

# Comparative study between kapandji technique and conventional percutaneous k-wiring fixation in distal radius fractures

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## ABSTRACT

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### Background:

Young adults compose a major portion of distal radius fracture cases. The compressive loading on the dorsiflexed wrist is considered to be the main cause of the majority of distal radius fractures. There are two distinct techniques of wire insertions: insertion of wire through the fracture sites, and insertion across the fracture sites.

### Aim:

To define and compare the functional and radiological results of extra-focal and Kapandji pinning methods.

### Patients & Methods:

This study was carried out on 40 patients attending Suez Canal University Teaching Hospital and El-salam Hospital and presenting with distal radius fracture patients. All patients preoperatively were subjected to 1) History taking, 2) Clinical examination, 3) Laboratory investigations, 4) Preparation. Then they were divided randomly into 2 groups according to the technique they had.

### Results:

There was a statistical difference among the two groups following residual deformity, subjective evaluation, objective evaluation, complications, and final results. The complications resulting from the kapandji technique cases are 40% pin tract infection, 10 % mal-union in the form of dorsal angulation, 25 % Sudek's atrophy, 10 % osteoarthritis, and 5 % tendon injury. The complications resulting from the extra-focal pinning technique cases are: 45% pin tract infection, 20% mal-union, 30% Sudek's atrophy, and 15% osteoarthritis.

### Conclusion:

Kapandji technique is considered to be a proper method in the extraarticular distal radius fracture. k-wire pinning is an innocent technique in the fixation of comminuted intra-articular distal radius fracture.

### Keywords:

Distal radius fractures, kapandji technique, conventional percutaneous k-wiring

## INTRODUCTION

Although distal radius fractures are seen most typically among females over 40 years, young adults compose a major portion of the cases. In females, the incidence rises sharply after the age of 40 from approximately 36.8/10000 to 115/10000 at the age of 70. This increase in the incidence among elderly females is due to estrogen withdrawal and reduced bone density which occurs with advanced ages [1].

Over time, the methods of management of displaced distal radius fracture have been changed. Recently, most of the studies have emphasized that when treating distal radius fracture, it is important to attain and maintain near anatomical reduction and stability [2]

There are various techniques of wire insertion, among these techniques there are two distinct

methods; 1) insertion of wire through the fracture sites, 2) insertion across the fracture sites [3].

The comparison of the radiologic and functional outcomes of various techniques is not abundant in the literature. So, this study aims to define and compare the functional and radiological results of extra-focal and Kapandji pinning methods.

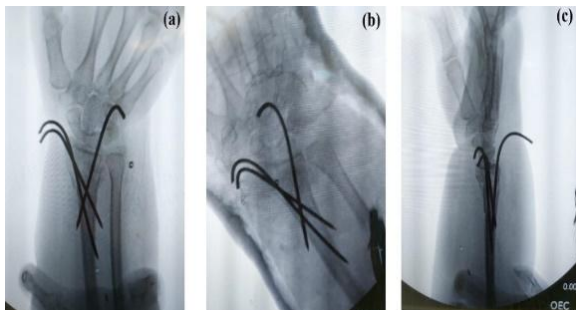
## PATIENTS AND METHODS

A Comparative study design was conducted at Suez Canal University Teaching Hospital and El-Salam Hospital in Port Said, and included 40 patients presenting with distal radius fractures Adult skeletally mature patients above 18 years old of both sexes, patients with radiologically confirmed extra-articular fractures of the distal radius, simple intra-articular noncomminuted distal radius fractures, and patients with injuries not older than two weeks.

Excluded: Patients with volar and dorsal Barton fractures, distal radius fractures associated with neurovascular injury, highly comminuted intraarticular distal radius fractures, and open fractures.

**Pre-operative Evaluation:** All patients enrolled in the study were subjected to A) Pre-operative Evaluation including (Full medical history, general and local examination, radiological and laboratory investigation). Then they were classified randomly into two equal groups according to the technique that will be used.

**Operative procedures:** The extra-focal technique was performed through general or local anesthesia: 1) Closed reduction was achieved by traction and counter traction, after mobilization of underlying tendons and soft tissue, the first wire through radial styloid and cross the fracture site was inserted and extended through the opposite cortex about 2-2.5 mm (Figure 1). 2<sup>nd</sup> and 3<sup>rd</sup> wires were inserted through the third-fourth and fourth-fifth extensor compartments, respectively. After the third wire insertion, the fracture alignments were once again checked and if they were acceptable the wires were bent out of the skin and cut out. Finally, a long arm cast was applied after proper dressing.



**Figure 1.** Intra-operative reduction and fixation under fluoroscopy of extra-focal case.

The Kapandji method was also performed under general or local anesthesia: 1) Reduction was achieved the same way as in the extra-focal method, but wires were inserted in a different pattern, the first wire was inserted parallelly and directly through the fracture site. Then the wire was angled 45 degrees obliquely proximally and was drilled to the opposite cortex. The second and third wires were inserted through the third-fourth and fourth-fifth extensor compartments, respectively (Figure 2). 5) The fracture and the overall alignments were checked with a fluoroscope and if there were any concerns about the malalignment, then the wires were removed and started over with the reduction.



**Figure 2.** Intraoperative reduction and fixation of kapandji case by three k-wires (Left), fluoroscopic guidance (right).

**Post-operative care and follow-up:** The patients were followed clinically and radiographically weekly till the removal of K-wires at the six-week postoperative duration, then every three weeks for the next three months. After 6 -8 weeks K-wires and cast were removed and patients were assessed clinically for fracture union, range of movements, and radiological parameters, physiotherapy was advised. After 6-8 weeks (Figures 3, 4).

**Assessment of outcomes:** At 6 months postoperative, the functional outcome of the patients was assessed by the Demerit score system of Gartland and Werley.



**Figure 3.** Four weeks postoperative x-ray of extra-focal pinning case.



**Figure 4.** Four weeks postoperative x-ray of kapandji case in AP and Lateral views.

**Statistical analysis:** Results were expressed as mean  $\pm$  SD or n, %, and  $p < 0.05$  was considered significant. Student's t-test for quantitative data and Chi-squared test for categorical data were used. They were undertaken using the SPSS 11.5

statistical analysis software (SPSS Inc., Chicago, Illinois, USA).

**Ethical consideration:** This study was approved by the research ethics committee of the faculty of medicine at Suez Canal University. Permissions to collect data were obtained from the FOM-SCU administration. The response of patients was voluntary, as they could refuse to respond without stating any reason. Patients were told that their information confidentiality was kept. Informed consent was written.

## RESULTS

The mean age of the Kapandji fixation technique group is (30.73 ± 4.89), while the mean age of the Extra-focal percutaneous k-wiring technique group is (31.79 ± 4.09), the majority of both groups were males. There was no statistical difference between the two groups according to the 3 months of radiological improvement, while at 6 months Kapandji fixation technique group showed statistically significant higher radiological improvement than the Extra-focal percutaneous k-wiring technique group. The Mayo score interpretation of the two techniques revealed that regarding the cases in which the Kapandji technique was utilized; anatomical results were excellent in 6 (30%), good in 9 (45%), satisfactory in 3 (15%), and unsatisfactory in 2 (10%) of the subjects treated. However, anatomical results were excellent in 3 (15%), good in 8 (40%), satisfactory in 5 (25%), and unsatisfactory in 4 (20%) of the patients treated with extra-focal pinning. The functional results were promising and the patient score was 90 % and 80% in the form of satisfactory, good, and excellent for the kapandji technique and extra-focal pinning respectively (Table 1).

**Table 1.** Mayo wrist score of cases.

Score	kapandji-technique (20 cases)	Extra-focal pinning (20 cases)
Excellent	6 (30%)	3 (15%)
Good	9 (45%)	8 (40%)
Satisfactory	3 (15%)	5 (25%)
Unsatisfactory	2 (10%)	4 (20%)

The complications resulting from the kapandji technique cases are 40% pin tract infection, 10 % mal-union in the form of dorsal angulation, 25 % Sudek's atrophy, 10 % osteoarthritis, and 5 % tendon injury. The complications resulting from the extra-focal pinning technique cases are 45% pin tract infection, 20% mal-union, 30% Sudek's atrophy, and 15% osteoarthritis. (Table 2).

**Table 2.** Follow up on complications.

Complications	kapandji-technique (20 cases)	Extra-focal pinning (20 cases)
Mal-union	2 (10%)	4 (20%)
Sudek's atrophy	5 (25%)	6 (30%)
Nerve injury	-	-
Tendon injury	1 (5%)	-
Osteoarthritis	2 (10%)	3 (15%)
Pin tract infection	8 (40%)	9 (45%)

## DISCUSSION

The incidence of distal radius fractures increases with age in women, starting at around 40 years of age [4]. Young adults more often sustain this injury as a result of high-energy trauma, such as a traffic accident or sports. In older adults, especially females, the fracture usually results from low-energy or moderate trauma, such as falling from standing height. This imitates the high bone fragility, resulting from postmenopausal osteoporosis or disuse [5]. There are some theoretical and biomechanical advantages in the Kapandji technique to the extra focal techniques, as the fixation in the Kapandji method is dynamic contrary to extra-focal fixations in which it is more static and its configuration is much more biomechanically stable [6]. Though the Kapandji method may lead to the collapse of the fracture site due to its dynamic fixation which is not confirmed to have a significant difference among other methods of wire insertions, it also may lead to early and rigid fixation and better functional outcomes due to its less immobilization. [7].

Although the functional score due to **Gartland and Warley** [8] was better in the Kapandji group in contrast to the extra-focal group both at the 3 months and 6 months after surgery the difference was not statistically significant. It is displayed that starting the motion before adequate union has occurred may cause excessive pain and may restrict the motion and therefore reduce the benefits of motion beginnings. **Mirhamidi et al.** [9] experienced the ease of use and ease of technique of Kapandji during their study rather than the extra-focal technique, they also noted that the number of fluoroscopic image shoots and the time of surgery decreased significantly at the time we used the Kapandji technique.

Kapandji described a technique in which he inserted wires inside the fracture side and drilled to the opposite cortex instead of the primary wiring method but he did not report his results. Epinete in 1982 reported his series of results with the Kapandji technique in which there were 84% excellent and good results [10]. Another study that assesses the Kapandji technique reported

84.6% excellent and good Mayo Clinic wrist score and also, they advocated the usage of this technique in fractures in which there is no volar cortex comminution or joint involvement [9].

**Mirhamidi et al.** [9] agree with them in that when there is joint involvement it is hard to reduce and even harder to keep the reduction by the Kapandji method.

In **Refai et al.** [11] study of evaluation of closed reduction and percutaneous pinning as a method of treatment of distal radius fracture in elderly patients, a good result was achieved by 36.3%, fair in 50% & poor in 13.3%. In **Salem et al.** [12] study of the role of the kapandji technique in percutaneous fixation of distal radius fractures, the PRWE score was used which is a 15-item questionnaire designed to assess wrist pain and disability in daily living activities. 12 cases achieved excellent and 8 cases achieved good scores.

Complications are associated with the injury itself. As well as concomitant injuries to soft tissues, fracture displacement can further compromise blood vessels, tendons, or nerves, with median nerve dysfunction being the most common early complication [13]. In **Lakshmanan et al.** [14] study, the infection rate was 21%, similar to the 20% quoted for hybrid external fixators.

**Botte et al.** [15] have shown elegantly that the incidence of the infection increases with the length of time the K wires are left in situ in the patient. There is, therefore, a trade-off between leaving the K wires in situ for the full 6 weeks to fracture union and an increasing infection rate versus removing them earlier (eg, 4 wk) and then continuing with a cast alone for the remaining time to 6 weeks (in this case, a further 2 wk). Leaving the wires in for 6 weeks might go some way to explaining a 34.4% infection rate in Hargreaves' paper [16].

Our study's strength is that it was a prospective study comparing 2 different techniques. However, there are some limitations which could be that the results of the study could be associated with a poor accuracy of reporting of complications in the fracture clinic.

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## CONCLUSION

Kapandji technique is considered to be a proper method in the extraarticular distal radius fracture, as its reproducibility and ease make it a choice in these settings. k-wire pinning is an innocent technique in the fixation of comminuted intra-articular distal radius fracture. Both techniques are equally recommended to be used in the management of distal radius fracture cases.

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