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## A study of the functional outcome of distal end radius fractures treated by intrafocal technique of Kapandji

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### Abstract

This study is aimed to assess the functional outcome of performing intrafocal technique of Kapandji in case of displaced extra-articular fracture of distal end of radius with 26 subjects, with Gartland and Werley Scoring, 64% patients had excellent results and 36% had good results and radiological assessment by Sarmiento modification of Lindstorm criteria, almost all patients turned out to be excellent.

**Keywords:** Extraarticular, distal end radius, kapandji technique, intrafocal

### Introduction

Distal end of radius fractures seem to be the most common fracture currently seen in accident and emergency units. These most common fractures encountered by orthopaedic surgeons account for 17.5% of all adult fractures [1, 2, 6].

The average age of all distal radius fractures in adults has been reported to be between 57 and 66 years with females being on an average in their 60s and men in their 40s. Young adults sustain these fracture following high energy trauma and older population group sustain these injury following domestic fall [6, 7].

Distal radius fractures, even undisplaced ones, when treated conservatively, suffer from secondary displacement. Distal radius is important in kinematics of radiocarpal and radioulnar joints, hence proper reduction of articular surface, restoration of radial height, volar tilt, radial inclination are prerequisites for good clinical outcome.

Failure to achieve and maintain reduction leads to visible deformity, degenerative arthritis, distal radioulnar and radiocarpal instability and ulnar impaction syndrome with resultant pain, decrease in mobility, decrease grip strength and function. Distal radius is foundation of wrist joint and indispensable part of ligamentous support. So reconstruction of articular congruity and stable fixation reduce the incidence of post traumatic osteoarthritis and allows early functional rehabilitation. Treatment option include cast immobilization, close reduction with K wiring, external fixation, plating using dorsal approach and volar approach or combination of any of the above. Closed reduction and cast immobilization has been the mainstay of treatment for undisplaced and minimally displaced fractures, after stable reduction in displaced fractures and in infirm and low demand patients. External fixation addressed some comminution but had problems of pin tract infections, tethering of muscle, tendons and capsule, immobilisation, hand stiffness and difficulty to reduce and maintain intraarticular fractures.

Open reduction internal fixation with dorsal and volar plating have been tried to address intra articular fractures and above mentioned troubles, with better outcomes but have hardware complications like irritation of tendons and at times even tendon ruptures.

Volar plating was introduced with ease of lesser dissection per operatively and reduced hardware impingement problems post operatively. Close reduction and internal fixation of distal end radius fracture with K wires and immobilization is done for two part intraarticular fracture or extraarticular fracture. It acts as a supplement to the short arm cast. This study takes into consideration one of such methods of closed reduction and internal fixation by intrafocal Kapandji Technique, in which there will be trapping of distal fragment by buttressing to prevent its displacement.

The wire are passed intrafocally into either dorsal or radial aspect of fracture site or in both sites and is levered to achieve the acceptable alignment, followed by directing them into the opposite cortex [1,6].

**Materials and Methods**

**Inclusion Criteria**

1. Skeletal mature patients with age more than 18 years
2. Closed/open extraarticular fracture of distal end radius
3. With /without involvement of styloid process of ulna
4. Fracture with duration <2 weeks
5. Patients who can come for 6 months follow up
6. Patients who are medically fit

**Exclusion Criteria**

1. Patients with age <18 years
2. Fractures with intraarticular extension
3. Duration of fracture >2 weeks

Patient who is likely to lose for follow up within 6 month  
 Clinical and radiographic evaluation of fracture was done by obtaining plain radiographs in the form of loss of palmer tilt, dorsal angulation, radial shortening, loss of radial inclination and articular incongruity.

**Instruments and Implants**

1. T handle with chuck and key
2. Hand drill
3. Power drill
4. Wire Bender
5. Wire Cutter
6. Plier
7. 1.5mm K wire
8. 1.8mm K wire
9. 2mm K wire
10. Plaster Of Paris

**Surgical Technique**

1. Under anaesthesia.
2. Under aseptic precaution, paint drape done and affected wrist kept free.
3. 1.5/1.8/2mm K wire just drilled intrafocally into the fracture site from the dorsum under IITV guidance.
4. K wire used to lever the dorsal displacement and reduction confirmed in lateral view under IITV and passed across the opposite cortex.
5. Another k wire passed intrafocally into fracture site from radial aspect and used to lever the radial displacement and confirmed in AP view under IITV and passed across the opposite cortex.
6. Another k wire passes from the styloid process of the radius across the fracture site upto the opposite cortex to maintain the reduction obtained by intrafocal pin which caused the buttress effect.
7. According to the convenience of the surgeon, another k wire has also been passed from the ulnar notch across the fracture site upto opposite cortex.

**Post-Operative Protocol**

Post operatively dorsal below elbow slab placed beneath elbow upto the neck of metacarpal and maintained upto 4-6 weeks followed by which, after confirmation after 6 weeks if radiological evidence of union was seen, k wires were removed and range of motion exercises were started with follow up after 3 months and 6 months.

**Evaluation of Outcome**

**Radiological:** The follow up protocol was 6 weeks, 3 months, and 6 months. Clinical & radiographic assessments were performed at every visit. Radiological assessment included measurements of volar tilt, radial height & radial inclination & they were assesses according to the Sarmiento's modification of Lind storm criteria.

**Table 1:** Shows Residual deformity, Loss of palmer tilt (degrees), Residual shortening (mm) and Loss of radial deviation (degrees)

	<b>Residual deformity</b>	<b>Loss of palmer tilt (degrees)</b>	<b>Residual shortening (mm)</b>	<b>Loss of radial deviation (degrees)</b>
Excellent	No or significant	0 <sup>0</sup>	<3mm	<5 <sup>0</sup>
Good	Slight	1 <sup>0</sup> to 10 <sup>0</sup>	3 to 6 mm	5 <sup>0</sup> to 9 <sup>0</sup>
Fair	Moderate	11 <sup>0</sup> to 14 <sup>0</sup>	7 to 11mm	10 <sup>0</sup> to 14 <sup>0</sup>
Poor	severe	At least 15 <sup>0</sup>	At least 12mm	>14 <sup>0</sup>

**Clinical**

Wrist range of motion was measured in flexion, extension, Pronation, Supination, ulnar deviation & radial deviation and

was compared with uninjured limb. Strength was evaluated by manual method. The overall function of the upper limb was assesses using the Gartland & Werley Score.

**Table 2:** Gartland and Werley Score (demerit system)

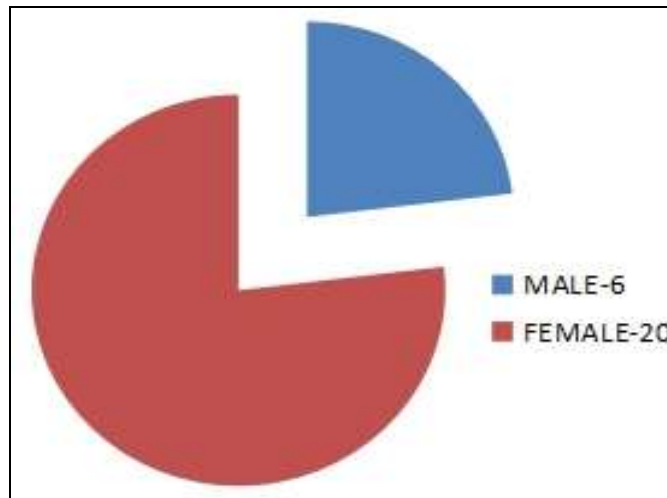
<b>Residual deformity</b>	<b>Prominent ulnar styloid</b>	<b>1</b>
	Residual dorsal tilt	2
	Radial deviation of hand	3-3
Subjective evaluation		
	Excellent: No pain, disability, or limitation of motion	0
	Good: Occasional pain, slight limitation of motion, no disability	2
	Fair: Occasional pain, some limitation of motion, feeling of weakness in wrist, no particular disability if careful, activities slightly restricted	4
	Poor: Pain, limitation of motion, disability, and activities more or less markedly restricted.	6
Objective evaluation		
	Loss of dorsiflexion	5
	Loss of ulnar deviation	3
	Loss of Supination	2
	Loss of palmar flexion	1
	Loss of radial deviation	1
	Loss of circumduction	1
	Pain in distal radio-ulnar joint	1
Complications		

	Arthritis change	
	Minimal	1
	Minimal with pain	3
	Moderate	2
	Moderate with pain	4
	Severe	3
	Severe with pain	5
	Nerve complications (median)	1-3
	Poor finger function due to cast	1-3
Result	0-2	excellent
	3-8	good
	9-20	fair
	>20	Poor

**Results and Discussion**

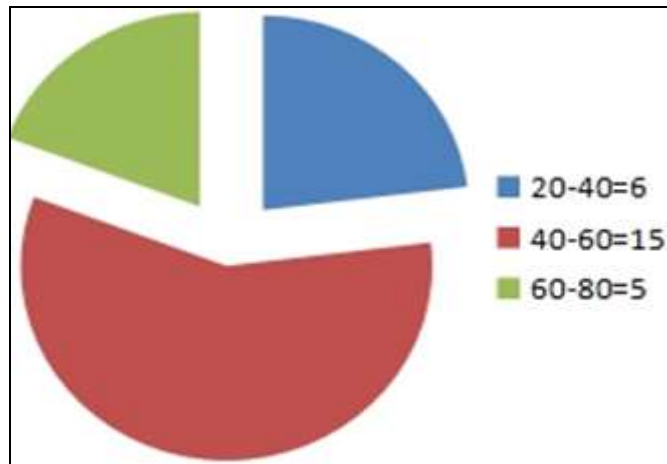
Our study included 26 patients with distal end radius after taking appropriate consent, who were treated by intrafocal

pinning technique of Kapandji. 1 Female patient lost to follow up.



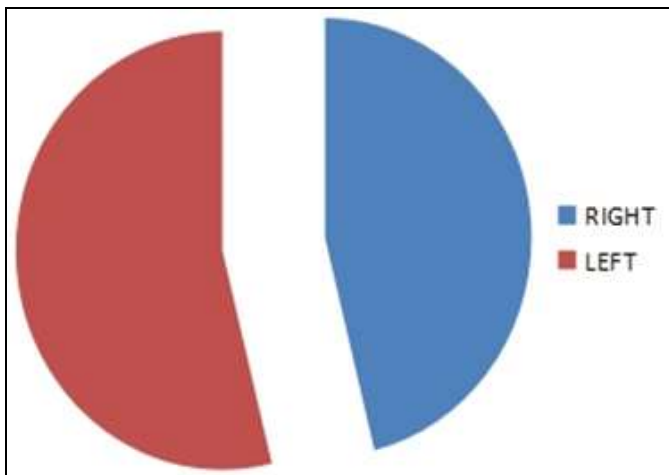
Out of 26 patients, 6-male and 20-female.

**Chart 1: Sex Distribution**

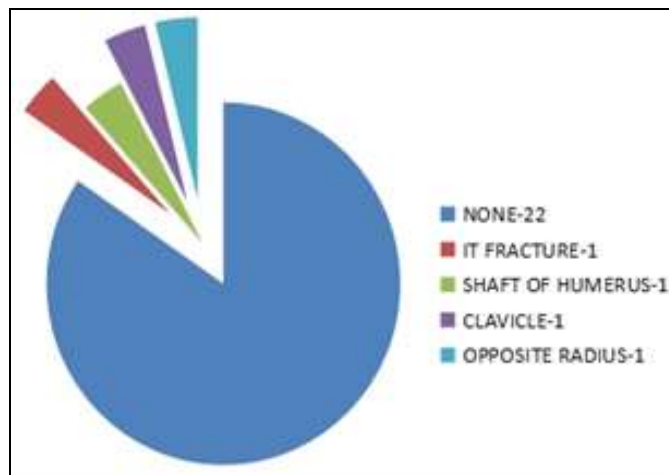


Mean age -49.3      Youngest age-26      Eldest age-72  
 Average age male- 50.8      Average age female-48.8

**Chart 2: Age Distribution**

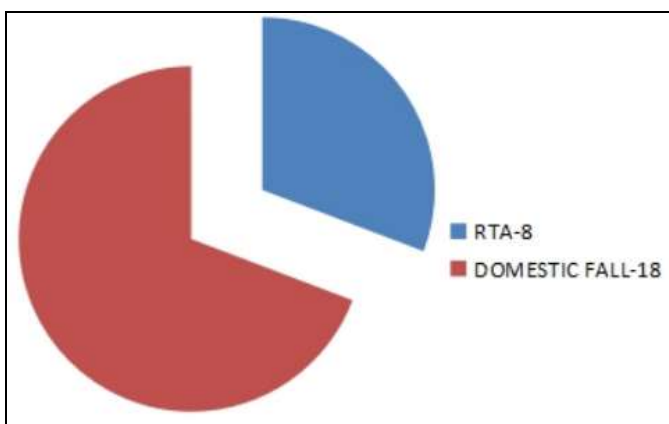


**Chart 3:** Side Involved



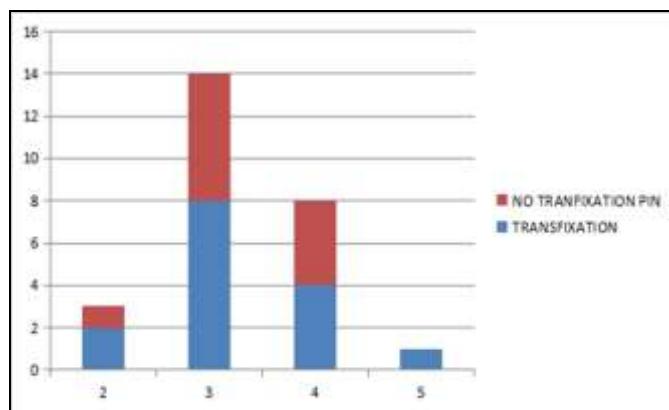
**Chart 5:** Associated Injuries

12 Patients were affected on the right side, out of which 10 had right predominance and 14 on the left side, out of which 2 had left predominance.



**Chart 4:** Mode of Trauma

Incidence of domestic fall was more as compared to road traffic accident (RTA).



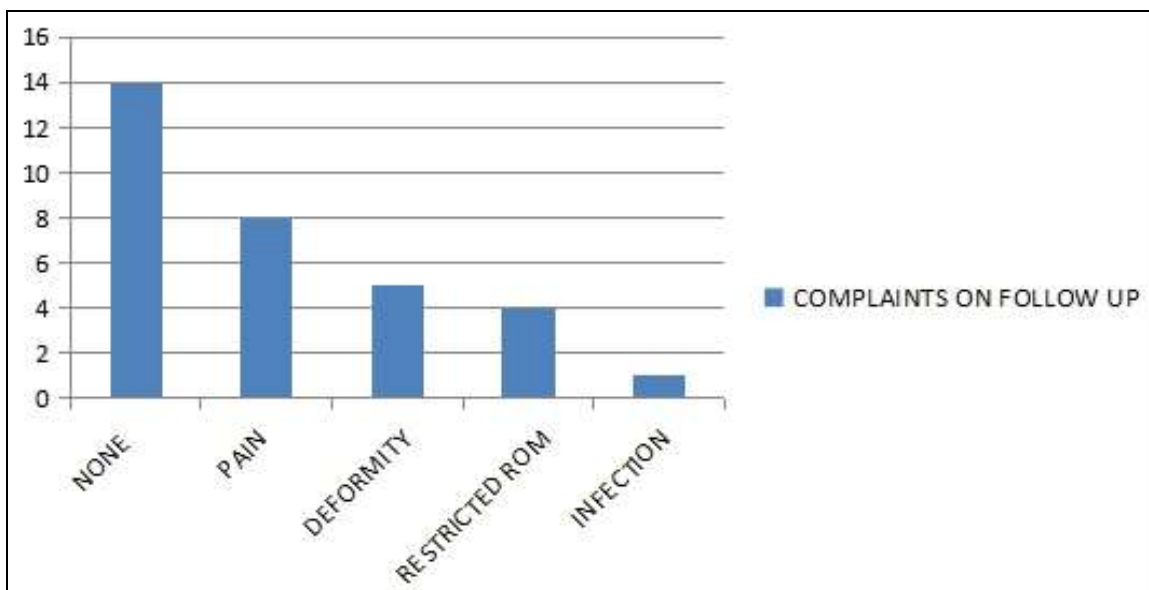
**Graph 1:** Number of K Wires Used

**Time Taken During Surgery**

The average time taken during the surgery was 15 minutes.

**Cost of Implants**

Each K wire costs approximately Rs.40. The average amount of implants (K wires) used per surgery was Rs.120.



**Graph 2:** Complaints on Follow up

Out of all the patients, 14 had no complaints on follow up, 8 had pain, 5 had deformity out of which 1 had prominence over the dorsum and 4 had prominent ulnar styloid, 4 had

restriction in the range of motion and 1 had infection. Few of the patients had overlapping complaints too.

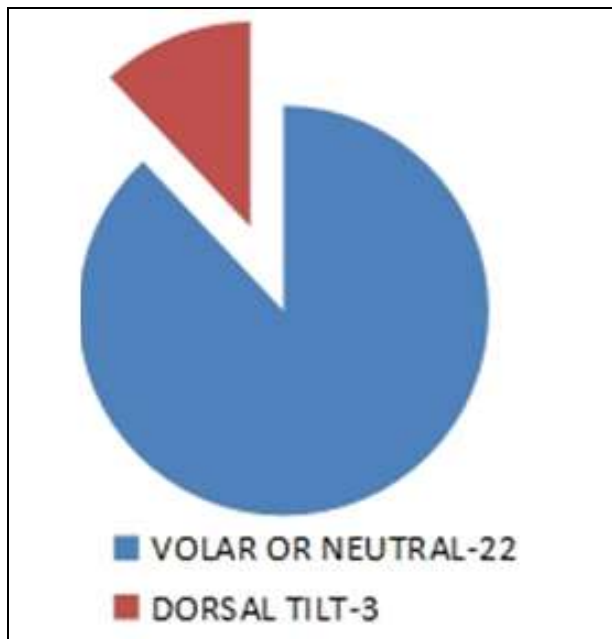


Chart 6: Palmar Tilt and Neutral/Dorsal Tilt

As per the acceptability criteria, the distal surface should have neutral tilt or volar tilt. 22 patients had either volar tilt (6 patients) or neutral tilt (16) and 3 patients had dorsal tilt.

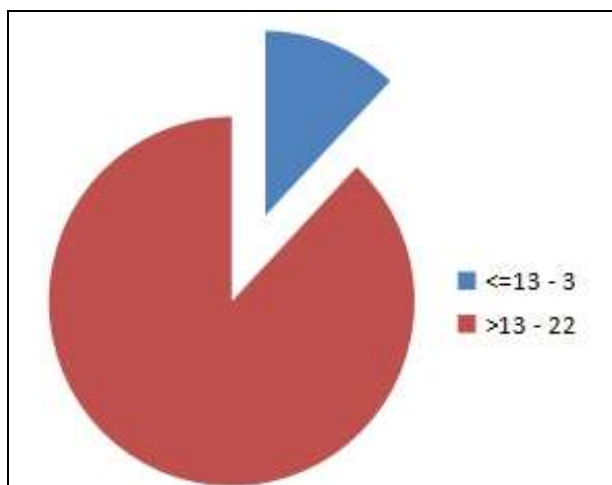


Chart 7: Radial Inclination

As per the acceptability criteria, radial inclination should be more than 13. 22 patients had more than 13 and 3 patients had less than or equal to 13.

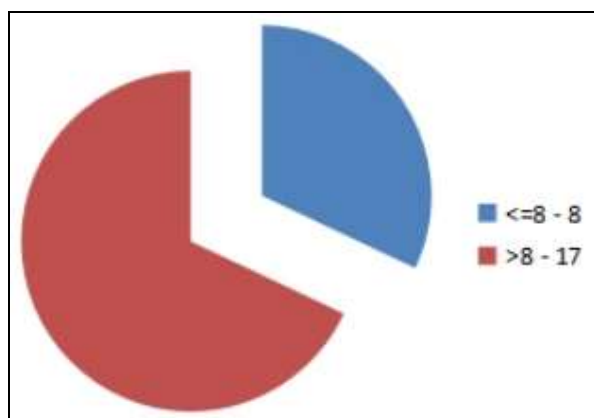


Chart 8: Radial Height

As per the acceptability criteria, the radial height should be more than 8. 17 patients had more than 8 and 8 patients had less than or equal to 8

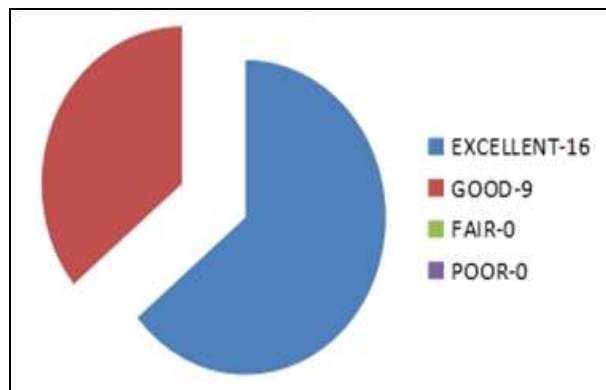


Chart 9: Gartland Werley Scoring

As per Gartland and Werley functional outcome scoring, we had excellent (16 patients) to good (9 patients) results.

Range of Motion

Table 3: The average range of motion achieved was as follows

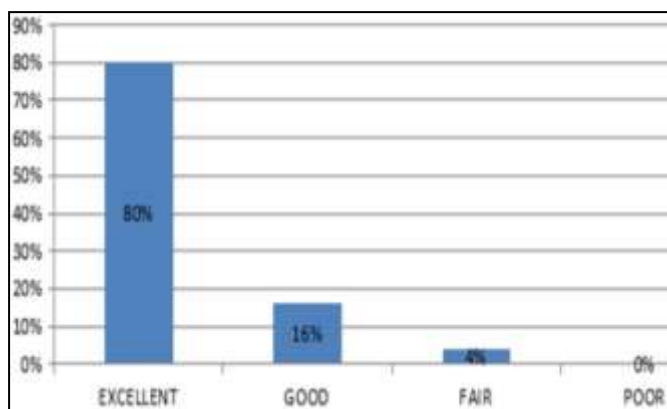
Movement	Range
Dorsiflexion	62
Palmarflexion	60.4
Pronation	82.6
Supination	80.8
Radial deviation	11.8
Ulnar deviation	29.8

Table 4: Sarmiento Modification of Lindstorm Criteria

	Residual deformity	Loss of palmar tilt (degree)	Radial shortening (mm)	Loss of radial inclination (degree)
Excellent	No/Insignificant	0	<3	5
Good	Slight	1-10	3-6	5-9
Fair	Moderate	11-14	7-11	10-14
Poor	Severe	>14	>11	>14

Table 5: Residual Deformity

Residual deformity	No. of Patients[%]	Results
No/insignificant	20(80%)	Excellent
Slight	4(16)	Good
Moderate	1(4)	Fair
Severe	0	Poor

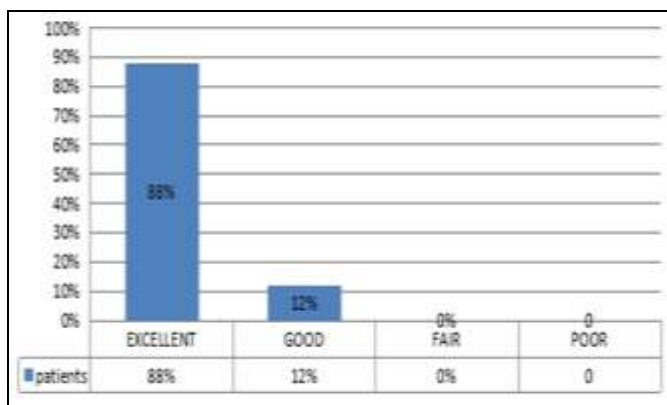


Graph 3: Residual Deformity

Only 3 patients showed deformity on follow up, 1 with dorsal prominence and 2 with prominent ulnar styloid and overall 22 patients showed excellent result.

**Table 6:** Loss of Palmar Tilt

Loss of Palmer tilt {degrees}	No. of Patients[%]	Results
0	22[88%]	Excellent
1-10	3[12%]	Good
11-14	0[0%]	Fair
At least 15	0	Poor



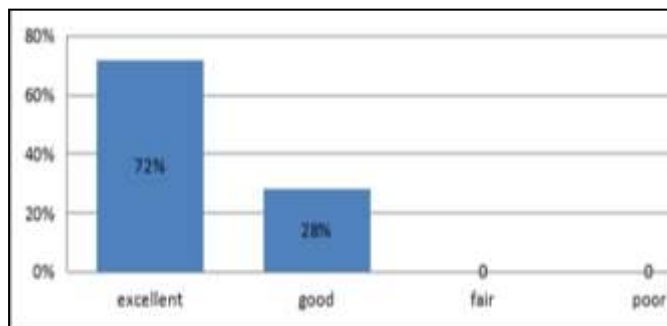
**Graph 4:** Results based on loss of palmar tilt

22 patients showed excellent results with neutral or volar tilt and 3

patients showed good result due to loss of volar tilt by 1-10 degree. The average palmar tilt was 0.88.

**Table 7:** Radial Shortening

Radial shortening in mm	No of Patients [%]	Results
<03	25[100%]	Excellent
03-06	0[0%]	Good
07-11	0	Fair
>11	0	poor

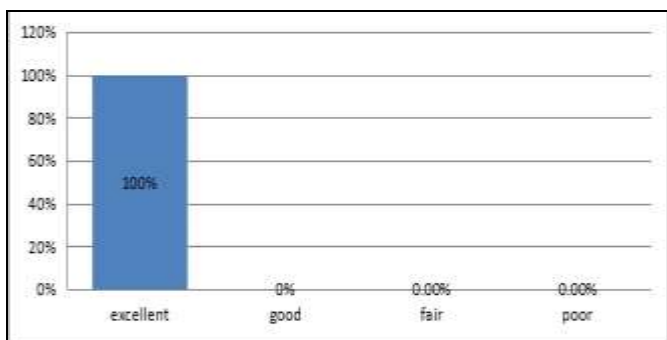


Minimum radial height achieved was 6 only in 1 patients, rest all had an acceptable radial height >or= 8, hence none showed loss of radial height more than 3, hence all 25 patients showed excellent result.

Average radial height was 9.32.

**Table 8:** Loss of Radial Inclination

Loss of Radial Inclination	No of Patients [%]	Results
<5	25	Excellent
5-9	0	Good
10-14	0	Fair
>14	0	poor



**Graph 6:** Loss of Radial Inclination

Average radial inclination was 20.24 and the least was 10. None had radial inclination deviated more than 5 degree from 13, hence all the patients showed excellent results.

**Table 9:** Complications

	No. of patients (%)
Infection	1(4%)
Prominent Ulnar styloid	4(16%)
Residual dorsal tilt	1(4%)
Radial deviation of hand	0
Carpal tunnel syndrome	0
Reflex sympathetic dystrophy	1(4%)
Irritation/ rupture of tendons	0
Palpable hardware	0
Grip weakness	1(4%)

Hence after the final follow up, and after subjective and objective evaluation of the patients through Gartland And Werley Scoring, 64%-excellent 36%-good results and radiological evaluation by the Sarmiento Modification of Lindstorm Criteria, showing overall results were excellent.

**Table 10:** Gartland and Werley Score

	Excellent	Good	Fair	Poor
Residual deformity	20(80%)	4(16%)	1(4%)	0
Loss of palmar tilt	22(88%)	3(12%)	0	0
Loss of radial inclination	25(100%)	0	0	0
Loss of radial height	25(100%)	0	0	0

- Out of all the patients, 1 patient showed up with infection.
- One patient presented with reflex sympathetic dystrophy at 3 months follow up which relieved at 6 months follow up after medication with pregabalin and nortryptiline and physiotherapy.
- Four of the patients had prominent styloid process but without any functional limitation.
- Three patients presented with ulnar styloid pain(without any fracture of ulnar styloid at presentation) at follow up which was relieved after ultrasonic therapy for 3 weeks.
- The following is the comparison of our studies with other studies for similar fracture pattern treated by Kapandji technique.

**Table 11:** Comparison of results with other studies

	<b>Our study N=26 patients</b>	<b>E. Lenoble <i>et al.</i> [11] (1995) N=54 patients</b>	<b>Antonio Piva Neto <i>et al.</i> [15] N=48</b>
Mean age	49.3(20-75)	57.5+or-18.7	55(20-89)
Palmer flexion	60.4	59	-
Dorsi flexion	62	58	-
Supination	80	76	-
Pronation	82.6	80	-
Radial deviation	11.8	60	-
Ulnar deviation	29.8	61	-
Radial length	9.32(9) mm	-	9.48
Radial inclination	20.24(19) degrees	23.1degrees	21.18(15-28)
Palmer tilt	Neutral	8.2 degrees	3.31(12 to -5)
Gartland and Werley	Excellent-84% Good-8%	Good-80%	Good-80%
Complication	N=3(12%)	N=11 (20.3%)	N=6(12.5)

### Conclusion

- Distal radius fracture is one of the most common fractures. It can occur in any age group, older people following low energy trauma and younger people, due to high energy trauma.
- This method of percutaneous fixation of extra articular fracture of distal end radius by intrafocal technique of Kapandji is safe, less invasive, cost effective, less time consuming with final outcome of excellent to good result as per Gartland and Werley Scoring and Excellent with Sarmiento modification of Lindstorm criteria, by helping in achievement as well as maintenance of the reduction.
- Holds the reduction by buttressing the distal fragment and prevents the collapse, which may occur with closed reduction with cast application and hence prevents malunion.
- Least number of complications have been encountered during the study.

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