Original Article

Functional outcome with Kirschner Wire Fixation Versus Volar Locking Plate Fixation for management of patients with dorsally displaced fractures of distal radius

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Objective: To determine functional outcome by mean dash score with Kirschner wire fixation versus volar locking plate fixation for management of patients with dorsally displaced fractures of distal radius

Methodology: A total of 100 patients of dorsally displaced fractures of distal radius (50 in each group) were included in this study. Randomization was done by the lottery method. Group A fractures were fixed by percutaneous k-wires while in group B fractures were fixed by volar locking plate.

Results: Mean age of the patients was 46.70±8.86 and 45.72±9.11 years in group A and B, respectively. There were 34 males (68%) in group A and 33 males (66%) in group B while females were 16 (32%) in group A and 17 (34%) in group B. Right side was involved in 41 patients (82%) of group A and 37(74%) of group B. Left side was involved in 9 patients (18%) of group A and 13(26%) of group B. Mean dash score in group A was 31.49±3.17 and in group 20.96±3.17 ($p<0.001$).

Conclusion: Use of a volar locking plate resulted in better early post-operative function. Volar locking plate achieved better radiographic reduction and measured grip strength. An earlier recovery of function may be of advantage to patients. (Rawal Med J 202;45:107-110).

Keywords: Fixation devices, Kirschner wires, radius fractures.

INTRODUCTION

Distal radius fracture is one of the most frequent injuries in elderly patients representing 17% of all skeletal fractures.[1] Fractures may be minimally displaced and stable without significant shortening of bone and without direct involvement of the radiocarpal joint. Most of these fractures can be treated adequately in a supportive cast or splint.[2,3] On the other hand, treatment of unstable dorsally displaced distal radial fractures remains a challenge. Conservative treatment for displaced fracture has suboptimal results. Surgical options for treatment of this injury include closed or open reduction followed by percutaneous pinning, internal or external fixation. Internal fixation with volar locking plate is gaining popularity, but its complications, particularly incidence of tendon rupture, are now becoming recognized.[4,5]

Two commonly used methods of treatment of unstable dorsally displaced fractures are percutaneous k-wire and volar locking plating. Postoperatively volar tilt, radial inclination, and radial height are checked on x-rays for adequacy of reduction. DASH (disabilities of arm, shoulder and hand) score can be used to assess the functional improvement in patient treated by either method.

Studies have shown that volar locking plate fixation provided lower DASH scores and reduced total postoperative complications, more specifically lowering the risk of postoperative superficial infection compared to K-wire fixation.[6,7] Literature is inconclusive about functional outcome of dorsally displaced distal radius fractures managed with volar locking plates or k-wire fixation. Rationale of this study was to compare the mean DASH score with Kirschner wire fixation versus volar locking plate fixation for management of patients with dorsally displaced fracture of distal radius.

METHODOLOGY

This Randomized Controlled Trial was conducted at

Department of Orthopedic Surgery, Combined Military Hospital, Rawalpindi from December 20, 2016 to June 19, 2017. Sample size of 100 cases was calculated with WHO calculator with 50 in each group with 95% confidence level, 90% power of test and taking magnitude of mean DASH score i.e. 15.89±8.44 with volar locking plating and 21.45±8.44 with K wires.[7] Non-probability consecutive sampling was used. Patients of age 20-60 years of either gender undergoing surgery under general anesthesia reporting within 48 hours of injury were included in the study. Patients with bilateral fracture or Volar Barton fracture or Die punch fracture or Open fracture (Gustilo grading >1) and those in whom articular surface of the fracture could be reduced by indirect techniques were excluded from the study. The study was approved by hospital ethical committee and an Informed consent was taken from all patients.

The posteroanterior (PA) projection radiograph of wrist was obtained with the arm abducted 90° from the trunk and the forearm flexed at 90° to the arm. With the wrist in the neutral position (with no ulnar or radial deviation), one-half or more of the lunate should contact the articular surface of the distal end of the radius.[8]

The disabilities of the arm, shoulder and hand (DASH) questionnaire consists mainly of a 30-item disability/symptom scale, scored 0 (no disability) to 100.[9] One of the main concepts behind DASH was to facilitate comparisons among different upper-extremity conditions in terms of health burden.[6,7] There are three main radiographic measurements on PA radiographs that are commonly used to assess the anatomy of the distal radius, namely, radial inclination, radial length, and ulnar variance. Radial inclination has an average of 22° (range from 13° to 30°). Radial length, which is the distance between the tip of the radial styloid and the ulnar head articular surface, has normal values ranging from 11 to 22 mm.[10]

Patients were randomly allocated to group A & B by lottery method. Group A fractures were fixed by percutaneous k-wires and Group B fractures were fixed by volar locking plate. Standard aseptic technique was used. All surgeries were done by consultant orthopedic surgeon or registrar with more than 1 year experience. Post operatively, patients were discharged after checking post op x-ray for adequacy of reduction. Patients were followed up in OPD after 6 weeks and 3 months and assessed by using DASH score.[9]

Statistical Analysis: Data were analyzed by SPSS version 23. Mean and standard deviation was calculated for age and DASH score. Independent sample t-test was used to compare mean DASH score in both groups. Data were stratified for age, gender, anatomical side. Post stratification, Independent sample t-test was applied with $P \leq 0.05$ was considered significant.

RESULTS

A total of 100 patients (50 in each group) were included in the study. Mean age of the patients was 46.70±8.86 and 45.72±9.11 years in group-A and B, respectively. There were 34 males (68%) in group-A and 33 males (66%) in group-B while females were 16 (32%) in group-A and 17 (34%) in group-B. Mean DASH score in group-A was 31.49±3.17 and in group-B 20.96±3.17 ($p<0.001$) (Table 1).

Table 1. Comparison of mean DASH score.

Group	Mean	S.D	P value
Group-A (Percutaneous k-wires)	31.49	3.17	P<0.001
Group-B (Volar locking plate)	20.96	3.17	

Table 2. Stratification for anatomical side

Anatomical side	Group	DASH Score		P value
		Mean	S.D	
Right	Group-A	32.04	3.13	P<0.001
	Group-B	20.77	3.43	
Left	Group-A	28.97	1.95	P<0.001

Table 3. Stratification for age.

Age (Year)	Group	DASH Score		P value
		Mean	S.D	
20-40	Group-A	33.61	2.48	P<0.001
	Group-B	20.07	3.12	
41-60	Group-A	30.82	3.09	P<0.001
	Group-B	21.27	3.16	

Table 4. Stratification for gender.

Gender	Group	DASH Score		P value
		Mean	S.D	
Male	Group-A	30.83	2.88	P<0.001
	Group-B	20.56	3.25	
Female	Group-A	32.04	3.13	P<0.001
	Group-B	20.77	3.43	

Right anatomical side was involved in 41 patients (82%) of group-A and 37 patients (74%) of group-B. Left anatomical side was involved in 9 patients (18%) of group-A and 13 patients (26%) of group-B (Table 2). Stratification with regard to age, gender is presented in Tables 3 and 4.

DISSCUSION

Upper extremity fractures can be managed both conservatively and invasively with a lot of options. Fracture of the distal end of radius is an injury that orthopedic surgeons deal with frequently, accounting for 1/6 of all the injuries seen in emergency department.[11] Early scholars managed these cases with conservative non-operative methods and achieved reasonable results.[12]

Fractures of the distal radius are treated non-operatively if the bone fragments can be held in anatomical alignment (reduction) by a plaster cast or orthotic. If this is not possible, surgical fixation is performed. This carries inherent risks for the patient and considerable cost implications; much of this cost is related to the choice of fixation.[13]

Kirschner wire fixation is a longstanding technique in which smooth metal wires with a sharp point are passed across the fracture site through the skin. This technique is rapidly being superseded by locking plate fixation, in which a plate is attached to the bone with fixed angle screws. Locking plates are widely considered to provide stronger fixation, which facilitates earlier return to normal activities. This potential benefit is said to justify the greater cost of the plates. To date, studies comparing the two methods have indicated that locking plates provide improved radiological and/or functional outcomes, particularly in the early stages of rehabilitation.[7,14]

Among the surgical strategies, several authors investigated minimally invasive procedures using Kirschner wire fixation, demonstrating good clinical and radiographic results.[14,15] On the other hand, since the early 2000s, internal fixation with plate and screws has increased in popularity, after some studies highlighted their benefits in both young and elderly patients.[16,17] Results of current study also demonstrated that locking plates provide improved radiological and/or functional outcomes which is comparable with most of the studies.

The main advantages of internal fixation with plate and screws are represented by the anatomical reconstruction of the fragments and articular surface, if the joint is involved. Moreover, it could allow early mobilization of the wrist, reducing the time to restore appropriate range of motion.[18]

The study has few limitations. Difference in DASH score in dominant versus non dominant hand, male versus female, younger age versus older age was not studied. The follow up time was not very appropriate due to study duration limitation. We suggest further studies with more sophisticated study design in order to generate generalizable results.

CONCLUSION

The use of a volar locking plate resulted in better early post-operative function. The volar locking plate achieved better radiographic reduction and measured grip strength. The earlier recovery of function may be of advantage to patients.

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