Article

Comparison of Volar Locking Plate versus External Fixation with Additional K-Wires for Displaced Distal Radius Fractures

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ABSTRACT

Background: The most frequent fractures of the upper extremities are distal radial fractures, which account for about one-sixth of all fractures treated in emergency rooms. **Objective:** Comparing the functional, clinical, and radiological results of two distinct fixation methods in patients with displaced distal radial fractures. **Patients and methods:** Over the course of six months, thirty patients with displaced distal radius fractures were treated; fifteen underwent open reduction and internal fixation using a volar-locked plate (group A), and the remaining fifteen underwent external fixator with K-wires augmentation (group B). The Quick DASH Scoring method, radial volar tilt, radial length, and radial inclination are among the radiological parameters were evaluated. **Results:** Volar plating group had better functional outcomes when compared to external fixation group; with median value of 11.2 for the volar plating group as compared to 15 for the external fixation group. There were complications in 5 cases (33.3%) in patients treated with volar locked plates. One case had malunion (6,7%), one patient had stiffness (6.7%), and one patient had carpal tunnel syndrome (6.7%), and one patient had delayed wound healing (6.7%), and one patient had scar hypertrophy (6.7%). There were complications in 6 cases (40%) treated by external fixator group, 3 cases had pin tract infection (20%), two case had stifness (13.3%) and one case (6.7%) had nerve injury. The radiographic results were approximately similar in the two groups regarding radial height, volar tilt and Radial inclination.

Conclusion: Treatment options for distal radius fractures include external fixation enhanced by k wires and volar plating. Comparing volar plating to external fixing, the Quick DASH grading method showed better functional results.

Keywords: Distal Radius Fracture; Volar Locking Plate; External Fixation; K-Wires

Introduction

Among all fractures treated surgically, distal radius fractures account for 16%. There is still disagreement over the best approach to treat this form of fracture, despite its high frequency. The fact that treating distal radius intra-articular fractures is still more difficult than treating unstable extra-articular fractures is a further serious issue [1]. Distal radius fractures are a major issue since they are among the most common fractures in middle-aged and older adults [2-3]. The rise in cases among women over 40 has been particularly notable, which indicates the potential consequences of oestrogen withdrawal and bone loss [4]. However, these fractures are prone to malunion since they are hard to stabilise and decrease [5]. Furthermore, they are likely to cause wrist and hand dysfunction, which is dependent on the alignment of the radius and the location of the carpal and ulnar joints [6]. If such fractures are not properly and anatomically reduced, they may worsen the long-term functional outcome. [7-8].

Volar locking plates (VLP) have become the most preferred treatment for distal radius fractures during the last ten years because of their better biomechanical properties [9-10]. While external fixation (EF) is less common, it was favoured by many surgeons because of its ease of use, enhanced reduction through ligamentotaxis, and satisfactory outcomes. But the increased rate of complications, such as complicated regional pain syndrome, loss of reduction, radial sensory nerve injury, and pin tract infection, should raise concerns [11-12].Therefore, this study aimed to compare the functional, clinical and radiological outcome of two different fixation techniques in patients with displaced distal radial fractures.

Patients and Methods

This study is a comparative prospective study conducted at Helwan university hospitals in a period of one year from the actual start time.This study conducted on 30 eligible patients with displaced distal radius fractures attending the emergency department throughout a period of one year including patients underwent external fixation with additional k-wires and others undergoing volar locking plate. Participants were numbered from 1 to 30 and categorized in 2 groups, each containing 15 patients with ID numbering. **Group (A)** included the Odd number patients, where open reduction and internal fixation by volar plate was done for them. **Group (B)** included the Even number patients, where external fixation augmented by K-wires was done for them.

Inclusion criteria:

Patients aged from 18 to 65 years old. Inta articular and extra articular distal radius fractures. Both genders were included. Fractures not older than 2 weeks.

Exclusion criteria:

Patients with open fractures, aged <18 or >65 years old, and associated forearm fractures were excluded.

Ethical Consideration:

The study was approved by the Academic and Ethical Committee of Helwan University (IRB# 64/2023).

Pre-operative assessment:

All patients were signed an informed consent preoperatively**.** A carefully detailed history was taken. A thorough examination for abrasions or bruises is part of the assessment process. Antero-posterior (AP) and lateral views of the elbow, forearm, and wrist were used for the radiological examination. Radial length, radial inclination, radial volar tilt, and computed tomography (CT) scan were measured both before and after surgery. CBC, coagulation profile, and liver and kidney function tests were among the laboratory tests conducted.

Intra-operative assessment:

The patients were anaesthetized either by General anaesthesia or regional anaesthesia. The patient was positioned in supine decubitus and the forearm was placed on a radiolucent side table. By abducting the shoulder, it is possible for the surgeon and the assistant to sit on either side of the side table. The position of the limb should allow complete imaging in the frontal and sagittal plane of the distal radius. A non sterile pneumatic tourniquet was used. Prophylactic antibiotics were administered according to local microbiological protocols.

- **Surgical technique:**

I- Group (A): Volar plating Approach:

The modified Henry technique was applied to determine the plane between the radial artery and the flexor carpi radialis tendon. A longitudinal cut was made across the tendon of the flexor carpi radialis (FCR). The tendon was located and ulnarly mobilised.In accordance with the skin incision, the floor of the flexor carpi radialis tendon sheath was cut. On the ulnar side, the belly of the flexor pollicis longus muscle was bluntly swept. After rough dissection, the anterior wrist capsule and the pronator quadratus muscle were revealed. Using an L-shaped incision, the distal and lateral borders of the pronator quadratus were released, mobilising it. Subperiosteal dissection was then used to raise it from its bed, revealing the fracture location.

The fracture was reduced and temporarily repaired under C-Arm utilising k-wires following exposure and refreshing of the fracture site. In intra-articular fractures, wires were used to reduce and temporarily fix big pieces. To ensure that the plate size and position, fluoroscopic pictures were acquired. The plate needed to be inserted proximal to the Watershed line on the distal radius. K-wires can be introduced to ensure the position if it is positioned correctly. The image intensifier verifies the plate's position. The plate might be positioned more ulnarly if there was a sagittal plane fracture line in the ulnar side of the distal radius, or more distally to cover the volar fracture line. A screw was placed into the plate's oval non-locking hole, allowing for precise proximal or distal plate position modification. The plate served as a buttress for the remnant of lunate facet.

After applying distal plate fixation to the bone, a 3.5-meter cortical screw was placed into the shaft's oblong hole. Completely seat the screw when the ideal plate position has been reached. Locking screws were used for the remaining screws, and inserted using the appropriate screw insertion procedure. Putting the locking drill guide (2.7 mm) into the screw hole. Using the 3.5 mm depth gauge or the drill bit's calibrations, determine the screw length after drilling with the short 2.7 mm drill bit. Using the 3.5mm screwdriver, insert the screw of the proper length.

Once the ideal plate position has been achieved, a screw is inserted into the plate's oblong hole in the bone shaft. The VA-LCP drill sleeve's funnel-shaped end was used to secure the plate to the bone distally, starting with the most ulnar screw at the appropriate angle. With this funnel-shaped sleeve, the drill bit can be angled up to 15 degrees around the locking hole's centre axis. To prevent articular perforation and to achieve the right screw length, the more ulnar screws can be orientated perpendicular to the plate or even tilted proximal. The image intensifier verified the screw position following each insertion. Instead of a standard lateral view, a 20° inclined lateral view was performed during surgery.

Lateral screw insertion completed the plate's distal fixation. One or two screws were orientated from the volar radial face of the plate in a dorsal and radial direction, provided that adequate angulation of the screws with respect to the plate's longitudinal axis could be accomplished. The screws' 2.4 mm size and orientation enable the capture of a little radial styloid fragment.

Proximally, at least three screws were introduced. The tourniquet was deflated and adequate haemostasis was carried out after verifying reduction, screw lengths, and that no screws were positioned intra-articularly. This was done to avoid post-operative haematoma and swelling, which could impede rehabilitation and increase the risk of postoperative median nerve dysfunction. If it could be fixed, the pronator quadratus (PQ) was fixed over the plate. The PQ was nearly always lacerated by the injury, as is the case with intricate fracture patterns. Both the skin and the subcutaneous layer were sealed off.

Post-operative treatment was described for patients with anti-edematous, with analgesic and antibiotic. Hand elevation and early active fingers and MP exercises were encouraged. First follow up visit after 1 weak for wound care and reassurance, second visit after two weeks postoperatively, then for 6 months. Patients started physiotherapy 2 weeks postoperatively.

II- Group (B): External fixation:

To keep the distal radius in a decreased position, we employed an external fixator that was pinned by K-wires. Restoring radial height through manual traction, reducing radial displacement through some ulnar deviation, and reducing dorsal deviation through volar tilt can be facilitated by placing a sterile pad beneath the radius proximal to the fracture site are all effective methods for reducing distal radius fractures. K-wires were placed percutaneously (with a helper keeping the reduction in place). Wires can be introduced from the dorsoulnar direction towards the volar aspect to hinge the opposing intact cortex, or one or two wires can be inserted from the radial styloid directed proximally towards the opposite intact cortex.

An incision was made on the dorsal radial aspect of the radial shaft using a mini-open technique to reveal the locations of the proximal fixator Schanz screws. Since the superficial branch of the radial nerve (SBRN) is vulnerable to damage during this procedure, it is crucial to locate and safeguard it prior to Schanz screw insertion. The danger of irritating the SBRN can be decreased by inserting proximal Schanz screws between the extensor carpi Radialis brevis and longus. The Schanz screws were pre-drilled and protected with soft tissue before being inserted into the radial shaft. At least two to three centimetres should separate the two proximal pins.

In order to apply the distal Schanz screws, a skin incision was made over the base of the second metacarpal dorsoradially. The skin was then dissected to reach the bone, and two 3 mm Schanz screws were inserted, the proximal of which engaged the base of the second metacarpal and possibly the third metacarpal base 40–60 degrees from the horizontal plane.

To prevent over-traction and joint stiffness, tighten the clamps to the proximal and distal Schanz screws. Then, tighten the rod to one clamp while allowing the other side of the rod to move freely inside the clamp. Allow traction on the distal segment (intercarpal distance equal to radiocarpal distance, guided by an image intensifier). To maintain this position, have an assistant tighten the other clamp. Use basic interrupted sutures to close the wounds.

Along with being requested to do shoulder and elbow mobilisation exercises, the patients were instructed to clean their pin tracts with saline every day. The fingers were urged to move actively. Within a week following surgery, the majority of patients were able to hold objects like a pen or a cup and felt at ease using frames. The external fixator and K wires were taken out six weeks after surgery, and the patients began physical therapy.

Post-operative assessment & Follow up:

After 6 weeks, clinical and radiological evaluation of union were assessed & the patients started physiotherapy regarding the standard Range of motion (ROM) exercises for the wrist and fingers & patients were allowed to do non-loaded activities of daily living, including eating and personal care. At 3 months, full evaluation was obtained and repeated at 6 months after full fracture consolidation. The follow up including Quick DASH scoring (Quick Disability of Arm, Shoulder and Hand Score), ROM (Flexion, extension, radial and ulnar deviation, supination and pronation), and distal radius radiological parameters were performed in both groups.

Statistical analysis:

IBM SPSS, a statistical program version 23 was used. The median and interquartile range (IQR) were presented for non-parametric data, whereas the mean, standard deviations, and ranges were given for parametric data. Numbers and percentages were used to represent qualitative variables. The Chi-square test, Fisher exact test, independent t-test was used. Mann-Whitney test, One Way ANOVA test, Kruskall-Wallis test, and Spearman correlation coefficients were used. A 95% confidence interval and a 5% acceptable margin of error were established. Thus, the following p-value was deemed significant: P-value <0.05 indicates significance (S), P <0.05 indicates non-significant (NS), and P < 0.01 indicates highly significant (HS).

RESULTS

The present study showed a comparison between patients treated with Ex Fix group and those treated with a volar plate. In Ex Fix group, 26.7% of the patients were young, while 33.3% were young in the volar plate group. The proportion of male patients was higher in both groups, with 66.7% in the Ex Fix group and 80.0% in the volar plate group. In the Ex Fix group, 60.0% of patients have an active occupation, compared to 86.7% in the volar plate group. For hand dominance, there was no statistically significant difference between the two groups (P = 0.309). Fall on out stretched hand (FOOSH) is found to be the commonest trauma to produce fracture as in group A (73.3%) and (60%) in group B. The mean operation time was 54.00 m ±12.28 in Volar plating group, in comparison to 36.33 m ±5.16 in Ex Fix group with a statistical significance between groups. The operative times between groups is highly significant suggests that the volar plate procedure takes significantly longer time to perform compared to external fixation **(Table 1).**

Table (1): Relation output of demographic results between two groups:

		Volar plate	Ex fix	Test Value	P-value
		No=15	No=15		
Age groups	Young	5 (33.3%)	4 (26.7%)	2.164*	0.339
	Middle-	10 (66.7%)	9 (60.0%)		
	Old	0 (0.0%)	2 (13.3%)		
Sex	Female	3 (20.0%)	5 (33.3%)	0.682*	0.409
	Male	12 (80.0%)	10 (66.7%)		
Occupation	Active	13 (86.7%)	9 (60.0%)	2.727*	0.099
	Sedentary	2 (13.3%)	6 (40.0%)		
Dominance	RT	15 (100.0%)	14 (93.3%)	1.034*	0.309
	LT	0 (0.0%)	1 (6.7%)		
Affected Hand	Right	7 (46.7%)	7 (46.7%)	1.000	0.000*
	Left	8 (53.3%)	8 (53.3%)		
Trauma	FOOSH	11 (73.3%)	9 (60.0%)	2.533*	0.639
	FFH	1 (6.7%)	2 (13.3%)		
	RTA	1 (6.7%)	3 (20.0%)		
	Motorcycle accident	1 (6.7%)	1 (6.7%)		
	Direct trauma	1 (6.7%)	0 (0.0%)		
Operative Time (min.)	Mean ± SD	54.00 ± 12.28	36.33 ± 5.16	5.137	0.000
	Range	40 – 90	30 – 45		

FOOSH=Fall on outstretched hand, FFH=Fall from height, RTA= Road traffic accident.

For pre-operative flexion, no significant difference was found between the groups, however, post-operative flexion showed a trend towards greater improvement in the Volar Plate group, (p=0.08). This indicates similar outcomes in extension range across both treatment methods. Similarly, ulnar and radial deviations exhibited no significant differences pre- and post-operatively. Supination and pronation showed no significant differences in both groups.

Supination measurements were identical pre-operatively, with a p-value of 0.98, and no significant difference post-operative (p= 0.52). Both approaches result in similar range of motion outcomes indicates the choice of treatment method does not appear to significantly influence the range of motion outcomes **(Table 2).**

The average pre-operative radial height is 5 ±0.5 mm for both groups, and the post-operative values are 10± 1 mm for Group A and 10.5 ± 0.75 mm for Group B with no significant differences, and p-values of 0.99 and 0.61, respectively. Pre-operative inclination of 11.5±0.75°, and post-operatively, Group A was 21±1and Group B was 20.5±0.75°. The p-values were 0.98 and 0.81 for pre- and post-operative inclination confirm the lack of significant differences. Pre-operative volar tilt measurements are identical at 4 ± 0.5° for both groups, and post-operative values are 10 ± 0.5° for Group A and 9.3±0.5° for Group B. Regarding step off, Group A has a lower average step off of 0.5±0.25 mm compared to Group B (1 ± 0.5 mm) Post-operatively. The average time of union is slightly shorter for Group A, with an average of 8.5 ± 0.75 weeks, compared to 10 ±1 week for Group B. Although the p-value of 0.091 suggests a trend towards significance, it does not meet the 0.05 level required for statistical significance **(Table 3)**.

Table (2): Relation output of range of motion between two groups:

Range of Motion	Group A (Volar Plate)	Group B (Ext. Fix)	Test value	P-value
Flexion (pre) *"min-max (Mean ± SD)*	10° - 20° (15° ± 2°)	10° - 20° (15° ± 2°)	1.091	0.290
Flexion (Post) *min-max (Mean ± SD*	55° - 70° (62.5° ± 7.5°)	45° - 65° (55° ± 10°)	2.81	0.08
Extension (pre) *min-max (Mean ± SD*	0° - 20° (10° ± 1°)	0° - 20° (10° ± 1°)	1.08	0.99
Extension (post) *min-max (Mean ± SD)*	45° - 65° (55° ± 5°)	40° - 60° (50° ± 5°)	2.18	0.61
Ulnar deviation (pre) *min-max(M ± SD)*	0° - 15° (7.5° ± 3.5°)	0° - 15° (7.5° ± 3.5°)	1.90	0.89
Ulnar deviation (post) *min-max (M ± SD)*	20° - 45° (32.5° ± 5°)	20° - 45° (32.5° ± 5°)	2.09	0.99
Radial deviation (pre) *min-max (M ± SD)*	0° - 10° (5° ± 1.5°)	0° - 10° (5° ± 1.3°)	1.98	0.97
Radial deviation (post) *min-max (M ± SD)*	10° - 20°(15° ± 2°)	10° - 20° (15° ± 2°)	2.02	0.88
Supination (pre) *min-max (M ± SD)*	10° - 30°(20° ± 10°)	10° - 30°(20° ± 10°)	1.01	0.98
Supination (post) *min-max (M ± SD)*	45° - 75°(60° ± 6°)	45° - 65° (55° ± 5°)	1.94	0.52
Pronation (pre) *min-max (Mean ± SD)*	10° - 20° (15° ± 2°)	10° - 20° (15° ± 2°)	1.76	0.78
Pronation (post) *min-max (Mean ± SD*	50° - 80° (65° ± 15°)	45° - 70° (57.5° ± 12.5°)	2.87	0.72

Table (3): Comparison of Radiological parameters between two groups:

Parameter	Volar Plate Group (A)	Ext. Fix Group (B)	Test of sig	P value
Radial height pre	4-6 mm (5 ± 0.5 mm)	4-6 mm (5± 0.5 mm)	1.922	0.99
Radial height post	8-12 mm (10 ± 1 mm)	9-12 mm (10.5 ± 0.75 mm)	2.109	0.61
Radial inclination pre	10-13° (11.5 ± 0.75°)	10-13° (11.5 ± 0.75°)	1.170	0.98
Radial inclination post	19-23° (21 ± 1°)	19-22° (21.5 ± 0.75°)	1.289	0.810
Volar tilt pre	3-5° (4 ± 0.5°)	3-5° (4 ± 0.5°)	2.211	0.99
Volar tilt post	9-11° (10 ± 0.5°)	8-11° (9.3 ± 0.5°)	1.920	0.78
Step off pre	3-5 mm (4 ± 0.5 mm)	3-5 mm (4 ± 0.5 mm)	2.85	0.99
Step off post	0-1 mm (0.5 ± 0.25 mm)	0-2 mm (1 ± 0.5 mm)	-2.98	0.087
Time of union	7-10 w (8.5 ± 0.75 w)	8-12 weeks (10 ± 1 w)	-1.91	0.091

Group A has an average Quick DASH score of 11.25 ± 4.375, whereas Group B has a higher average score of 15 ± 6 with p-value of 0.061 indicates that the Ex FixGroup may experience more disability or discomfort in the arm, shoulder, and hand compared to the Volar Plate Group with no significant difference **(Table 4)**.

Group B showed a higher occurrence of stiffness in 13.3% of patients, compared to 6.7% in Group A. This suggests that external fixation associated with post-operative joint or soft tissue stiffness. Carpal tunnel syndrome was only observed in Group A (6.7%), this difference might be linked to the volar plating technique's proximity to nerve structures, increasing the risk of nerve compression syndromes. A significant finding is the higher rate of pin tract infections in Group B (20%), which was expected due to the nature of external fixation involving pins that penetrate the skin. scar hypertrophy observed only in Group A (6.7%) due to the required surgical incision for plate placement, resulted in scar tissue formation. One case of delayed wound healing (6.7%) in Group A. However, nerve injury occurred in Group B (6.7%) indicates a possible risk of nerve complications with external fixation devices. Group A had one case of malunion (6.7%), with the affected patient being diabetic and presenting poor radiological alignment during follow-up, potentially contributing to this outcome **(Table 5)**.

Table (4): Comparison of Functional Outcome between two groups

Parameter	Volar Plate Group (A)	Ext. Fix Group (B)	Test of sig	P value
Quick DASH score	2.5-20 (11.25 ± 4.375)	3-27 (15 ± 6)	2.13	0.061

Table (5): Relation output of complications between two groups

Complication	Volar Plate Group (A)	Ext .Fix Group (B)	Test of sig	P value
Not Complicated	10 (66.7%)	9 (60%)	2.091	0.92
Complicated	5 (33.3%)	6 (40%)		
Stiffness	1 (6.7%)	2 (13.3%)		
Carpal tunnel syndrome	1 (6.7%)	0 (0%)		
Pin tract infection	0 (0%)	3 (20%)		
Scar hypertrophy	1 (6.7%)	0 (0%)		
Delayed wound healing	1 (6.7%)	0 (0%)		
Nerve injury	0 (0%)	1 (6.7%)		
Malunion	1 (6.7%)	0 (0%)		

A 39 years old male hypertensive patient from Volar Plate Group (A) with RTA history, intact neurovascular, with right dominant distal radius fracture for fixation by polyaxial plate. Clinical scores were (Flexion: 70, Extension: 60, Radial deviation: 10, Ulnar deviation: 35, Supination: 75, pronation: 70, Radial inclination: 20, Radial height: 11, Volar tilt: 10, Articular stepoff: 0.8, and QDASH: 4.5) **(Figure 1)**.

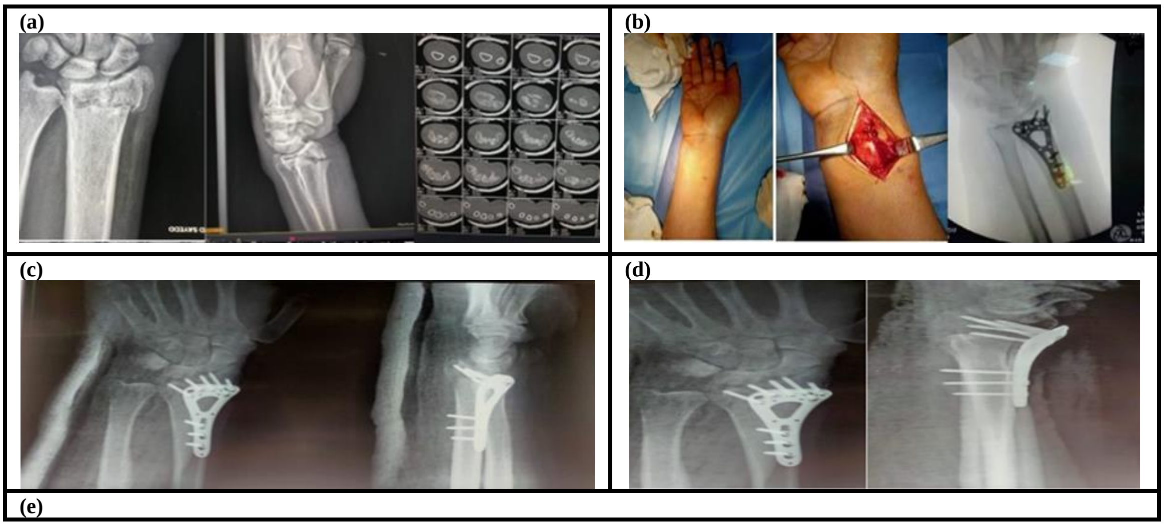

Figure (1): A 39 years old male patient with right dominant distal radius fracture for fixation by polyaxial plate; (a) preoperative x-ray and CT; (b) intraoperative photos; (c) 1 week postoperative; (d) 6 months post-operative; and (e) post-operative ROM.

A 46 years male patient from Ext. Fix Group (B) with history RTA, the patient is smoker, intact neurovascular, with left non dominant comminuted distal radius fracture for external fixator and k-wires. Clinical scores were (Flexion: 60, Extension: 75, Radial deviation: 15, Ulnar deviation: 20, Supination: 75, pronation: 65, Radial inclination: 18, Radial height: 8, Volar tilt: 6, Articular stepoff: 1.2, QDASH: 11.5) **(Figure 2)**.

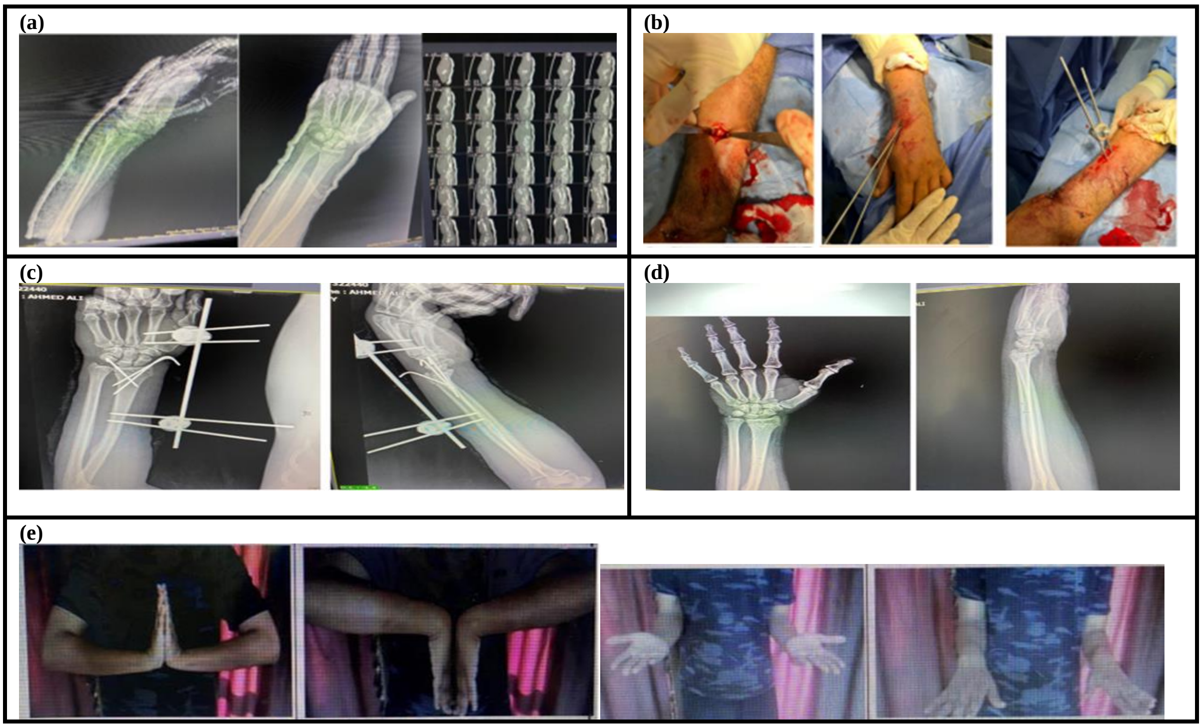

Figure (2): A 46 years male patient with left non dominant comminuted distal radius fracture for external fixator and k-wires; (a) preoperative x-ray and CT; (b) intraoperative photos; (c) 1 week postoperative; (d) 6 months post-operative; and (e) post-operative ROM.

Discussion:

Fractures of the distal radius are among the most common injuries. They are usually caused by high-energy trauma in young people and low-energy trauma in the elderly. The primary goal of current treatment is to restore the bone structure of the distal radius (radial inclination, radial length, and volar tilt), with an emphasis on rebuilding the articular surfaces of the radiocarpal and radioulnar joints [13].

Over the past decade, the volar locking plate (VLP) has emerged as the most widely used treatment for distal radius fractures because of its exceptional biomechanical qualities [9,10]. Although external fixation (EF) is less common, many surgeons have chosen it because it is easy to use, enhances reduction by ligamentotaxis, and yields satisfactory results. Nevertheless, the increased risk of complications, including pintract infection, loss of reduction, and radial sensory nerve injury, should raise concerns [11,12].

In this study, thirty patients had comminuted distal radial fractures; fifteen of these were treated with open reduction and internal fixation with a volar plate, and the remaining fifteen were treated with external fixation assisted by K-wires. The affected patients were between the ages of 18 and 65. Six months was the follow-up period for our inquiry. This time frame was enough to assess our patients' results, as **Yu et al.** [14] shown that distal end radius fractures recover most of their grip strength and range of motion within six months

According to **Schreiner et al.** [15], surgeons are limited by uncertain factors such as the angle of the fracture line or overlapping fracture patches, which often leads to long operation time, excessive blood loss, and uneven joint surface, resulting in increased incidence of postoperative complications and also have an impact on surgeon’s preference on selection of management.

Several studies support our findings, including **Yu et al.** [14] and **Sharma et al.** [16]. The mean operative time was 54.00 minutes ±12.28 in the Volar plating group, compared to 36.33 minutes ±5.16 in the External fixation group. The mean operative time was statistically significant and was lower in the external fixation group (Range: 30-45 min) than in the volar plate group (Range: 40-90 min).

Egol et al. [17] compared the effects of external fixation (38 patients) and volar plating (39 patients) and found that the former improved wrist range of motion statistically significantly in the early stages, but that this benefit waned over time and that the difference in range of motion was clinically insignificant. **Rozental et al.** [18] compared the effects of external fixation (22 patients) and ORIF (23 patients) in treating distal radius fractures, and found that the volar plating group initially showed improved wrist motion and grip strength. However, both procedures restored wrist function well one year after surgery. At the end of the follow-up period, the objective range of movement in each direction was measured, and we discovered that there was little difference between the two treatments.

Kreder et al. [11] compared ORIF (91 patients) to external fixation (88 patients) showed no significant difference in the radiological restoration of anatomical features between the groups. **Wei et al.** [19] compared the radiological results in 46 patients which randomized to be treated with augmented external fixation (22 patients) and ORIF (24 patients). There were no significant differences in radial inclination, volar tilt, ulnar variance, radial length, and step-offs with gaps between the two methods of fixation. **Drobetz et al.** [20] revealed that ORIF group and external fixation group gave the same radiographic values.

When the radiological outcomes were compared, there were insignificant difference in radial height and radial inclination between External Fixation (10.5 and 21.5) and Volar plating (10 and 21), respectively. Similarly **Duramaz et al.** [21] found that EF was more effective at correcting radial length and radial inclination; however, this did not affect functional outcomes during the 2-year follow-up. K-wire supported External Fixation may be successful, particularly in very distally located comminuted fractures that do not permit the placement of screws.

Nevertheless, EF should be removed after a certain amount of time and cannot stabilise the fracture as rigidly as VLP, it might not be able to withstand the collapse of the fracture. **Dicpinigaitis et al.** [22] reported that volar plating was higher than external fixation in correcting volar angulation and afforded enough support via subchondral distal locking screws for 12 months or more. By comparison, loss in volar angulation would continue after removal of the external fixator, from 0.9° at immediate surgery to 4.2° at 6 month follow-up. However **Yu et al.** [14] did not observe a significant difference of volar tilt value between the two groups at the final follow up.

The volar tilt was better corrected in our study by volar plating (10 ± 0.5°) than external fixation (9.3 ± 0.5°) but with no significant value. In a retrospective cohort of 115 patients with AO type C2/C3 fractures; **Richard et al.** [23] demonstrated the better DASH score and more improved pronation/supination arc in VLP group at postoperative 12 months. **Williksen et al.** [24] compared between Volar plating (52 patients) and external fixation (59 patients) and patients with volar locked plates had a higher Mayo wrist score (90 vs 85) and better supination (89° vs 85°) at 52 weeks compared to external fixation group.

Ludvigsen et al. [25] compared between volar plating (69 patients) and external fixation (73 patients) and demonstrated that the Quick DASH score was better in the VLP group than in the EF group at 6 weeks and 3 months but no longer at 1 year.

In our study, volar plate group patients had better functional outcomes in Quick DASH score (11.2 ± 4.3) vs (15 ± 6) when compared to external fixation group patients. But that didn't differ significantly (P value>0.05). Volar plating had an overall decreased incidence of complications compared with external fixation; generally, five cases were reported complicated in 15 patients treated by volar plating in comparison to sex cases in 15 patients treated by external fixation in which 3 patients had postoperative pin tract infection (20%). These results are in concordance with most of the prior studies, which have tended to show less complications in patients treated with ORIF as in **Abramo et al**. [26] study which reported 14 complications in 26 patients treated with ORIF and 20 complications in 24 patients treated with external fixation.

Grewal et al. [27] reported 7 complications in 29 patients treated with ORIF and 8 complications in 33 patients treated with external fixation. **Kreder et al.**[11] reported 11 complications in 91 patients treated with ORIF and 13 complications in 88 patients treated with external fixation. **Wilcke et al.** [28] reported 7 complications in 33 patients treated with ORIF and 12 complications in 30 patients treated with external fixation and **Williksen et al.** [24] reported 15 complications in 52 patients treated with ORIF and 18 complications in 59 patients treated with external fixation.

On the other hand, some studies showed higher incidence of complications in ORIF patients than external fixation patients, which is different than the results of the current study, as in **Navarro et al.** [29] study which reported 35 complications in 69 patients treated with ORIF and 29 complications in 65 patients treated with external fixation and **Egol et al.** [17] study which reported 8 complications in 39 patients treated with ORIF and 7 complications in 38 patients treated with external fixation.

Nerve injury was observed in one patient (6.7%) of the ORIF group (in the form of median nerve neuropathy) and was found in one patient (6.7%) in external fixation group (in the form of superficial radial nerve injury). The median nerve is most commonly affected nerve because of its close proximity to the fracture and its confinement within the carpal canal, followed by the radial and the ulnar nerves. It is difficult to ascertain if the neuropathies involving the median nerve were the result of the initial injury or the effect surgical procedure. The incidence of this complication can be reduced by avoiding immobilization in excessive wrist flexion and ulnar deviation (Cotton-Loder Position). **Liu et al.** [30] reported that median nerve dysfunction was the most common complication (9%), occurring in nine patients out of 92 patients with distal radius fracture treated by ORIF using a volar locked plate**.** The incidence of median nerve complaints was found to be 22% in 236 individuals who had various forms of treatment [31]. In 60 patients with conservatively treated distal radius fractures, **Bienek et al.** [32] found a 20% incidence of carpal tunnel syndrome, with symptoms typically appearing 10 months after the injury.

Only one patient (6.7%) in the ORIF group had stiffness, compared to two patients (13.3%) in the external fixation group.The majority of earlier research on radiological and functional outcomes [22–27]. Only three patients (20%) in the external fixator group had a pin tract infection, whereas the ORIF group did not have any infections. The use of antibiotics and regular pin site care helped to eradicate this illness. This incidence was in line with other research, such as the study by **Abramo et al.** [26] who found that 26 patients treated with ORIF had no infection cases, while 24 patients treated with external fixation had three cases.

Egol et al. [17] found one infection case among 39 patients receiving ORIF treatment and two infections among 38 patients receiving external fixation. 29 patients treated with ORIF had no infection, but 33 patients treated with external fixation had two cases, according to **Grewal et al.** [27]. Eight occurrences of infection were reported in 26 individuals treated with external fixation, while 27 patients treated with ORIF experienced no infection. **Wilcke et al. [28]** observed that 30 patients receiving external fixation experienced 4 incidences of infection, while 26 patients using ORIF experienced no infection.

Karantana et al. [33] reported 2 case of infection in 66 patients treated with ORIF and 5 cases of infection in 64 patients treated with external fixation. **Kreder et al.** [11] reported 5 case of infection in 91 patients treated with ORIF and 9 cases of infection in 88 patients treated with external fixation. **Navarro et al.** [29] reported no case of infection in 69 patients treated with ORIF and 2 cases of infection in 65 patients treated with external fixation. **Rozental et al.** [18] reported no case of infection in 23 patients treated with ORIF and 3 cases of infection in 22 patients treated with external fixation. **Williksen et al.** [24] reported no case of infection in 52 patients treated with ORIF and 6 cases of infection in 59 patients treated with external fixation.

Conclusion:

Treatment options for distal radius fractures include external fixation enhanced by k wires and volar plating. Although external fixation still plays a big part in treating distal radius fractures, many surgeons now treat some kinds of these fractures differently thanks to ORIF with locked volar plating.

Comparing volar plating to external fixing, the Quick DASH grading method showed better functional results. In contrast, the two groups' ROM data were comparable. Early wrist motion initiation and certain radiological results, such as preserving radial height and enhancing articular congurance, were better achieved with volar plating.

Complications were less common with ORIF than with external fixation. Compared to external fixation, ORIF permits early postoperative range-of-motion exercises because to its more stable construction and superior anatomical reduction of fracture pieces. In contrast to external fixation, ORIF had a shorter union period.

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