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Role of Kapandji Technique in Percutaneous Fixation of Distal Radius Fractures

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ABSTRACT

Background: The most common fracture in adults is distal radius fracture (DRF). The surgical treatment for distal radius fractures is Kapandji's surgical procedure that uses intrafocal pinning and provides unique fixation.
Objective: The aim of the work was to evaluate distal radius fracture union and healing after Kapandji's technique of percutaneous fixing.
Patients and Methods: We managed a group of twenty patients, aged from 18 years to 50 years of both sexes with distal radius fracture by K- wires using Kapandji technique at Zagazig University Hospitals and Al Farafra Hospital. The results have been studied regarding complications, time of recovery and rehabilitation.
Results: Mean Patient-Rated Wrist Evaluation (PRWE) -Specific Function was 30.95, the mean PRWE-Pain subscore was 29.25, the mean PRWE-total score was 54.29. Radial inclination, Volar tilt, and radial height were statistically significant higher in the examined group following surgery. Only 40% of the studied group had superficial infection but no cases had tendon or NV injury or Sudek's atrophy.
Conclusion: It could be concluded that for totally displaced fractures, the Kapandji method of K-wiring is an effective means of reducing the fracture and keeping it reduced over time. By employing the Kapandji technique approach, a close reduction can be achieved with minimal effort.
Keywords : Kapandji Technique, Distal Radius Fractures.

INTRODUCTION

Distal radius fractures (DRF) are the most common in adults. In the emergency room, it accounts for 17.5% of all fractures [(1)]. About 2.5 percent of all emergency room visits are attributed to distal radius fractures [(2)].

The trochanteric fracture is the most common fragility fracture in persons over the age of 50. Women have a 15 percent lifetime risk of distal radius fracture, while men have a 2 percent lifetime risk [(3)].

The frequency of DRF is gender-specific. DRF commonly occurs in younger male patients as a result of high-energy trauma, older women are more likely to suffer from DRF due to low-energy trauma, such as falls from a standing height, than younger women [(1)].

Osteopenia and osteoporosis are risk factors in women with DRF with percentage of 85%, 52% respectively. For reasons not fully understood, DRF frequency is rising faster than the ages of the Western population. Changes in lifestyle, such as more physical exercise among the elderly, alone cannot explain this finding. The most frequent pattern of fracture is dorsally displaced distal radius fractures. Abraham Colles first described this pattern in 1814, and named it after him [(3)].

Distal radius fractures have met different kinds of managements such as conservative treatment that first Colle's described, external fixation, closed reduction and cast immobilization, as well as closed reduction and percutaneous fixation with Kirschner wires and open reduction and internal fixation. There have been many studies since their introductions to find out the advantages of one over the other and although some of these treatment methods have known advantages among others, the gold standard treatment method is still a matter of discussion [(4)].

Kapandji was the first to identify a surgical procedure that involved intrafocal pinning and provided unique fixation. Different from the standard method of pinning, this procedure is unique in that the pins are implanted directly into fracture sites on both sides of the fracture line. Francophone countries have embraced this new method of teaching. By the late 1980s, it had become the standard treatment for distal radius fractures in those countries [(5)].

The purpose of this study was to examine the healing and union of distal radius fractures after Kapandji's technique of percutaneous fixation.

PATIENTS AND METHODS

This cross-sectional study included a total of twenty patients of both sexes, aged from 18 to 50 years with distal radius fracture managed by K- wires using Kapandji technique, at Zagazig University Hospitals and Al Farafra Hospital.

Ethical Consideration:

This study was ethically approved by Zagazig University's ethical committee (ZU-IRB#6240). Ethics guidelines for human experimentation were adhered to in accordance with the Helsinki Declaration of the World Medical Association. Written informed consent of all the subjects was obtained.

Inclusion criteria: Patients who are skeletally mature and have extra-articular fractures of the distal radius are admitted to the orthopedic department.

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Exclusion criteria: Patients with severe osteoporosis, an intra articular fracture involving the radiocarpal joint, and patients who are ineligible for surgery are excluded from this procedure.

All patients were subjected to:

Medical history taking and clinical evaluation: Age, sex, gender, type, mechanism, and time of injury were all recorded in a thorough medical history. Medications, and general assessment of the patient were all taken into consideration for the presence of systemic or other orthopedic ailments.

Radiological evaluation: As part of the diagnostic process, an x-ray plain AP/Lat. views of the radius.

Laboratory evaluation: Complete blood picture (CBC), liver and kidney function tests, plasma glucose, as well as virology markers.

Operative technique:

Patients received regional or general anesthesia. Broad spectrum prophylactic intravenous antibiotic (3^{rd} generation cephalosporin) was given for patients with simple fracture within half an hour before surgery.

The steps of procedure:

Fluoroscopic guiding was used to minimize the fracture. Radial height and anatomic radial inclination and volar tilt were the primary objectives of the reduction. In order to protect the radial nerve and the extensor tendons, a tiny cutaneous incision was created and dissected bluntly down to bone prior to insertion. Re-establish palmar tilt by leaning distally on a dorsal-to-volar wire that is inserted into the fracture gap over Lister's tubercle and levered distally, re-establishing the fracture. The wire is then inserted into the cortex near the fracture, ensuring the fixation. On the radial side, the wire is then placed into the fracture gap's center. Afterward, the drill was lifted to a height that restored the radial orientation of the fractured fragment by supporting it with the wire. Finally, the wire is inserted into an area of cortex near the fracture site in order to ensure a strong hold on the fixation method.

Fluoroscopy was utilized to check the pin's position and stability after insertion. It is checked to make sure that there are no tethered tendons in passive finger and wrist movement. Using a blade, tethers of any kind can be severed. One centimeter of skin was removed from the pins. After surgery, a well-padded splint is used.

Patient assessment and postoperative follow up:

After the procedure, radiographs were taken to measure the decrease and length of the wires. After ten days, stitches were removed from the skin. Pins were removed about 4-6 weeks after surgery. One week after the splint was removed, the patient was normally put in a short arm cast. For six weeks, the patient was in a cast.

The Patient-Rated Wrist Evaluation (PRWE) score:

The PRWE is a 15-item questionnaire that assesses wrist pain and impairment in daily activities. Using the PRWE, patients are able to score their amount of wrist pain and disability from zero to ten .

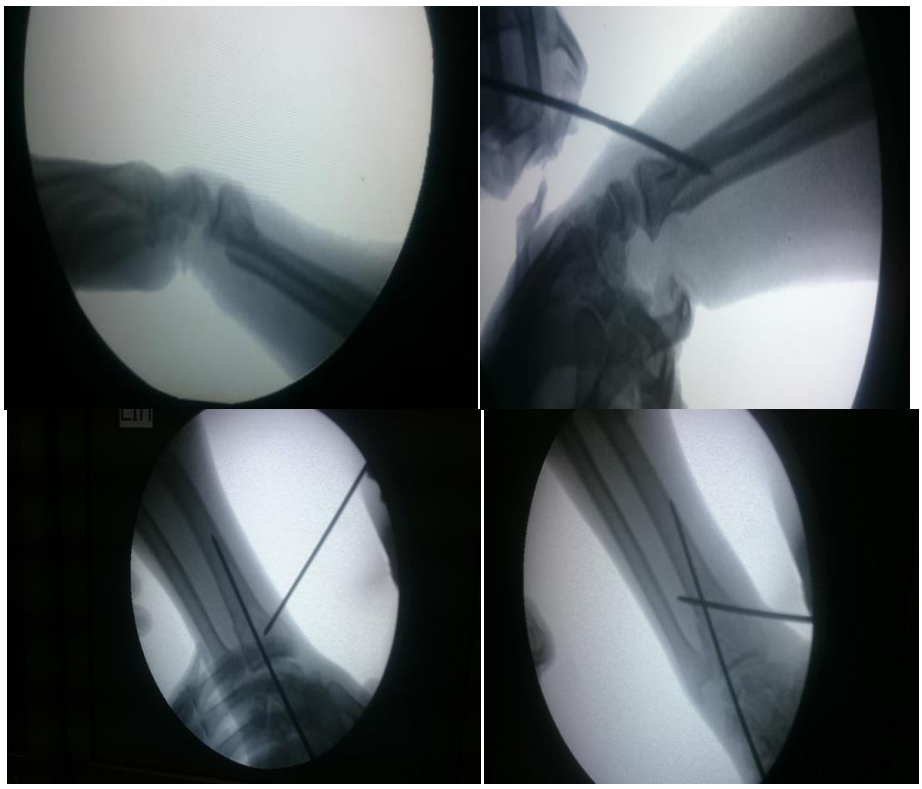

Figure (1): intraoperative correction of radial deviation and dorsal angulation with k-wires

Statistical analysis

In order to analyze the data acquired, it was loaded into a computer and run via the Statistical Package of Social Services, version 25. (SPSS). Tables and graphs were used to present the findings. The Shapiro–Wilk test was used. For quantitative independent data, the student's t test (T) and was employed to examine the data as needed. To examine qualitatively independent data, researchers employed the Pearson Chi-Square Test and the Chi-Square for Linear Trend (χ^2). Wilcoxon's signed rank test was used to Compare of not-normally distributed quantitative data within the same group at different time points. P value equals or less than 0.05 was considered significant.

RESULTS

It was found that ages 18 to 50 years old comprised the study group, with a mean age of 34 years. Regarding sex 60% of the studied group were female. Eighty percent of the studied group had closed fracture and only 20% had open. Regarding time between fracture to surgery 30% had operation in the same day, 20% had it within week and 50% had it after 1 week from injury.

Operation time among the studied group ranged from 10 to 15 min with mean 11.5 min. regarding hospital stay all cases stay 1 day at hospital then discharged **(Table 1).**

All cases had 6 weeks to caste. When it came to the length of the union, it lasted anywhere from four to six weeks, on average, also ROM time after cast remove ranged from 3 to 6 weeks with mean 4.2 week **(Table 2).**

Mean PRWE-Specific Function was 30.95, the mean PRWE-Pain subscore was 29.25, the mean PRWE-total score was 54.29 **(Table 3).**

After surgery, the Radial inclination, Volar tilt, radial height of the investigated group increased significantly, the mean ulnar variance was 5.5±3.2 **(Table 4)**

only 40% of the studied group had superficial infection but no cases had tendon or NV injury or Sudek's atrophy **(Table 5).**

Table (1): Operation data among the studied group:

Variable	(n=20)
Operation duration: (min) Mean ± SD Range	11.5 ± 2.45 10 - 15
Hospital stay time: (day) Mean ± SD Range	1 ± 0 1

Table (2): The mean Union period among studied group

Variable	(n=20)
Union period : (week) Mean ± SD Range	13.19 ± 2.2 6-16

Table (3): Healing time among the studied group:

Variable	(n=20)
PRWE-total score Mean ± SD Range	54.29±17.55 20-70
PRWE-Pain subscore Mean ± SD Range	29.25±8.79 15 – 41
PRWE-Specific Function Mean ± SD Range	30.95±12.89 15 – 45

Sd: Stander deviation W: Paired Wilcoxon test

Table (4): Radial inclination, Volar tilt, Radial height among the studied group pre and post operation:

Variable	Pre (n=20)	Post (n=20)	W	P	Mean % of improvement
Radial inclination: (degree)					
Mean ± SD	14.2 ±5.03	21.2 ±0.92			
Median	16	21.5	2.81	0.005*	76.62%
Range	5 - 20	20 – 22			
Volar tilt: (degree)					
Mean ± SD	-15.5 ±12.39	7.4 ± 2.99			
Median	-11.5	8.5	2.80	0.005*	165.62%
Range	-40 - 0	2 – 10			
Radial height: (mm)					
Mean ± SD	2.11 ± 2.42	8.78 ± 1.79			
Median	2	9	2.68	0.007	153.81%
Range	(-1) - 6	5 – 11		**	

Table (5): Complication of operation among the studied group

Variable	(n=20)	
	No.	%
Tendon or N.V injury:		
No	20	100
Yes	0	0
Superficial infection:		
No	12	60
Yes	8	40
Sudek's atrophy:		
No	20	100
Yes	0	0

(A) **(B)**

Figure (2): A) Preoperative x-ray (AP&LAT) RT forearm, **B)** AP&LAT x-ray 6-week postoperative a six-years old boy presented to orthopedic casualty with history of fall down which led to midshaft fracture of both bone of right forearm. The patient was operated at the same day and was fixed by elastic stable intramedullary nail. The fracture was completely united within 6 weeks and the final outcome was Excellent according to price score.

DISCUSSION

When a distal radius is fractured, it is among the most common. Reduced bone mineral density, white race, female gender, early menopause, and family history all increase the risk of these fractures in the elderly. In most cases, a fall on an outstretched hand with the wrist in dorsiflexion results in a fracture known as a Colles' fracture [(1)].

If the fracture reduction does not match the acceptable criteria regarding radial inclination, radial height and palmar tilt with closed reduction we shift to operative technique to reduce the fracture to at least near anatomical reduction through Kirschner wires, minifixators or plates [(6-7)].

For fractures of the distal end of the forearm bones, Kirschner wires are one of the most widely utilized means of fixation. Using intrafocal Kirschner wires, Adalbert Kapandji developed a method for repairing distal radius fractures. Initially, this procedure was suggested for patients under the age of 18. As a result of its success, it is now being used more widely and for more conditions. In addition, it has the following benefits: Minimal blood loss, with only a small amount of effort, a nearly anatomical closed reduction can be produced which is important regarding the osteoporotic quality of the bone commonly encountered in elderly people, Short operative time, which is critical given the elderly patients' longer anesthetic duration. Short hospital stay time, decreased time of immobilization in comparison to closed reduction [(8)].

Because percutaneous fixation does not give a hard fixation, it can be difficult to maintain the postoperative reduction of the fracture, requiring the use of plaster-cast immobilization after the procedure [(9-10)]. **Greatting and Bishop** the Kapandji technique in elderly individuals without using postoperative cast and observed that the deformity recurred.

According to a number of studies, the early mobilization method has been found to be ineffective, leading to a wide range of problems such as severe pain and reflex sympathetic dystrophy, among others [(12)].

There is a strong association between satisfactory radiological reduction till fracture consolidation is completed and good function. It is very difficult to restore and maintain the natural palmar angulation of the distal radius with the closed reduction and immobilization procedures [(13)].

Regardless of the patient's age, the surgeon's primary goal in this procedure is to accomplish and maintain an anatomical reduction [(14)].

Both the functional and radiological outcomes of the Kapandji approach were found to be significantly superior to those of the standard technique in a prospective, randomized investigation of 100 distal radius fractures in adults treated by K-wiring. Traditional extrafocal K-wiring in distal radius fractures can only be performed if a good reduction has been accomplished. Using the Kapandji intrafocal K-wiring approach, an irreducible distal radial fracture can be reduced as well as stabilized [(15)].

A series of 140 patients with severely dislocated distal radius fractures treated with traditional K-wiring had an 8 percent open reduction and 6.4 percent loss of reduction rate, according to **Strohm *et al.*** [(15)].

The PRWE score which is a 15-item questionnaire was designed to measure wrist pain and disability in activities of daily living. The PRWE allows patients to rate their levels of wrist pain and disability from 0 to 10, and consisted of 2 subscales: Pain subscale (0 = no pain, 10= worst ever) in 5 items summed up of 50 and Function subscale (0 = no difficulty, 10 = unable to do) in 10 items summed up of 100 then divided by 2. The total score is the sum of the two subscales where the more the score result, the worse the outcome. We achieved 12 excellent cases and 8 good.

Out of the 20 wrists operated, all of the patients nearly attained parameters that would be considered ideal. They all were put in cast postoperatively for 6 weeks. They all were fully united after 6 weeks. They showed accepted radial inclination, radial height and palmar tilt values. 18 of them were successful. 12 regained good range of motion, 8 were excellent.

None of them showed nerve injury nor Sudek’s atrophy. Only four cases had pin tract infection and were treated by repeated dressing and antibiotic spray and showed complete subsidence of the infection with no affection of the reduction.

The difference between the results of this study may be due to the difference in the number of patients in the studied group.

The method originally described by Dr. Adalbert Kapandji [(5)] is viable, according to the results. It's a straightforward and fast operation that doesn't require a lot of time or effort. Trauma surgeons are capable of performing it, and the radiographic outcomes are acceptable.

CONCLUSION

It could be concluded that reduction and stability can be achieved and maintained using the Kapandji method of K-wiring. Using the leverage technique, close reduction can be done with minimal force. A shorter casting time is possible since there is no risk of the mould being accidentally moved. Shortening the follow-up period for patients with no clinical deformity will save time.

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