but that there was no difference between the groups in terms of grip strength. In the present study, no difference was observed between the two groups in terms of grip strength and joint mobility. In the present study, we were unable to achieve satisfactory reduction and joint restoration in the VP group due to impaired bone quality in some elderly patients. This was probably the reason why the advantages of VP such as better joint mobility and grip strength were not evident in this age group.

In the present study, we found that the duration of surgery was shorter in the EF group but the scopy time was longer in the EF group. Especially considering the morbidity and high mortality rates in this patient group, it could be concluded that EF is a very advantageous procedure in elderly patients, and that the radiation exposure, which is a disadvantage in all closed surgeries, is less than expected for these fractures.

In our study, a patient in the VP group developed superficial infection in the third week, which was treated with a one-week of oral antibiotic therapy, and two patients had median nerve entrapments. We did not encounter these problems in the patients treated with EF. Similar results were observed in previous studies. These results suggested that EF offers a safer surgery for the elderly patient group.

Retrospective study design, limited number of patients and short follow-up period were among the limitations of the study. More efficient studies with larger patient populations are needed.

Conclusion

In conclusion, it could be stated that both VP and EF treatments had similar functional and radiological outcomes in patients over 65 years of age, and that EF treatment was a more suitable method for patients over 65 years of age due to its shorter surgical duration and less invasive nature.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

All authors declare no financial support.

Ethical approval

This article was approved by the Clinical Research Ethics Committee of Malatya Turgut Özal University with protocol number 2021/17.

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