

Evaluation of Distal Radius Fractures in Adults Using Kirschner Wires among Zagazig University Hospitals

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ABSTRACT

Background: The use of closed reduction and percutaneous K-wires, with or without external fixation, is a common surgical solution for patients with an unstable distal radius fracture. **Objective:** To detect effectiveness of K-wiring as an efficient method for treating distal radius fractures in adults and elderly in Zagazig University Hospitals. **Patients and Methods:** At Orthopedic Departments of Zagazig University Hospitals, 24 cases with distal radius fractures were treated by percutaneous K-wiring with six months follow-up. **Results:** Most of the participants met the Mayo wrist score criteria in 13 of the cases where they were evaluated clinically as outstanding. One patient had Sudeck atrophy, seven patients had superficial skin infection, and two patients had stiffness. **Conclusion:** In adults and the elderly, distal radius fractures can be effectively treated by percutaneous K-wiring. The surgery is safe, has a low rate of complications, and requires only a brief stay in the hospital. By sticking to the fundamental principles and technical features, most of the complications can be avoided.

Keywords: Distal radius fractures, Kirschner wires.

INTRODUCTION

Fractures of the distal radius are prevalent in adults, especially in those who are white and older and live in high-income nations⁽¹⁾. Starting about age 40, women are more likely to suffer from these fractures. For guys younger than this, the prevalence is higher⁽²⁾.

A fall on outstretched arms or direct impact to the distal radius can cause the injury. In most cases, wrist abnormalities and impairment result from a fracture in an abnormal posture⁽³⁾. It is common for young individuals to suffer a comminuted fracture of the distal end of the radius, while elderly patients are more likely to have a fracture of this type due to low-energy trauma⁽⁴⁾.

In order to better manage fractures, surgeons have categorised them according to their anatomical configuration or fracture pattern. Radio-carpal and radio-ulnar joint fractures can be classified using the Frykman classification system, which explains whether or not a distal ulnar fracture is present⁽⁵⁾. Open reduction and casting, closed reduction and percutaneous pinning, and others are among the treatment options accessible to orthopedic surgeons for distal radius fractures⁽⁶⁾.

Open reduction and external fixation, as well as open reduction and internal fixation with implants like screws, plates or screws with locking plates, are further treatment options⁽⁶⁾. The use of closed reduction and percutaneous K-wires, with or without external fixation, is a common surgical solution for patients with an unstable distal radius fracture⁽⁷⁾.

The K-wire fixing is inexpensive and less intrusive. Osteopenic bone was successfully handled by this treatment, which permitted early return to work, satisfactory final results, and a low complication rate in the older population⁽⁸⁾. The main complications of this technique will be pin loosening, pin tract infection at the skin entry point, loose of reduction, carpal tunnel syndrome, and radial nerve injury⁽⁹⁻¹¹⁾.

It was the goal of this study to detect effectiveness of K-wiring as an efficient method for treating distal radius

fractures in adults and elderly in Zagazig University Hospitals.

PATIENTS AND METHODS

At Orthopedic Departments of Zagazig University Hospitals, 24 cases with distal radius fractures were treated by percutaneous K-wiring in prospective research.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee (ZU-IRB#8025). Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria: Patients included were older than 18 years and of both sexes, patients with distal radius fracture for 2 weeks post injury, and when acceptable reduction was obtained by closed method.

Exclusion criteria: Patients below 18 years old, failure to achievement of acceptable reduction by closed methods, previous wrist deformity, intra-articular fractures, and associated ulna fracture proximal to the ulnar styloid of the same wrist.

Primary management: Careful history taking was done for all patients as follows:

1. Full personal history: name, age, sex, occupation, and dominant side.
2. Past history: details of previous disease or injury to the affected wrist.
3. Mechanism of injury: fall on outstretched hands, road traffic accident, direct trauma, or others.
4. Clinical examination: throughout examination of ipsilateral elbow and shoulder. Neurological examination: median and ulnar nerves, and vascular examination: capillary refill.

Thirteen patients (type I), seven patients (type II), three patients (type III), and one patient (type IV) were all classified according to the Frykman classification in this study.

Radiological Assessment:

All patients had their wrist joints radiographically analysed for radial length, radial inclination, and volar tilt using anteroposterior and lateral plain radiographs.

Preoperative preparation:

- First aid treatment as analgesia, closed reduction and slab.
- Preoperative testing was performed on all patients, including a complete blood count, liver as well as kidney functions.

Surgical technique:

- Prophylactic IV antibiotics were given immediately before operation
- Under general or local anesthesia without using tourniquet.
- All patients were treated by using two to three K-wires fixations under image intensified fluoroscopy control.

Steps of surgery:

Under general or local anesthesia, the procedure was performed using a completely sterile environment. On a radiolucent table, the patient was placed in a supine posture. Rotation of an image intensifier allowed for anteroposterior and lateral views of the distal radius and distal radioulnar joint to be obtained. Preparing the entire forearm for surgery included the wrist and elbow joints as well. Extensive external manipulation and traction were used until appropriate reduction was achieved by reinforcing the proper position of the radius and the volar tilt, which was validated by fluoroscopy (Figure 1). By raising palmar angle, and then with traction applied, distal fragment was moved distally to diminish the dorsal cortex by reducing its impact.



Figure (1): Reduction and dis-impaction of the fracture.

The radial styloid tip was incised by a 1 cm incision. This procedure involved a blunt dissection of the radial

styloid, which was done with extreme care to avoid injuring any of the extensor compartments' tendons.

The K-wire was gently inserted with a power drill after the reduction and anticipated direction of the K-wire have been checked using intensification. The K-wire should only reach the radial shaft's opposing cortex.

Control of the distal fragment may need to be taken into consideration when inserting the initial K wire. By inserting two K-wires one through the radial styloid and one between the fourth and fifth extensor compartments in this fashion, but in the opposite direction (Figures 2 and 3).



Figure (2): First K-wire introduction from radial styloid.



Figure (3): Second K-wire introduction from radial styloid.

The third K-wire was inserted into the anterior cortex of the radial shaft from the dorsoulnar rim of the radius under image intensifier control. Using an image intensifier, the reduction in fracture size and proper placement of the wires were both validated. The wires were cut and bent at the ends. As a precaution against pin track infection, the ends might be left in the skin's surface. An above-elbow cast and sterile wound irrigation were used (Figure 4).

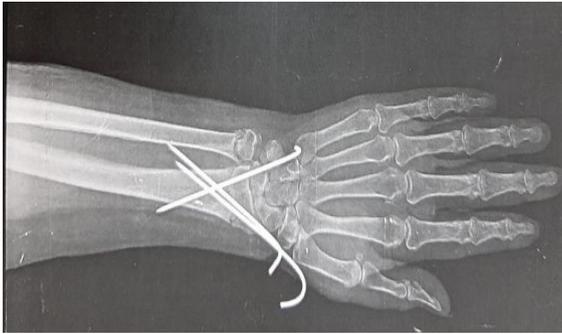


Figure (4): Confirmation of reduction and K-wires by image intensifier.

Functional assessment and outcome: All patients were functionally assessed on the basis of Mayo Wrist score⁽¹²⁾.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS), version 20, was used to execute analyses on the data collected. The mean, median, standard deviation and range were used to summarise the quantitative data. Qualitative data were expressed as frequency and proportions and were compared by Chi-Square test or Monte Carlo test. Quantitative data were examined for normality by using the Kolmogorov-Smirnov test and were compared by t-test when normally distributed and by Mann-Whitney test when abnormally distributed. P value < 0.05 was considered significant.

RESULTS

The characteristics of the studied patients are shown in table 1.

Table (1): Characteristics among studied group

	N=24	%
Age (year):		
Mean ± SD	41.5 ± 13.48	
Range	25 – 66	
Sex:		
Female	13	54.2
Male	11	45.8
Side:		
Left	9	37.5
Right	15	62.5
D	15	62.5
Non-D	9	37.5
AO fracture classification:		
A2	19	79.2
A3	4	16.7
B1	1	4.2
Frykman classification:		
I	13	54.2
II	7	29.2
III	3	12.5
IV	1	4.2
Medical disorder:		
No	19	79.2
DM	1	4.2
HPN	3	12.5
DM and HPN	1	4.2

Statistically, there was no correlation between Mayo wrist score and the time till union (Table 2).

Table (2): Relation between the score and time till union of the studied patients

Parameter	Groups			P
	Excellent	Good	Fair	
	N=13 (%)	N=6 (%)	N=5 (%)	
Time				
5 weeks	5 (38.5)	2 (33.3)	0 (0)	0.265
6 weeks	8 (61.5)	4 (66.7)	5 (100)	

The postoperative increase in radial length relative to the preoperative level was statistically significant (Table 3).

Table (3): Change in radial length pre and postoperatively among the studied patients

	Median	Range	P
Preoperative	2 mm	-1 – 9 mm	<0.001**
Postoperative	9.5 mm	8 – 11 mm	

Postoperatively, the radial inclination was statistically significantly higher than preoperatively (Table 4).

Table (4): Change in radial inclination pre- and postoperatively among the studied patients

	Mean ± SD	Range	P
Preoperative	15.04° ± 3.86	5°– 20°	<0.001**
Postoperative	20.83° ± 0.87	20°– 22°	

Postoperatively, the volar tilt was statistically significantly higher than preoperatively (Table 5).

Table (5): Change in volar tilt pre and postoperatively among the studied patients

	Median	Range	P
Preoperative	-14°	-40– 0°	<0.001**
Postoperative	9°	7– 10°	

Thirteen patients (54.2%) were excellent regarding Mayo wrist score clinical assessment (Table 6).

Table (6): Clinical outcome according pain, functional status, ROM, grip strength and Mayo wrist score distribution among studied group

	Mean ± SD	Range
Pain	19.38 ± 3.06	15 – 25
Functional status	20.63 ± 3.06	15 – 25
ROM	22.5 ± 4.17	15 – 25
Grip strength	22.08 ± 4.4	15 – 25
Mayo wrist score:	N=24	%
Excellent	13	54.2
Good	6	25.0
Fair	5	20.8
Poor	0	0

There was significant association between Mayo wrist score and medical disorders. Among five patients with fair score, two only had no comorbidities, one had HTN, and one had both diabetes and HTN (Table 7).

Table (7): Relation between Mayo wrist score and medical disorder of the studied patients

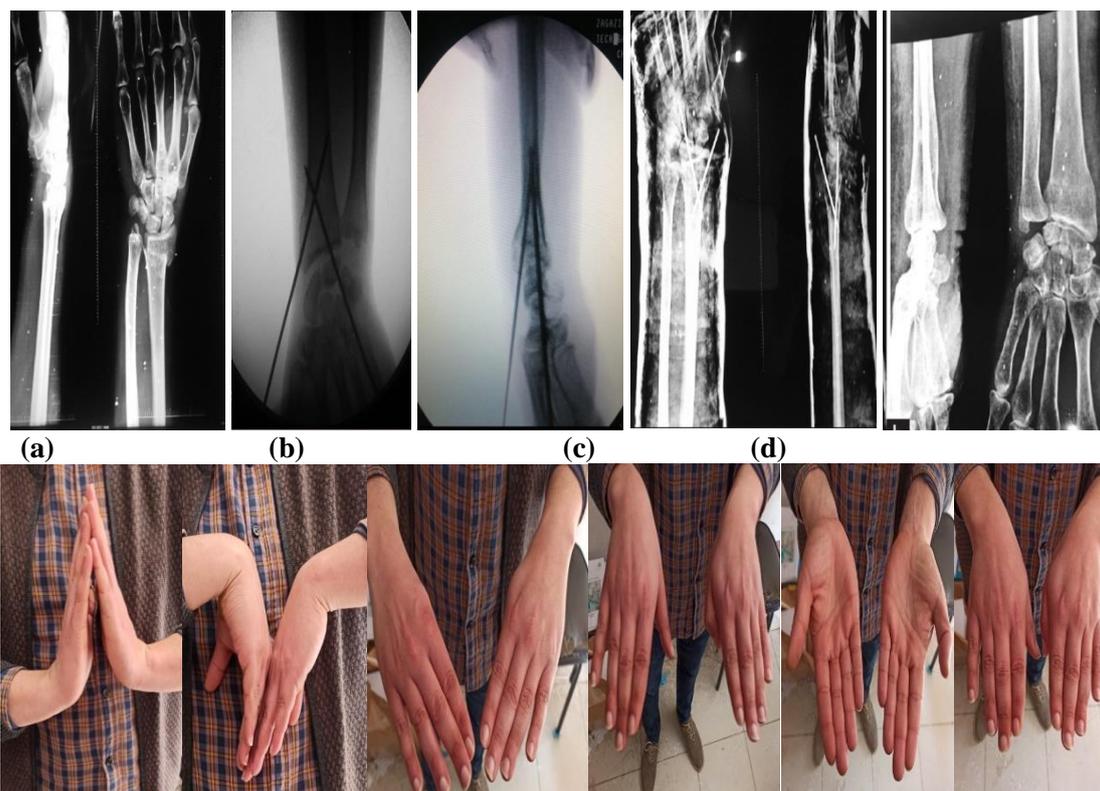
Parameter	Mayo wrist score			p
	Excellent	Good	Fair	
	N=13 (%)	N=6 (%)	N=5 (%)	
Medical disorder:				0.042*
Free	12 (92.3)	5 (83.3)	2 (40)	
Diabetes	0 (0)	0 (0)	1 (20)	
Hypertension	1 (7.7)	1 (16.7)	1 (20)	
Diabetes+ HTN	0 (0)	0 (0)	1(20)	

There was statistically non-significant relation between score and either tendon injury, superficial infection, or Sudeck's atrophy. There was statistically significant relation between score and stiffness. Stiffness occurred in 40% of those with fair score (Table 8).

Table (8) Relation between score and complications of the studied patients

Parameter	Groups			p
	Excellent	Good	Fair	
	N=13 (%)	N=6 (%)	N=5 (%)	
Tendon injury				1
No	13 (100%)	6 (100%)	5 (100%)	
Yes	0 (0)	0 (0)	0 (0)	
Superficial infection:				1
No	9 (69.2%)	4 (66.7%)	4 (80%)	
Yes	4 (30.8%)	2 (33.3%)	1 (20%)	
Sudek's atrophy:				0.25
No	13 (100%)	6 (100%)	4 (80%)	
Yes	0 (0%)	0 (0%)	1 (20%)	
Stiffness:				<0.001**
No	13 (100%)	6 (100%)	3 (60%)	
Yes	0 (0%)	0 (0%)	2 (40%)	

Figure 5 shows the result of the operation in one patients 4 months postoperatively.



(e) Clinical photo of wrist flexion, extension, radial deviation, ulnar deviation, supination and pronation after 4 months.

Figure (5): A thirty four years old male presented with closed fracture of the left distal radius (type I) according to Frykman classification and A2 according to AO classification. The trauma was due to road traffic accidents (RTA). Surgery was performed on the same day by closed reduction and fixation using two K-wires under general anesthesia. The fracture was united after 6 weeks. The final functional and clinical outcome was excellent for this patient according to Mayo wrist score.

DISCUSSION

Pain, mid-carpal instability, and arthritis are all symptoms of distal radius fracture mal-union. Radial distal end fractures that are just slightly displaced and stable can be treated conservatively in elderly patients with satisfactory results, while treatment of fractures that are significantly displaced and unstable is debatable at this time. Patients with substantial radial shortening have poor functional outcomes⁽¹³⁾.

Recent advances in the treatment of distal radius fractures have resulted from a greater understanding of pathological anatomy, injury mechanisms, and innovative implant technologies. For the distal radius fracture, the goal of therapy was to restore the wrist's anatomy such that it could be used without pain. There are several treatment options for treating distal radius fractures, including closed reduction and immobilisation with a cast or splint, percutaneous pin fixation, external fixation, volar locking plates, and intramedullary nails⁽¹⁴⁾. Percutaneous Kirschner wires (K-wires) fixation with plaster immobilisation is one of the most prevalent treatment options for distal radial fractures⁽¹⁴⁾.

Adults with distal radius fractures were evaluated in this study to see if percutaneous pinning could help treat them. It involved 24 patients with distal

radial fracture at Zagazig University Hospitals with a mean age 41.5 ± 13.48 years.

There were 13 females (54.2%) and 11 males (45.8%) with a female predominance. In way of comparison to our findings, **El-Adawy et al.**⁽¹⁴⁾ found that patients' ages ranged from 18 to 63, with a mean of 45 years; 56 (80%) patients were between the ages of 20 and 50, while 14 (20%) patients were between the ages of 50 and 63. 40 patients (57.14 percent) were men, and 30 (42.855 percent) were women in the total.

According to AO classification, most patients in this current study were classified as A2 (79.2%), with A3 (16.7%), and B1 (4%) being the other two classifications that were seen. To put this in perspective, consider the findings of **El-Adawy et al.**⁽¹⁴⁾ who found that all 70 of the patients in their research had closed distal radius fractures, with 40 having A2 fractures, 26 having A3 fractures, and four having B1 fractures, all according to the AO classification. **Jirangkul et al.**⁽¹⁵⁾ conducted another investigation in which the preoperative radiographs identified fractures as B2 in 5.26 percent of cases, B3 in 17.5%, C1 in 56.14 percent, and C2 in 21.05 percent using the AO/OTA classification. According to **Shahid and Robati**⁽¹⁶⁾, the AO classification of fractures revealed that type A (61 patients), type B (4), and type C (four patients) were

found (5). One patient's X-ray was not classified, and the results for nine other patients were also uncertain.

The radial inclination before and after surgical treatment was evaluated in this study, and we discovered a considerable rise in radial inclination following surgery; the mean preoperative radial inclination was $15.04^{\circ} \pm 3.86$ (range: 5° to 20°) and the mean postoperative measurement was $20.83^{\circ} \pm 0.87$ (range: 20° to 22°). Thirteen patients (54.2 percent) were excellent, 6 patients (25 percent) were good, and 5 patients (20.8 percent) were fair in this study's results regarding outcomes. In agreement with our findings, the study of **El-Adawy et al.** ⁽¹⁴⁾ reported that 36 patients (51.4%) got excellent score, 18 patients (25.7%) were good, 12 patients (17.1%) were fair, and 4 patients (5.7%) were poor. About 72.1% of patients had good results after three months, 89.7% after six months, and 96.6% after 12 months, according to **Ruschel and Albertoni** ⁽¹⁷⁾. In **Jirangkul et al.** ⁽¹⁵⁾ study, at two months, 74% of the Kapandji group had excellent or good Herzberg scores. These outcomes are on par with those of individuals who were operated on while under general anesthesia as well. It is important to note that functional outcomes will improve as the functional rehabilitation process progresses.

In **Refai et al.** ⁽⁴⁾ study, the mean of the score was 12.23 using Gartland and Werley score with $SD \pm 6.354$. According to scoring system, no excellent result was found, good results were 36.3%, fair were 50%, and poor were 13.3%. Evaluation of radiological parameters results showed significant correlation between palmar inclination radial height, radial inclination and the final functional score with p -value ≤ 0.05 .

Finally, regarding complications, neither of the studied patients had tendon or nerve injury. Superficial infection occurred in 29.2% of patients. Sudeck's atrophy and stiffness occurred in 4.2% and 8.3% of the studied patients respectively and there were statistic significant in the outcome among complicated patients. In **Jirangkul et al.** ⁽¹⁵⁾, during surgery, there were no serious medical complications. There were no infections, delays in union, or nonunions among the patients. There was just one case where the intrafocal K-wire approach failed to achieve adequate reduction in a 57 year old woman because of bone fragility and long-term bisphosphonate use. In order to reach the fractured metaphysis, the surgeons had to make a dorsal incision in order to get a proper approach and a successful reduction. After that, double plates were put on.

CONCLUSION

In adults and the elderly, distal radius fractures can be effectively treated by percutaneous K-wiring. The surgery is safe, has a low rate of complications, and requires only a brief stay in the hospital. By sticking to the fundamental principles and technical features, most of the complications can be avoided.

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