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Percutaneous Fixation of Distal Radius Fracture using kapandji Technique

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Abstract

Background: distal radius fracture is one of the common injuries seen in casualty and can be managed by closed reduction and percutaneous pinning.Surgical treatment is indicated for displaced and unstable distal radius fractures. Kapandji percutaneous pin fixation technique is widely practiced on account of its efficiency and relative reproducibility.

Aim and Objectives: The main purpose of this study was to evaluate the results of union and healing and the outcome of fracture distal radius after using percutaneous fixation with Kapandji's technique.

Subjects and methods: This was a Prospective Interventional study, which was conducted on 18 cases with a distal radial fracture at Zagazig university hospital; the study was carried out for six months.

Results: Results of the study revealed that there was a significant increase in radial inclination, radial length, and volar tilt postoperatively, and the present study found that 11 (61.1%) patients were excellent, and 7 (38.9%) patients were good.

Conclusion:Percutaneous pinning using Kapandji's technique is a simple, minimally invasive technique and is aimed at preventing re-displacement of the distal radius fracture fragments to provide sound bone healing and achieve good radiological and functional results.

Keywords: Distal Radius Fracture, Infection, Percutaneous Kirschner Wires Fixation, Kapandji's Technique.

1. Introduction

Fractures of the Distal Radius continue to be one of the most common injuries treated by orthopedic surgeons, accounts for about one six of all fractures seen and treated in the emergency room; the most common type of wrist fracture was first described by Abraham Colles in 1814; it is at the Distal Radius and typically the lower radial fragment is dorsally and laterally angulated together with rotational deformity in supination [1].

Reducing a Colles fracture is not a problem, but maintaining the reduction certainly is. Various types of casts and positions have been recommended, but none have been uniformly accepted[2].

The maximally flexed and ulnar-deviated position of the wrist impairs the function of the hand and increases pressure in the carpal tunnel and should be avoided. Neuropathies, ischemic complications, and stiffness are most often related to the type and position of cast immobilization [3].

Percutaneous pinning techniques are an attempt to bridge the therapeutic gap between the external fixators and pure casting alone. Although there is no doubt that external fixators have a role in the treatment of some highly displaced distal radial fractures, many unstable distal radial fractures may be treated adequately with far less complicated percutaneous pinning techniques [4].

Kapandji pinning may be most appropriate for the patient,with significant initial displacement, but with a minimum of dorsal comminution. In this patient,the early motion would like possible, reducing the overall recovery period. Kapandji pinning is a simple procedure that requires minimal equipment and has been demonstrated to have satisfactory results[5].

2.Patients and Methods

1.1. Technical design

1.1.1. Site of study: in Zagazig University Hospitals.

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1.1.2. **Sample size:** the attendance rate of unstable distal radius fracture is 3 cases/month, so the total number of cases in the study period (6 months) is 18 cases, and it will be included as a comprehensive sample.

1.1.3. **Subjects included in the study:**

a) Inclusion criteria:

Both genders of Patients with any age which admitted to orthopedic department with extra articular fracture distal Radius.

b) Exclusion criteria:

- Patients who suffer from osteoporotic boneIntra articular fracture with involvement of the radiocarpal joint.

1.2. Operational design

1.2.1. **Study Design:** Prospective interventional study.

1.2.2. **Steps of performance and techniques used:**

a) History taking regarding:

Age, sex, date and time of trauma, and other risk factors for chronic diseases like coronary artery disease (CAD) as hypertension, diabetes mellitus, smoking, dyslipidemia, obesity, stress, positive family history for fragility fractures.

b) General and Local examination:

- **General:**

Alert, Aware, Conscious.

Blood pressure, Pulse, Temperature

- **Local:**

a. Inspection:

- Skin: color, sinus, scar, pigmentation, Muscle: wasting – hypertrophy, generalized swelling - localized, Limb deformities: adduction, abduction, flexion, and extension.

b. Palpation:

- Tenderness, Pulse, and temperature.

c. Other musculoskeletal abnormalities.

c) Pre-operative set of investigations (CBC, P.T., PTT, INR…)**.**

d) X-ray (A-P, Lateral).

e) Anesthetic technique:

- -Supine position, Regional or General Anesthesia, and No hematoma block.

f) Surgical approach and positioning: Percutaneous pinning of distal radius.

g) Operative technique:

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1) Under general or regional anesthesia Kapandji's pinning technique applied to unstable extra-articular distal radius fracture. First, the fracture was reduced under fluoroscopic guidance to restore radial height while recreating anatomic radial inclination and volar tilt.

2) The lateral wire is inserted into the fracture site in a radial to ulnar direction until it reaches the ulnar cortex of the radius. The drill and wire are then moved distally 45° to lever the distal radial fragment or until the wire buttresses the proximal fragment. Then wire drives through the ulnar cortex. Then insert a dorsal to the volar wire with the starting point centered about the third metacarpal axis over Lister's tubercle into the center of the fracture gap and levered distally buttressing the proximal fragment restoring palmar tilt. The wire is then passed through the cortex proximal to the fracture securing the fixation

3) After pin insertion, fluoroscopy was used to evaluate alignment and stability. Passive finger and wrist flexion is examined to ensure no tendons have been tethered. Any skin tethering is released with a blade. Pins were bent and cut approximately 1 cm from the skin. A well-padded cast is placed postoperatively.

4) In cases with highly dorsal comminuted, we used a third lateral to the medial wire.

1.3. Administrative design:

Approvals was obtained from Zagazig university institutional review board.

1.3.1. Post-operative follow up

Post-operative radiographs were done to check for reduction and wire length. Pins are removed approximately 4-6 weeks postoperatively. The patient remains in a cast for approximately 6 weeks.

1.3.2. Functional Assessment:

We used Green and O'Brien Score (Cooney modification) technique to evaluate functional outcome of the patients. This score based on evaluation of pain, range of movement and grip strength.

2.3.3.Green and O'Brien Score (Cooney modification)

I. Pain (25 points)

- 25 None
- 20 Mild, occasional
- 15 Moderate, tolerable
- 0 Severe or intolerable

II. Range of motion (25 points): flexion + extension, percentage of normal

- 25 100
- 15 75-99
- 10 50-74
- 5 25-49
- 0 0-24

III. Grip strength (25 points), percentage of normal

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- 25 100
- 15 75-99
- 10 50-74
- 5 25-49
- 0 0-24

IV. Activities (25 points)

- 25 Returned to regular employment
- 20 Restricted employment
- 15 Able to work but unemployed
- 0 Unable to work because of pain

V. Final result

- 90-100 Excellent
- 80-89 Good
- 65-79 Fair
- <65 Poor

3. Result

Table (1): Demographic data of the studied patients

Variable		The studied population(N=18)
Age (years)		
Mean ± SD		44.67 ± 9.82
Range		22 – 65
Sex	Female	10 (55.6%)
	Male	8 (44.4%)

Table 1 demonstrates that the age of the patients ranges 22 – 65 years with mean of 44.67 years;the majority of patients were females by 55.6%.

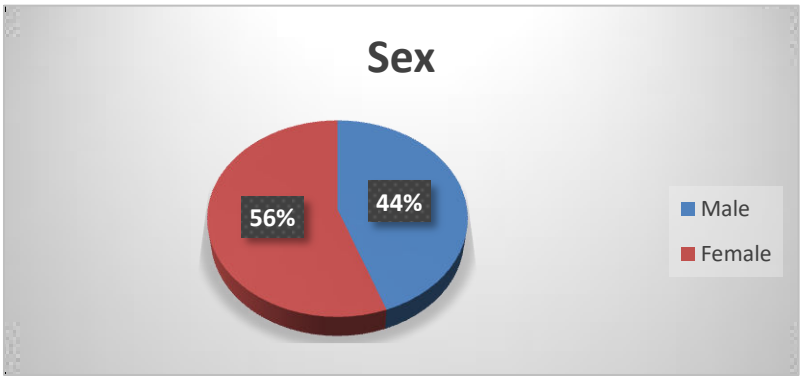

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Figure 1: Demographic data of the studied patients.

Table (2): Fractures characteristics of the studied patients

		The studied patients(N=18)
Time since fracture (day) Mean ± SD		4.28 ± 2.72
Time since fracture	Same day	5 (27.8%)
	< week	5 (27.8%)
	Week	8 (44.4%)
Type	Closed	13 (72.2%)
	Open	5 (27.8%)
Side	Right	13 (72.2%)
	Left	5 (27.8%)

Table 2 shows that the right side was fractured in 72.2% of the patients. The predominant type was closed fracture in 72.2% of patients. 44% of the patients came after a week since fracture, 28% of the patients came in less of a week since fracture and also 28% of the patients came at the same day of the fracture

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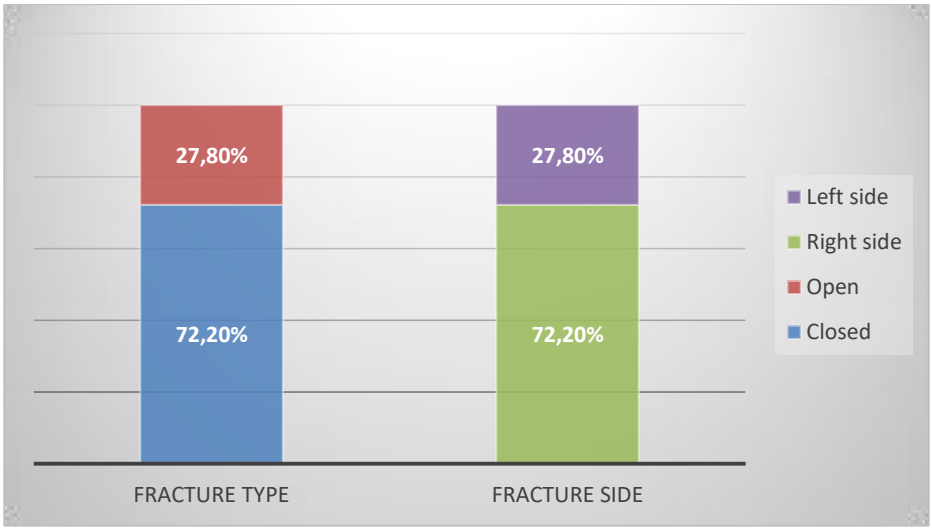

Figure 2: Fractures characteristics of the studied patients.

Table (3): A.O. classification of the studied patients

	The studied population(N=18)
A2	10 (55.6%)
A3	6 (33.3%)
B1	2 (11.1%)

Table 3 demonstrates that A2 was the predominant classification in 55.6% of the patients, A3 was found in 33.3%, and B1 was found in 11.1%

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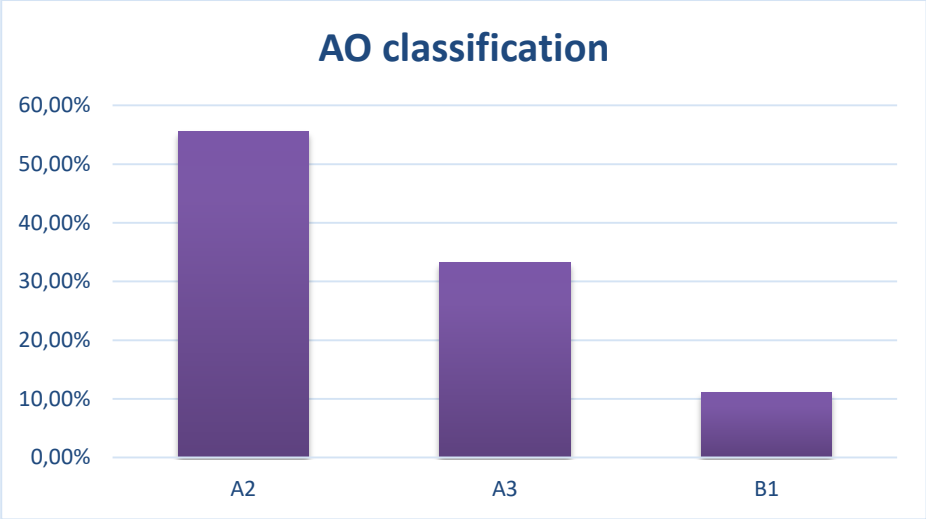

Figure 3: A.O. classification of the studied patients

Table (4): Mechanism of fracture of the studied patients

	The studied population(N=18)
Fall	8 (44.4%)
Sport	5 (27.8%)
RTA	5 (27.8%)

Table 4 clarifies that The predominant mechanism of the injury in 44.4% of patients was fall, 27.8% were sport, and 27.8% were RTA.

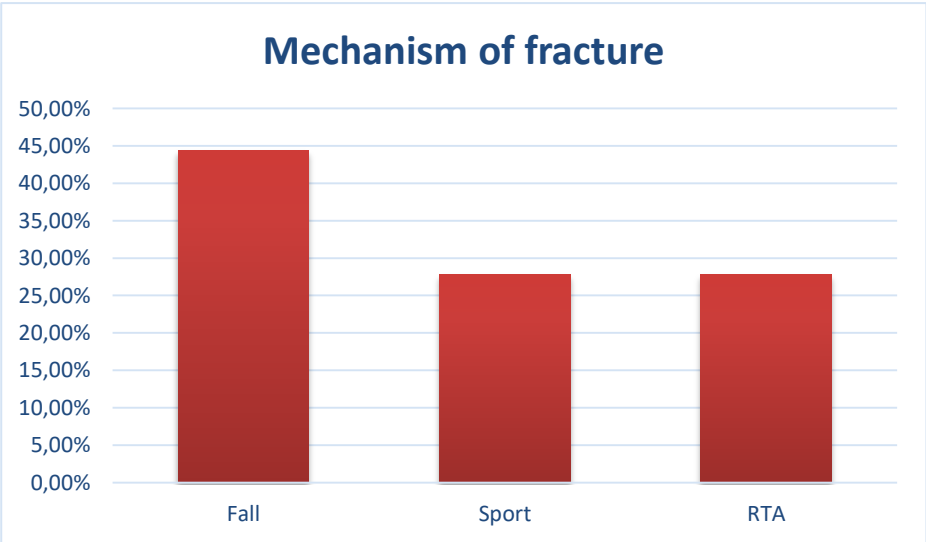

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Figure 4: Mechanism of fracture of the studied patients.

Table (5): operative time and a hospital stay of the studied patients

	The Studied Population(N=18)
Operation time (min) Mean ± SD	11.72 ± 2.19
Hospital stay (days) Mean ± SD	1.19 ± 0.349

Table 5 demonstrates that The mean operative time was 11.72 ±2.19 min and mean hospital time 1.19 ± 0.349 day

Table (6): Clinical characteristics of the studied patients

	The studied population(N=18)
Casting time (week)	
Mean ± S.D.	6 ± 0
(Range)	6
Union time (week)	
Mean ± S.D.	5.06 ± 0.873
(Range)	4 - 6
Immobilization time (weeks)	
Median	4
(Range)	3 - 5
ROM time after cast removal	
Mean ± S.D.	4.53 ± 0.944
(Range)	2 - 6

Table 6 indicates that Median casting time was six weeks with mean union time was 5.06 ±0.873 week, Mean ± S.D. of ROM time after cast removal was4.53 ± 0.944, and median immobilization time was four weeks.

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Table (7): Radial inclination before and after surgical treatment

Variable	The studied population (N=18)		t	P
	Pre-operative	**Post-operative**		
Radial inclination				
Mean ± SD	13.67 ± 4.86	21.17 ± 0.924	**7.24**	**.000**
Range	5 - 20	20 - 22		

Table 7 demonstrates that there is a significant increase in radial inclination postoperatively.

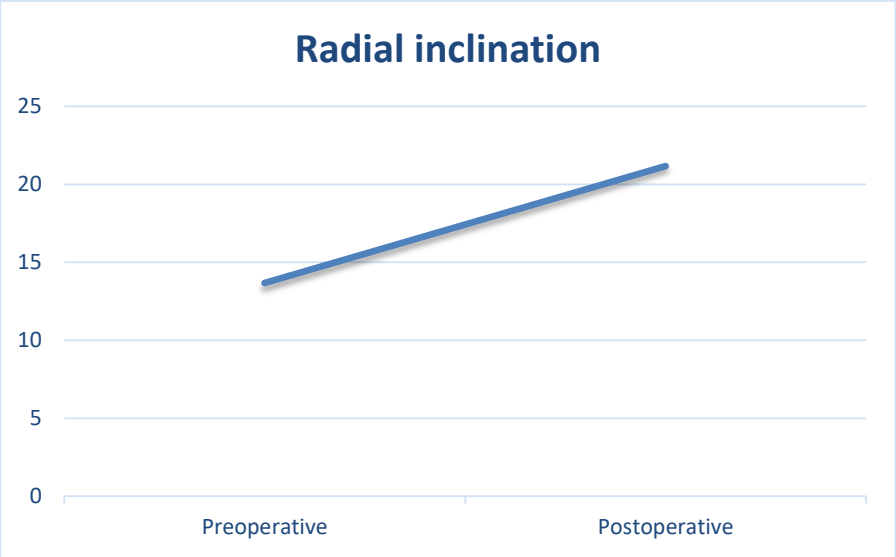

Figure 5: Radial inclination before and after surgical treatment.

Table (8): Volar tilt before and after surgical treatment

Variable	The Studied Population (N=18)		t	P
	Pre-operative	**Post-operative**		
Volar tilt				
Mean ± SD	-13.44 ± 10.92	8.72 ± 2.39	**10.1**	**.000**

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Range	-36 – 0	5 - 12

Table 8 shows that there is a significant increase in Volar tilt postoperatively.

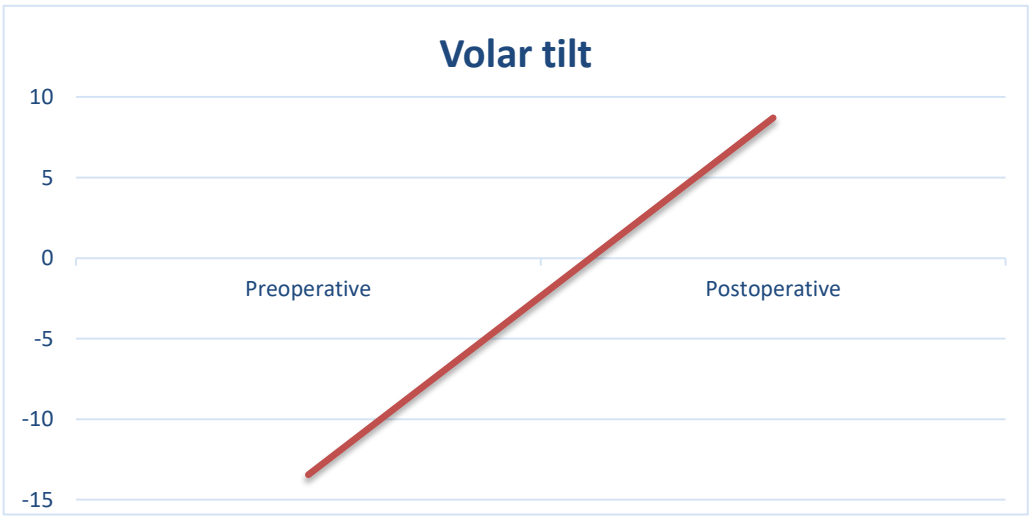

Figure 6: Volar tilt before and after surgical treatment.

Table (9): Radial height before and after surgical treatment

Variable	**The studied population** (N=18)		**t**	**P**
	Pre-operative	**Post-operative**		
Radial height				
Mean ± SD	2.22 ± 1.96	9.83 ± 2.48	**14**	**.000**
Range	0 - 6	7 - 15		

Table 9 displays that there a significant increase in radial height postoperatively.

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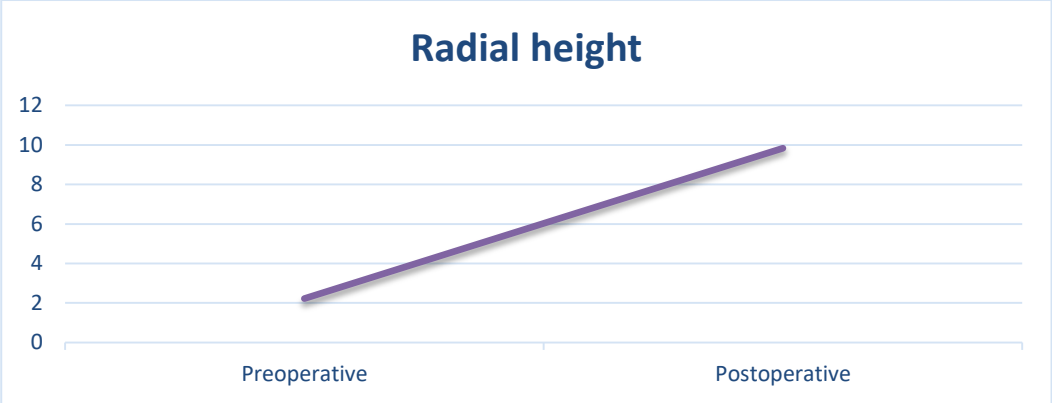

Figure 7: Radial height before and after surgical treatment.

Table (10): Outcome of the studied patients

	The studied population(N=18)
Excellent	11 (61.1%)
Good	7 (38.9%)

Table 10 demonstrates that regarding the outcome, 11 (61.1%) patients were excellent, and 7 (38.9%) patients were good.

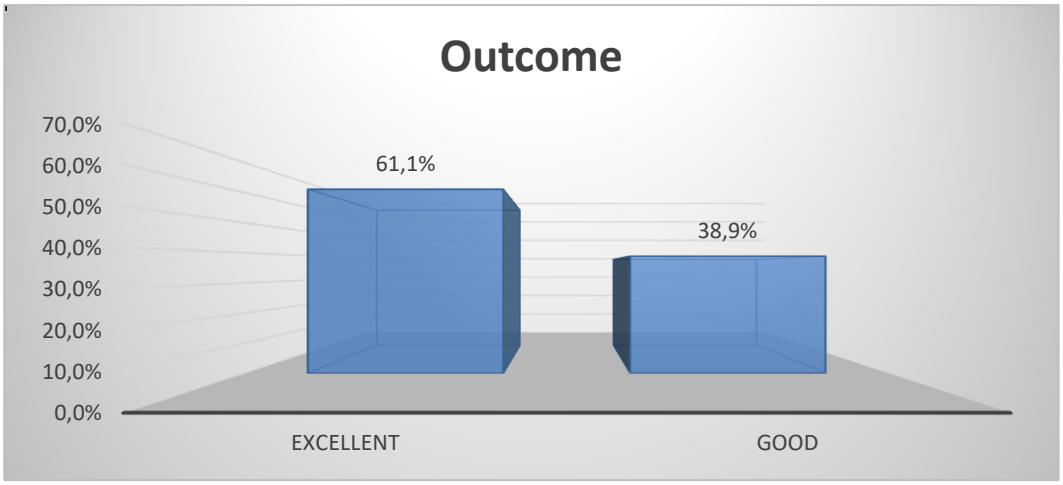

Figure 8: Outcome of the studied patients.

Table (11): Complications distribution of the studied patients

	The studied population(N=18)
Superficial infection	10 (55.6%)

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Tendon or N.V injury	1 (5.6%)
Sudek's atrophy	0

Table 11 shows that regarding complications, 10 (55.6%) patients have a superficial infection, and one (5.6%) patient has tendon injury. No patients reported havingsudek's atrophy

Case presentation

Case 1

History: Gender: male, Age: 42 years, mode of trauma: fall over the ladder outstretched hand, Complain: pain, tenderness and edema over right distal radius with limitation of movement of wrist joint, Neurovascular injury: no, Medical history: hypertension, time since fracture: 4 hours and type of fracture: closed

***Imaging*:**X-ray was done in both Anteroposterior and lateral view.

Figure 9: Pre-operative X-ray A-P and lateral views of the case (1)

Diagnosis:Right distal radius fracture, type 2 according to Frykman classification.

Management plan:

The patient was admitted to Zagazig university hospital at the orthopedic department and prepared for closed reduction and fixation by K wires, Laboratory investigations: complete blood count and bleeding profile were within normal values, under general anesthesia, two K- wires were inserted using Kapandji technique.

Intraoperative imaging:

Near anatomical reduction was obtained. The operation lasted 10 minutes. He was discharged the next day in an above elbow cast.

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Figure 10: Intraoperative C-arm images and photos of the case (1)

Follow up:Patientcontinued following up in the outpatient clinic till k-wires removal patient regained full range of motion by four weeks after cast removal.According to Green and O'Brien Score (Cooney modification) score the result was good. The patient suffered occasional pain with the full range of motion. She has no residual deformity with minimal arthritic changes.

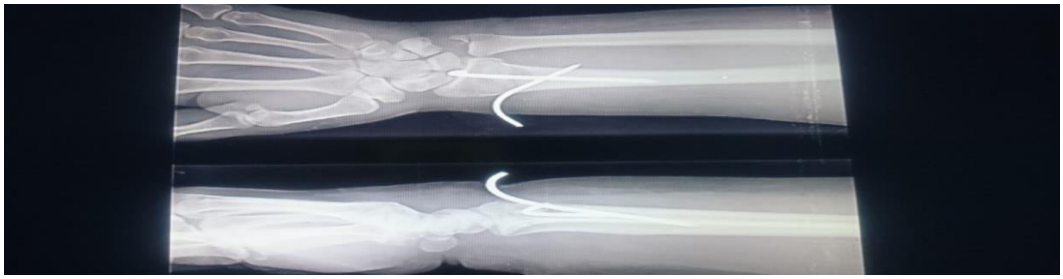

Figure 11: 6 weeks post-operative x-ray of the case (1)

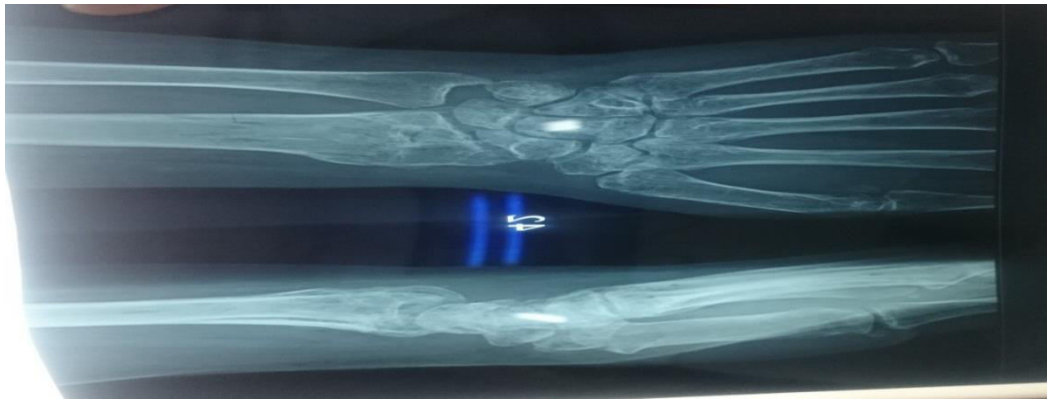

Figure 12: 8 weeks post-operative x-ray after removal of K-wires of the case (1)

Case 2

History:Gender: Male, Age: 14 years, mode of trauma: fall outstretched hand Complain: pain, tenderness and edema over left distal radius with limitation of movement of wrist joint, Neurovascular injury: no, Medical history: no medical condition, time since fracture: 10 hours, type of fracture: closed

Imaging:X-ray was done in both Anteroposterior and lateral view

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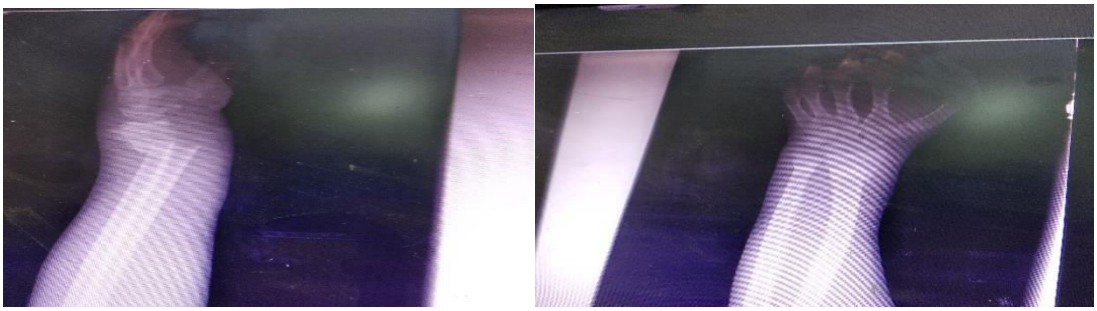

Figure 13: Pre-operative X-ray A-P and lateral views of the case (2)

***Diagnosis*:**Left distal radius fracture type 2 according to Frykman classification.

Management plan:The patient was admitted to Zagazig university hospital at the orthopedic department and prepared for closed reduction and fixation by K wires., Laboratory investigations: complete blood count and bleeding profile were within normal values, and Under general anesthesia, two K- wires were inserted using the Kapandji technique.

Intraoperative imaging:Near anatomical reduction was obtained. The operation lasted 15 minutes. He was discharged the next day in an above elbow cast.

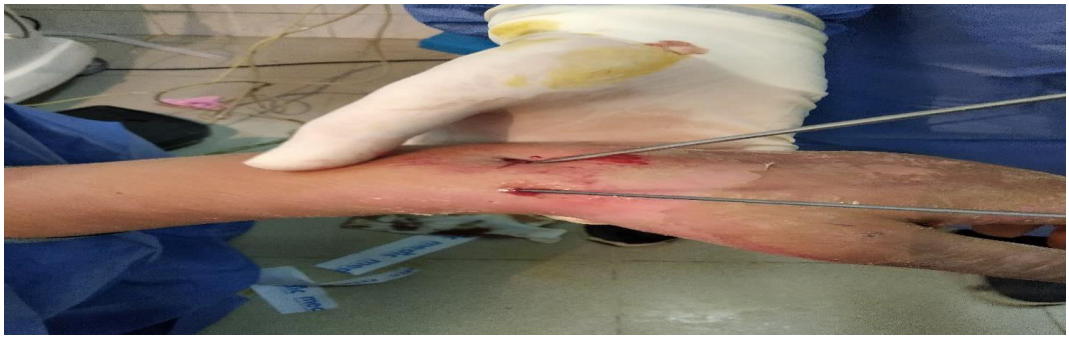

Figure 41: Intraoperative C-arm images and photos of the case (2)

***Follow up*:** He continued following up in the outpatient clinic till k-wires removal. He regained full range of motion by three weeks after cast removal.According to Green and O'Brien Score (Cooney modification) score the result was excellent. The patient suffered no pain with the full range of motion.

Figure 42: 4 weeks post-operative x-ray of the case (2).

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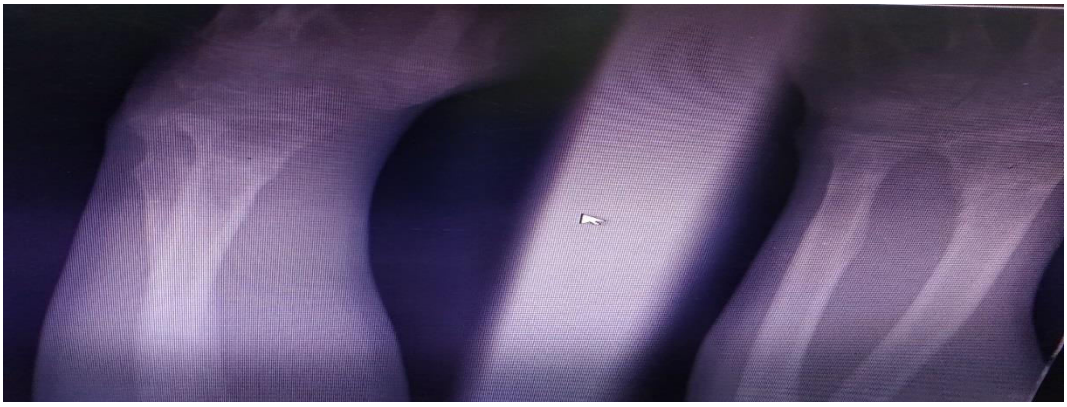

Figure 43: 8 weeks post-operative x-ray after removal of K-wires of the case (2).

Figure 44: flexion, extension and handGripstrength case (2)

4. Discussion

Fractures of the distal radius are the most common of all orthopedic injuries accounting for nearly 16–20% of all fractures presenting to the emergency department. Some surgeons advocate treatment by manipulation and plaster immobilization [6].

Distal radius fractures are the most common fractures of the upper extremity seen in clinical practice. The commonest mode of injury is a fall on an outstretched hand, although it is not uncommon in high-energy trauma patients. Distal radius fractures have been a subject of ongoing discussion for over two hundred years [7].

Mal-union of distal radius fractures leads to post-traumatic arthritis, mid-carpal instability, and pain. Conservative treatment of minimally displaced and stable fractures of a distal end of radius in elderly patients usually shows a good outcome, but the treatment of severely displaced and unstable fractures has been controversial. The functional results in patients with significant radial shortening are poor [8].The management of distal radius fractures has undergone tremendous changes in the recent past owing to a better understanding of pathological anatomy, mechanism of injury, and development of newer implants. The objective of the treatment of distal radius fracture was to restore the anatomy of the wrist to obtain early painless function. Closed reduction and cast immobilization, percutaneous pin fixation, external fixator, volar locking plate, and intramedullary nail fixation have been used as a single or combined procedure in the management of distal radius fractures [9]. Closed reduction and percutaneous Kirschner wires (K-wire) fixation with plaster immobilization is one of the commonest modes of treatment employed in the management of distal radius fracture [10].

The patient outcomes rely on the metaphyseal alignments after reduction, including radial height, radial inclination, ulnar variance, and dorsal/palmar tilt. In an attempt to predict functional outcomes, the poorer functional outcome could be predicted by age, residual dorsal angulation, positive ulnar variance, and carpal mal-alignment[11]. Hence, good quality reduction is the main factor of a satisfactory outcome.

The reduction K-wire technique was firstly described by Adalbert Kapandji in 1976 [12]; the Kapandji pinning technique is typically used and maintained throughout the fracture-healing period. Most authors apply a short-arm casting after percutaneous pinning up to 6 weeks [13]; the Kapandji technique

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is typically indicated for displaced 2-part Colles' fracture without involving the articular surface and no or minimal comminution of the dorsal cortex, and extra-articular and intra-articular fractures with only one fracture line. In general, the Kapandji technique is not recommended for intra-articular fractures involving the radio-carpal joint and severe osteoporotic bone [14].

The main purpose of this study was to evaluate the results of union and healing and the outcome of fracture distal radius after using percutaneous fixation with Kapandji's technique.

This was a Prospective Interventional study, which was conducted on 18 cases with a distal radial fracture at Zagazig university hospital; the study was carried out for six months.

Analysis of our findings regarding sociodemographic characteristics of studied cases revealed that the age of the patients ranges 22 – 65 years with mean of 44.67 years;the majority of patients were females by 55.6%.

In comparison to our findings, the study of **El-Adawy et al., 2018** [10] .reported that the age of the patients ranged from 18 to 63 years, with a mean of 45 years; 56 (80%) patients were from 20 to 50 years of age, and 14 (20%) patients were from above 50–63 years of age. A total of 40 (57.14%) patients were males, and 30 (42.85%) patients were females.

In another study of **Fanjalalaina et al., 2016** [15],**which** was a single-center prospective comparative study from January to June 2013, Patients were randomly assigned to Group 1 or Group 2. Forty patients were enrolled on18 in Group 1 (Kapandji treatment) versus 20 in Group 2 (no operative treatment) and reported that of the 38 included patients, 25 were female and 13 males. The mean age was 48 (17-77) years.

In contrary to our findings, the study of **Bhasme et al., 2018** [7], was conducted on 30 patients with fractures of the distal radius were studied both prospectively and retrospectively at Karnataka Institute of Medical Sciences, Hubballi, Karnataka, from July 2016 to July 2017. The mean age of the patients at the time of presentation of the fracture was 45 years, with the youngest patient being 21 years and the oldest patient being 75 years. Sex Distribution-There were 21 male (70%) and nine female (30%) patients.

Distal radius fractures are the most common fractures of the upper extremity. The commonest mode of injury is a fall on an outstretched hand. Closed reduction and percutaneous pinning with 'The five-pin technique' improves the reliability of fixation [7].

Furthermore, as regard fractures characteristics of the studied patients, we found that the right side was fractured in 72.2% of the patients. The predominant type was closed fracture in 72.2% of patients. 44% of the patients came after a week since fracture, 28% of the patients came in less than a week since fracture, and 28% of the patients came on the same day of the fracture.

While in the study of**Bhasme et al., 2018**[7]reported that16 patients were operated on in less than one week, nine patients in 1 to 2 weeks, and five patients by 2-3 weeks.

El-Adawy et al., 2018[10]demonstrated in his study that Patients with 0 days before intervention were 16 (22.85%), patients with one day before intervention were 16 (22.85%), patients with two days before intervention were 20 (28.75%), and patients with 3–7 days before intervention were 18 (25.71%).

Moreover, the study of **Mirhamidi and Bayat, 2013**[16]was a prospective study performed on 45 patients with extra-articular distal radius fractures. Of these, 23 were treated with extra-focal pinning technique, and 22 were treated with Kapandji technique and revealed that of the 23 patients in the extra-focal group, 4 (17.4%) were left hand dominant, and 19 (82.6%) were right hand dominant and in 56.52% the fracture was at dominant hand. Of the 22 patients in the Kapandjigroup, 2 (9.1%) were left-hand dominant, and 20 (90.9) were right-hand dominant, and in 54.54%, the fracture was at the dominant hand. The mean age in the extra-focal group was 49.52±22.46 (S.D.) (17- 82) and in the Kapandji group was 42.68±20.53 (S.D.) (18-84).

The Müller AO classification of distal radius fractures (DRFs) was first published in 1987 as a part of the group's overall classification system for long bone fractures.This scheme was adopted by the Orthopedic Trauma Association as the system of choice in 2007 and termed the "AO/OTA Classification of Fractures and Dislocations."It was originally designed to provide a measure of injury

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severity, provide information for planning treatment, and facilitate scientific communication. It remains one of the most widely used classification systems for DRFs in clinical research today [17].

In the current study, A.O. classification of the studied patients revealed that A2 was the predominant classification in 55.6% of the patients, A3 was found in 33.3%, and B1 was found in 11.1%.This comes in comparison with the study of **El-Adawy et al., 2018**[10]where according to the A.O. classification, there were 40 patients with A2 fractures, 26 patients with A3 fractures, and four patients with B1 fractures, and all 70 patients sustained closed distal radius fractures.

In another study by**Puripun et al., 2019**[14], According to the AO/OTA classification, the fractures were classified on the basis of the pre-operative radiographs as B2 in 5.26% of cases, B3 in 17.5%, C1 in 56.14%, and C2 in 21.05%.

Moreover, the study of **Shahid and Robati, 2013**[18], demonstrated thatthe fractures according to the A.O. classification revealed type A (61 patients), type B (4), and type C (5). An x-ray for one patient was unclassified, and for nine patients, data is unknown.

On the other hand, in the current study, the predominant mechanism of the injury in 44.4% of patients was fall, 27.8% were a sport, and 27.8% were RTA, this is in comparison with the study of **Rozental et al.,2002**[19] found that majority of these open distal radial fractures resulted from high energy injuries. **Shahid and Robati, 2013**[18] data, however, showed that only 33.3% were high energy injuries (majority comprising falls from height- 54.5%) and the remainder low energy injuries (majority comprising from falls- 94.3%). Falls, in general, were the most common mode of injury (62.9%) and occurred mostly in females (92.4%). More men, however, suffer injuries from falls from height (54.2%) and vehicle RTA (78.6%).

McQueen and Jupiter, 1999[20] also again record similar trends for closed distal radial fractures where falls (81%) were the most common injury mode and in females (85%).

Distal radial fractures are among the most common fractures encountered. These fractures are second only to hip fractures as the most frequent fragility fractures. Considering the general increase in life expectancy of the population, the number of distal radial fractures can only be expected to increase in the coming decades. The importance of anatomic reduction has been demonstrated by clinical studiesas well as by laboratory assessment of force and stress loading across the radio-carpal joint[21].

In the present study, we found that the mean operative time was 11.72 ±2.19 min and mean hospital time 1.19 ± 0.349 day, and this comes in comparison with the study of**Puripun et al., 2019**[14]. in which timing to surgery averaged 4.77 days. The operation time averaged 61.32 minutes.

Distal radius fractures (DRFs) are a common occurrence in clinical practice and account for 20% of all fractures seen in emergency departments. Due to the involvement of the wrist joint, patients often have limited range of motion (ROM) in multiple planes of movement - namely, wrist flexion and extension, wrist radial and ulnar deviation, forearm supination and pronation. As the wrist joint is imperative for the proper function of the hand, fundamental hand functions such as making a full composite grip and thumb opposition are also often affected despite not being injured. These can adversely impact on one's ability to perform activities of daily living (ADLs), work or leisure, which causes loss of productive work hours, the school inattendance, loss of independence, and even lasting disability – extending beyond the direct healthcare costs. Hence, occupational therapists and patients spend a considerable amount of time addressing these multiple ROM impairments with the aim of functional restoration [22].

In addition to the above findings, the present study revealed that Median casting time was 6 weeks with mean union time was 5.06 ±0.873 week, mean ± S.D. of ROM time after cast removal was4.53 ± 0.944, and median immobilization time was 4 weeks.

In comparison to our findings, the study of **Puripun et al., 2019**[14]reportedthatthe range of motion was evaluated three months postoperatively compared with the contralateral wrist. Even though statistically significant differences were observed between the post-operative range of motion and contralateral wrist motion, all patients were able to achieve the functional range of motion for activities of daily living without pain.Moreover, the clinical outcomes were evaluated using the modified Mayo wrist scoring system24, including pain, motion, grip strength, and the ability to return to regular employment or activities every two weeks postoperatively until ten weeks. Good to excellent outcomes could be achieved in most cases. An excellent result was defined as 90 to 100 points, good was 80 to 89, the fair was 65 to 79 points, and poor was <65 points.Furthermore, in the present study, we assessed the radial

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inclination before and after surgical treatment and found that there was a significant increase in radial inclination postoperatively.In accordance to our findings, the study of **Neto and Lhamby, 2015**[23]reported that the mean pre-operative radial inclination was 13.14° (range: 4° to 26°) and the mean post-operative measurement was 21.18° (range: 15° to 28°),

with mean correction of 8.47°. Another study of **Puripun et al., 2019**[14]revealed that the average immediate post-operative radial length was 10.89 mm, the radial inclination was 21.15 degrees, and volar tilt was 10.23 degrees. Statistically significant differences were found between the pre-operative and post-operative parameters. In contrast, all parameters exhibited no statistically significant differences between the post-operative injured side and the contralateral side. All patients achieved complete fracture union and maintained good reduction after locking compression plate (LCP) fixation.

Kapandji technique has some theoretical and biomechanical advantages upon the extra-focal techniques. Of these is that the fixation in the Kapandji method is dynamic in contrast to extra-focal fixations in which it is more static, and its configuration is much biomechanically stable. Although Kapandji method may lead to collapse of fracture site because of its dynamic fixation that is not confirmed to has significant difference among other methods of wire insertions, but it also may lead to soon and rigid fixation and better functional outcome because of less immobilization [24].

Moreover, we demonstrated that mean ± S.D. of Volar tilt preoperatively was -13.44 ± 10.92, with Range -36 – 0, and mean ± S.D. of Volar tilt postoperatively was 8.72 ± 2.39, with range 5 – 12, and there a significant increase in Volar tilt postoperatively.

In another study by**Khadkaet al., 2017**[25] reported that at final follow up at 24th week, radial height was 9.23mm (p-value 0.467), radial inclination 21.33 (p-value 0.941), and volar tilt was 6.37 (p-value 0.126).

In the study on our hands, we assessed the radial height before and after surgical treatment and found that mean ± S.D. of radial height was 2.22 ± 1.96 preoperatively, with range 0 - 6, and mean ± S.D. of radial height postoperatively was 9.83 ± 2.48, with range 7 – 15, and they're a significant increase in radial height postoperatively.

In agreement with our findings, the study of **El-Adawy et al., 2018**[10] reported that the Assessment of post-operative radiographs showed that the average radial height was 11 mm (range: 7–15 mm). The average volar tilt was 8.5° (range: 5–12°) on immediate post-operative radiographs.

Refai et al., 2019[26]**reported** thatthe mean radial height was 8.033 with SD ± 3.46 and according to the T-test there is a statistically significant relationship between palmar inclination and functional score r (28) =.661, p < 0.006.

Yang et al., 2014[27]which wasa retrospective cohort study on patients who sustained such fractures treated with percutaneous pinning. The main outcome measures in this study included four radiographic measurements: radial height, radial inclination, radial tilt, and ulnar variance**,** all fractures in this cohort were diagnosed as displaced, meaning the fractured fragments were out of normal alignment. The mean (±SD) RH, RI, RT, and UV values in groups 1 and 2 patients before fracture reduction were 9.63 (±2.84) mm versus 8.76 (±2.31) mm (P =0.143), 20.00 (±5.37) degrees versus 18.63 (±4.43) degrees (P = 0.228), −17.64 (±12.81) degrees versus −19.01 (±9.81) degrees (P = 0.757), and 3.25 (±3.04) mm versus 3.74 (±2.24) mm (P = 0.617), respectively. Attempts to manipulate the fractured fragments back into acceptable alignment were performed through the above-mentioned surgical techniques. The mean (±SD) RH, RI, RT, and UV values in groups 1 and 2 patients after fracture reduction were 11.82 (±2.32) mm versus 12.13 (±1.80) mm (P = 0.510), 23.63 (±4.05) degrees versus 24.36 (±2.60) degrees (P = 0.323), 2.06 (±5.78) degrees versus 3.78 (±4.35) degrees (P = 0.136), and 1.36 (±2.70) mm versus 1.37 (±1.65) mm (P = 0.996), respectively. Although there were no significant differences in the radiographic measurements before/after fracture reduction between the two groups, the reduction technique used in group 2 patients produced a more anatomic reduction in R.H. (2.20 ± 2.32 mm versus 3.38 ± 2.06 mm, P = 0.010) and RI (3.64 ± 2.59 degrees versus 5.73 ± 3.86 degrees, P = 0.015) compared to that used in group 1 patients (other $P \geq 0.136$).

Regarding outcome, in the present study, we found that 11 (61.1%) patients were excellent, and 7 (38.9%) patients were good.

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In agreement with our findings, the study of **El-Adawy et al., 2018**[10]reported that thirty-six (51.4%) cases got an excellent score, 18 (25.7%) cases were good, 12 (17.1%) cases were fair, and four (5.7%) cases were poor.

Kapandji pin fixation technique is easy to perform and offers good surgical outcomes (anatomic reduction and stable fixation leading to good functional results). Thus, it is the most operative technique used by orthopedists. **Strohmand et al.**, **2004**[28] confirmed these good outcomes in a randomized study comparing intra-focal Kapandji-pinning and Willenegger- styloid pinning in the treatment of Colles' fractures. They used Martini score to define the best technique. Kapandji group resulted in excellent or good outcomes whereas Willenegger group resulted in only good or satisfactory results.

In **Puripun et al., 2019**[14]series, 74% excellent or good Herzberg score were obtained in Kapandji group at 2 months. These results are also comparable to those reported in patients operated under general anesthesia. It must be noticed that functional results will be improved along the functional rehabilitation.

Ruschel and Albertoni, 2005[2], effectively reported 72,1% excellent results at 3 months, 89,7% at 6 months and 96,6% at 12 months.

Finally, regarding complications, we revealed that 10 (55.6%) patients have superficial infection, and one (5.6%) patient have tendon injury. No patients reported to have sudek's atrophy.

In **Puripun et al., 2019**[14]**,** no major medical complications were recorded during surgery. No patient had an infection, delayed union, or nonunion. Only one 57-year-old woman could not achieve the satisfactory reduction by intra-focal K-wire technique due to bone fragility and long-term use of bisphosphonate.

Iatrogenic metaphyseal comminuted fracture occurred during the process of the fragments being levered by K-wires; they had to perform dorsal incision for adequate approach and satisfactory reduction. Double plates were applied thereafter.

In**Refai et al., 2019**[26] **study,** Post-operative complication was encounter in six cases. Four cases had pin tract infections. Eradicated with antibiotics in all cases through follow-up. Two cases had loss of reduction and refused revision. Two cases had carpal tunnel syndrome, and one had superficial radial nerve numbness.

In a previous study by**Peyroux et al., 1987) **[28]treated 159 cases of distal radius fractures with the Kapandji technique and introduced the use of a third pin for more complex fracture patterns. However, the majority of the fractures were extra-articular fractures with minimal to moderate posterior comminution. Postoperatively plaster casts were placed for any fixation that demonstrated movement at the fracture gap with flexion and extension. Complications included secondary displacement, infection, pin migration, tendinous complications, and nervous complications. Results revealed 91 % subjective good/very good results, 93 % good/very good range of motion, and 73 % good/very good radiographic results. Subsequent large-scale studies expanded indications and also demonstrated more frequent use of plaster casting all with largely satisfactory results.

Zhu, et al., 2016[5]performed a Cochrane review on percutaneous pinning of distal radius fractures and concluded that while there was some evidence to support the use of percutaneous pinning, no recommendation could be made on type and indications for pinning. It was noted that Kapadnji type pinning was found to have higher risks of complications in trials included in the review. Common complications associated with Kapandji pinning include loss of fracture reduction, tendon rupture, radial sensory nerve irritation, and reflex sympathetic dystrophy**.**

In conclusion, percutaneous pinning by Kapandji technique is an excellent technique for both extra-articular and intra-articular fractures in cases without severe comminution of the distal radius. The technique involves a minimal procedure that provides anatomic reduction, fracture fixation, and maintenance of reduction with an adequate method of immobilization.

6.Conclusion

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Applying the intra-focal Kapandji pinning technique was feasible as a reduction tool for unstable intra-articular fracture of the distal radius. This reduction technique not only could be easily performed but is also reproducible. The satisfactory reduction alignment could be accomplished with minimal leverage force .From the results obtained, it is a minimally invasive procedure that is simple to perform and fast. It can be done by trauma surgeons and produces acceptableradiological results. The complications encountered with the original method can be avoided. This operation is easy to carry out and minimally invasive, with minimal surgical complications. It is a low-cost method and produces reliable bone stability.

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