ORIGINAL ARTICLE

Comparative study between volar locked plates versus closed reduction with percutaneous pinning in management of unstable extra-articular distal radius fractures

Zaid Wajeh Al-Shahwanii,[1] Saher Habeeb Qaryaqos[2]

Abstract

Background: Unstable extra articular fractures of distal radius need operative treatment, either by manipulation and closed pinning by K-wires, or by locked types of plates that give good anatomical restoration.

Objective: To compare the volar locked plate versus manipulation and percutaneous pinning method of fixations for unstable extra articular fractures of distal radius.

Methods: A prospective comparative study was conducted on 26 patients with mean age of 48.42±10.7 years having closed, unilateral, unstable extra articular distal radius fracture according to the one or more of the following criteria; (dorsal displacement ≥20 degrees, metaphyseal dorsal comminution, age ≥60 years , ulnar fracture, initial displacement ≥ 1cm, radial shortening ≥ 5 mm). Patients were divided in two treatment groups, thirteen were fixed with k-wires and thirteen with volar locked plate.

The follow up visit was scheduled after 3 months after surgery to assess the union and functional outcomes using Modified Mayo score and Quick DASH score at 3 months postoperatively and then up to 6th months to assess clinical outcomes and complications for each case.

Results: No significant difference in time of union was observed in both groups, but better functional outcome was seen in the locked plate group compared to the K-wire group.

The total infection rate, was 4(30.76 %) patients for wire group and one (7.70%) patient for plate group, mal-union was seen in 4(30.70%) patients in wire group and one (7.70%) patient in the plate group, tendonitis was encountered in one (7.70%) patient in wire group and 3(23.08%) patients in the plate group. Painful hardware was noted in one (7.70%) patient in the wire group and 2(15.40%) patients in the plate group. Re-operation was required in 2(15.40%) patients in wire group and one (7.70 %) patients in the plate group.

Conclusion: In distal radius extra articular unstable fracture, volar locked plate provides a superior functional outcome, less complications compared to closed percutaneous k-wires pinning.

Keywords: Distal radius fracture, Percutaneous K. wires, Volar locked plate, AO classification of distal radius.

(JPMA 71: S-35 [Suppl. 8]; 2021)

Introduction

Fractures of the distal radius are among the most common fractures seen in emergency department, it is subjected to many different types of fractures depending on multiple factors as age, transfer of energy, mechanism of injury and bone quality. The wrist can suffer substantial ligamentous injury causing instability to the carpus or distal radio-ulnar joint. Colles' is transverse fracture of the radius just above the wrist with dorsal displacement of distal fragment. This is the most common of all fractures in older people, especially postmenopausal women due to osteoporosis and falling on an outstretched hand. The force is applied to the length of the forearm with wrist in extension and the bone gets fractured at the cortico-cancellous junction. The distal fragment collapses into extension with dorsal displacement, radial tilt and shortening, giving a dinner fork deformity.[1-3]

AO classification of distal radius fractures[4] was used in this study. Surgical approaches, to distal radius can be divided into volar, radial, and dorsal. Most distal radial fractures are treated with immobilization after closed reduction; however, surgical interventions may become necessary in those with unstable fractures or when the initial reduction was not acceptable. Lafontaine et al. identified five factors indicative of instability: Initial dorsal angulation of more than 20 degrees, dorsal metaphyseal comminution, and intra-articular involvement, an associated ulnar fracture, patient's age more than 60 years.[5,6]

Patients and Methods

A prospective comparative study was conducted on 26 patients, 13 males and 13 females during the period January 2016 to November 2017. The mean age of the patients was 48.42 ±10.7 years ranging from 32-66 years. The patients

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were selected from either emergency department or outpatient clinic of Al- Yarmook teaching hospital in Iraq-Baghdad. The inclusion criteria was: (skeletally mature subjects, with closed dorsally displaced, unilateral, extra articular AO 23 A distal radius fractures). These patients had acquired acute injuries of a few days duration without any previous manipulation with unstable extra-articular fracture as they had one or more of the following criteria for instability as follows:- dorsal displacement ≥20 degrees, metaphyseal dorsal comminution, age ≥ 60 years, associated ulnar bone fracture, initial displacement ≥1cm, or radial shortening ≥5 mm). The exclusion criteria was any patients with partial articular or intra articular extension (AO type 23 B and 23 C), bilateral fractures, open fracture, pathological fractures, skeletally immature, multiple injuries, diabetes, wrist with arthritic changes in X-ray and those who refused to participate. Patients were divided into two groups by day of presentation (in a ratio of 1:1 into either plate fixation group or k.wire fixation group) assessment of union time, functional outcomes by Quick DASH score and Modified Mayo score at 3rd months postoperatively and to assess clinical outcomes and complications up to six months postoperatively. The main causes of injuries are fall on outstretched hand, 20 (77%) patients, fall from height 3 (11.5%) patients and road traffic accident 3 (11.5%) patients. The hands dominancy in patients was the right in 20 (77%) patients and the left in 6 (23%) patients.

After detecting the patient medically and presence of radiological signs of fracture instability, the patients were prepared for the earliest elective surgery list which was within seven days of presentation.

In the plates group (group one), 13 patients were treated by fixed angle 2.4 mm anatomical volar locked plate, through a 6-8 cm skin incision directly over the FCR tendon. The FCR

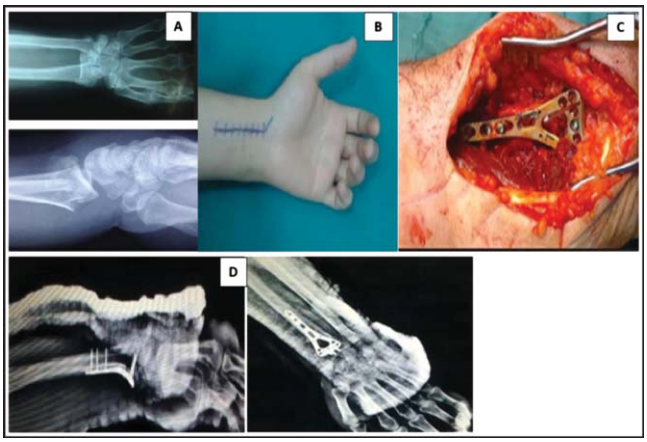

Figure-1: A and B) Pre-operative AP and lateral view X-ray of distal radius extra articular fracture. C) Skin incision marking FCR approach, D) post-op. X-ray with locked plat fixation. (Al Shahwanii, Qaryaqos. Al Yarmook Teaching Hospital 2017).

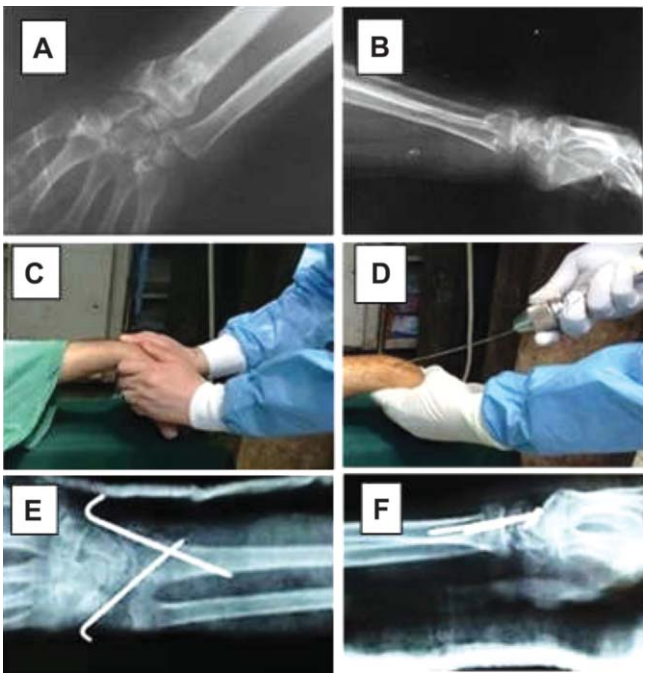

Figure-2: A-B) Pre-operative X-ray, C-D) Closed reduction and percutaneous k.wire fixation, E-F) AP and lateral postoperative X-ray (Al Shahwanii, Qaryaqos. Al Yarmook Teaching Hospital 2017).

tendon was displaced radially with due attention to the relationship to the branch of the radial artery and the superficial palmar arch and then divided the septum between the FCR tendon and the flexor pollicis longus (FPL) tendon distal to the wrist crease. The pronator quadratus muscle (PQ) was visualized and L shaped flap released and reflected, the fat cleared from the volar wrist capsule, the fracture reduced and fixed and the plate placed directly on the bones. The reduction was checked by fluoroscopic aids, the skin closed and dressing done and below elbow back slab placed (Figure-1). In k. wires fixation group; (group two); 13 patients were treated with closed reduction and percutaneous pinning under general or regional anaesthesia (Bier's block, regional block or haematoma block), for closed reduction (traction, dis- impaction and slight flexion with ulnar deviation) was done under fluoroscopic guide and fracture fixed by two crossed k. wires (Figure-2). In Clancy pinning technique wires were placed into the radial styloid and the dorsal ulnar corner of the radius, crossing the fracture site with care to prevent injury to superficial branch of radial nerve, pin was left subcutaneously, dressing and below elbow back slab was applied in both groups. A check X-ray was taken before discharge. The wound was examined on the 10th postoperative day and the stiches removed from plate group and back slab replaced by complete POP for both groups for 6 weeks in order to assure standardization. The k wires and POP were removed from both groups and the

wrist physiotherapy started. The follow up visit was scheduled after 3 months of surgery to assess the union and functional outcomes using Modified Mayo score and Quick DASH score.[7,8] and then up to 6th months to assess clinical outcomes and complications for each case.

Fracture union was determined by the presence of bridging trabeculae on AP and lateral view radiography or by complete obliteration of the fracture line.

Results

There were a total of 26 patients divided in two groups of 13 in the plate group and 13 in the k. wire group with a ratio of 1:1. The mean age of patients in both groups was 48.42±10.7 years, range: 32-66 years. There was no significant difference in demographics of each group regarding age, sex, causes of injuries. All patients were followed up for union and functional outcome by Quick DASH score and Modified Mayo score at 3rd post operatively and for clinical outcomes and complications up to six months post operatively (Table-1 and Table-2).

The study showed that there is significance difference in functional outcomes in 3rd months postoperatively follow-up between two group as the mean Modified Mayo score for plate group was 85.08±5.62 and 77.23±7.85 for k.wire group. The mean Quick DASH score for plate group was 15.08±5.49 and 22±6.36 for k.wire group. The total infection rate both superficial (3 patients) and deep (one patient) was 4(30.76%) patients for wire group and one (7.70 %) patient for plate group, malunion rate was 4 (30.70%) patients for wire group and one (7.70%) patient for plate group, tendonitis was seen in one (7.70%) patient for wire group and 3(23.08%) patients in plate group, painful hardware was encountered in one (7.70%) patient in wire group and 2 (15.38%) patients in plate group. Re-operation was required in 2(15.40%) patients in wire group and in one (7.70%) patient in the plate group.

The mean union time for the wire group was 7.3±0.94 weeks whereas for the plate group it was 7.08±0.86 weeks. No significant difference in time to union between both groups was observed (Table-3).

Table-1: Functional outcomes for k. Wire group at 3 months post-operatively.

Patient No.	Sex	Age years	Site of fracture	Cause of injuries	Quick dash score (44 points)	Modified Mayo score (100 points)
1	Male	46	Right	Fall on outstretched hand	17	80
3	Male	32	Left	Fall on outstretched hand	8	86
5	Male	66	Right	Fall on outstretched hand	22	81
7	Female	33	Right	Fall on outstretched hand	22	70
9	Male	62	Left	Road traffic accident	17	71
11	Male	38	Right	Fall from height	25	80
13	Female	63	Right	Fall on outstretched hand	31	66
15	Female	38	Right	Fall on outstretched hand	18	83
17	Female	36	Right	Fall from height	24	66
19	Male	45	Right	Fall on outstretched hand	26	70
21	Male	56	Right	Fall on outstretched hand	29	80
23	Female	47	Left	Fall on outstretched hand	18	91
25	Female	46	Right	Fall on outstretched hand	29	80

Table-2: Functional outcomes four plate group at 3 months post-operatively.

Patient No.	Sex	Age years	Site of fracture	Cause of injuries	Quick dash score (44 points)	Modified Mayo score (100 points)
2	Male	46	Right	Fall on outstretched hand	12	83
4	Female	45	Left	Fall on outstretched hand	23	78
6	Male	53	Right	Fall on outstretched hand	11	88
8	Female	47	Right	Fall from height	14	85
10	Female	66	Right	Fall on outstretched hand	11	84
12	Female	53	Left	Fall on outstretched hand	10	92
14	Male	41	Right	Fall on outstretched hand	12	87
16	Male	36	Right	Road traffic accident	9	93
18	Female	50	Right	Fall on outstretched hand	13	84
20	Male	64	Left	Fall on outstretched hand	20	78
22	Female	39	Right	Fall on outstretched hand	21	77
24	Male	46	Left	Road traffic accident	14	94
26	Female	65	Right	Fall on outstretched hand	26	83

Table-3: Time to union in both group.

Patients number	Method used	Time to union in weeks
1	Wire fixation	7
2	Plate fixation	7
3	Wire fixation	5
4	Plate fixation	7
5	Wire fixation	9
6	Plate fixation	6
7	Wire fixation	8
8	Plate fixation	8
9	Wire fixation	7
10	Plate fixation	7
11	Wire fixation	7
12	Plate fixation	8
13	Wire fixation	8
14	Plate fixation	9
15	Wire fixation	7
16	Plate fixation	7
17	Wire fixation	7
18	Plate fixation	7
19	Wire fixation	7
20	Plate fixation	6
21	Wire fixation	8
22	Plate fixation	6
23	Wire fixation	8
24	Plate fixation	7
25	Wire fixation	7
26	Plate fixation	7

This proved that the functional outcomes using Quick DASH and Modified Mayo score in early post-operative period was significantly more advantageous in the plate group. It was also observed that volar locked plate gave better results with ROM in the early post-operative period with best Quick DASH and Modified Mayo score and lower malunion, re-operation and infection rate but the cost was higher. There was more pain with tendonitis as it was more invasive, while k. wires is less expensive, less invasive and easy to perform with more risk of malunion, infections, nerve related symptoms and reoperation rate with no significant difference in time to union between two groups.

Discussion

Unstable extra articular distal radius fractures require a precise decision between surgical and non-surgical management.[9] surgical management is preferable as conservative treatment has more complications. However conservative treatment becomes necessary in some selected patients.[10] Lafontaine M et al experienced that the presence of dorsal tilt > 20 degrees, dorsal comminution of distal radius, intra articular involvement, associated ulnar fractures and age > 60 degrees, resulted in secondary displacement of the fractures, even after satisfactory initial reduction by early surgery which helped the patient to gain a significantly good radiological and functional result.[5,6] The studies published by Arora R et al[11] and Zhuang Cui et al[12] showed that radiographic results after unstable distal radius fractures are significantly better in patients treated by ORIF using volar locked plate rather than in patients treated conservatively by cast immobilization, with high rate (89%) of malunion of primary reduced unstable fractures. Our study showed a malunion rate of 7.70% for plate group and 30.70% in k.wire group. Studies by Maire et al[13] and Karantana et al[14] on plate management showed significantly better functional results in early 12 weeks of the post-operative period. Our study had similar results with a better Quick DASH score in early post-operative period in the plate group. The study by Francesco Franceschi and Edoardo Franceschetti[15] showed that in patients undergoing Kirschner wiring recorded a statistically greater number of infections (8.0% versus 2.9%), malunion (2.0% versus 0%) compared to plating group; on the other hand in plating group there was a higher rate of tendonitis and tenosynovitis (1.2% versus 0.03%). Painful hardware was higher in plate group than wires group (3.0% versus 2.8%). Re-operation rate was higher in k.wire group (2.5%), while it was (0.8%) for plate group, which is similar to our results.

Kamano M et al[16] stated that palmer plating system can make fixation of distal radius easy, safe, and effective in treatment of unstable Colles fracture. Oshige T et al[17] concluded that volar locked plate can maintain surgically corrected reduction of unstable distal radius fractures better than intrafocal pinning; also volar locked plate enhances early recovery in range of motion and grip strength compared to intrafocal pinning especially in the older age group. McFadyen's[18] study showed that unstable distal radius fractures across all age groups achieved a superior functional outcome and minimal complications with the volar locked plate technique and advocated that percutaneous pinning was an economical and simple method for management of distal radius fractures. Orbay JL and Fernandez[19] showed that for unstable distal radius fractures, treatment with volar fixed angle plate provides stable internal fixation and allows early function. This technique also minimized morbidity in the elderly population by successful handling of osteopenia by allowing early return to function and provides good final score and is associated with a lower complications rate. The study by Rozental et al[20] showed that both closed reduction with percutaneous pinning fixation and open reduction with internal fixation with use of volar plate are effective methods for the treatment of displaced unstable extra-articular fractures, better functional results in early postoperative period in association with open reduction and internal fixation and this form of treatment should be considered for patients requiring a faster return to function after injury. This study shows better functional outcomes using Quick DASH

and Modified Mayo score in early post-operative period in favour of plate group. This study also shows that volar locked plate results in better ROM in early post-operative period with best Quick DASH and Modified Mayo score and lower malunion, reoperation and infection rate but higher cost, painful hardware and is more invasive. The k. wire used for fracture fixation is cheaper, less invasive and easy to perform but with more risk of malunion, infection and re-operation. There was no significant difference in time to union between the two groups.

Conclusions

The presented study showed that the treatment of extra-articular fractures, volar locked plate achieved superior functional outcome with minimal complications. Fixed angular stability with percutaneous wires was better than closed reduction, along with better ROM in the early post-operative period. There was lower malunion, low risk of reoperation and infection rate, but the procedure was more invasive.

In k. wires close fixation is cheaper, less invasive and easy to perform with more risk of malunion, infection and a higher reoperation rate.

Disclaimer: We the authors have participated in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.

This manuscript has not been submitted to, nor is under review at, another journal or other publishing venue.

We the authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

Conflict of Interest: None.

Source of Support: None.

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