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

Dr. Siddhant R Shah, Dr. Mohammed Nawaz M Malik and Dr. Sagar D Khanpara

DOI: https://doi.org/10.22271/ortho.2020.v6.I4j.2409

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 intraarticular 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 [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 assessed according to the Sarmiento’s modification of Lind storm criteria.

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 assessed using the Gartland & Werley Score.

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

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

Table 2: Gartland and Werley Score (demerit system)

| Residual deformity | Prominent ulnar styloid | 1 |
|--------------------|-------------------------|---|
|                    | Residual dorsal tilt    | 2 |
|                    | Radial deviation of hand| 3-3|

Subjective evaluation
Excellent: No pain, disability, or limitation of motion
Good: Occasional pain, slight limitation of motion, no disability
Fair: Occasional pain, some limitation of motion, feeling of weakness in wrist, no particular disability if careful, activities slightly restricted
Poor: Pain, limitation of motion, disability, and activities more or less markedly restricted.

Objective evaluation
Loss of dorsiflexion
Loss of ulnar deviation
Loss of Supination
Loss of palmar flexion
Loss of radial deviation
Loss of circumduction
Pain in distal radio-ulnar joint
| 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

**Chart 2:** Age Distribution

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

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

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.

**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.
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.

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.

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.

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    |
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 palmar 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 patient, 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 unlar 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

|                          | Our study N=26 patients | E. Lenoble et al.13(1995) N=54 patients | Antonio Piva Neto et al.15 N=48 |
|--------------------------|-------------------------|----------------------------------------|---------------------------------|
| 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)                    |
| Palm 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.

References

1. Rockwood and Green’s Operative Orthopaedics.
2. Green’s Operative Hand Surgery, 7e.
3. Hand and Wrist Biomechanics. A Comprehensive Guide. Bernhard Hirt, Harun Seyhan, Michael Wagner, Rainer Zumhasch.
4. The Wrist. Richard H. Gelberman 3e.
5. Mastercases Hand and Wrist Surgery. Kevin D. Plancher.
6. Distal Radius Fracture. Liev M Hove, Tommy Lindau, Per Holmer.
7. Fracture and Injuries of Distal Radius and Carpus. The Cutting Edge. Daviv Slutsky, Lee Osterman.
8. A Randomized Prospective Study of 40 Patients Who Presented To the Tertiary Care Hospital in Gwalior with Fracture of Distal End Radius. Dr Sunit Pal, Dr Gargi Yadu Pal, Dr Sameer Gupta, Dr Tushar Verma, Dr Shrishi Yadu And Dr Ashish Siriskar International Journal Of Orthopaedics Science, 2016.
9. Operative Treatment of Distal Radius Fractures. Jarkko Vasenius, Dextra Hand Clinic, Helsinki, Finland (Soomen Ortopedia Ja Traumatologia Vol 32).
10. Casting Versus Percutaneous Pinning For Extra-Articular Fractures of Distal Radius In Elderly Chinese Population: A Prospective Randomised Controlled Trial The Journal Of Hand Surgery, 2009.
11. Fracture of the Distal Radius. A Prospective Comparison between Trans-Styleid and Kapandji Fixations. E Lenoble, C Dumontier, D Goutallier, a Apoil (Jbjs 1995).
12. Functional Outcome of Unstable Distal Radius Fractures Treated By Percutaneous K Wire Fixation. Chatla Srinivas, Kali Vara Prasad Vadiamani, V.S. Moorthy, P Satish, T. Narasimha Rao, Yamshi Journal Of Evolution Of Medicine And Dental Science, 2015.
13. Functional And Radiological Outcomes Of Distal End Radius Fractures Treated With Closed Reduction And Percutaneous Five Pin Technique- A Prospective Cohort Study. Cherian Jacob, Anoop R L, Nitin Thomas Philip (International Journal of Recent Trends in Science and Technology, 2014.
14. Percutaneous Pinning For Treating Distal Radius Fracture in Adults. Handoll Hhg, Vaghela Mv, Madhok R (Cochrane Library).
15. Fixation of Fractures of Distal Extremity of Radius Using the Modified Kapandji Technique: Evaluation of Radiological Results. Antonio Piva Neto, Pablo Coila Lhamby Review Brazil Orthopaedics, 2011.
16. A Prospective Comparison between Kapandji and Percutaneous Extra-Focal Fixation in Extra Articular Distal Radius Fractures. Seyed Mehdi Mirhamidi, Farzad Merrkh Bayat.
17. Intrafocal (Kapandji) Pinning of Unstable Distal Radius Fractures.SN Parikh, PA Divatia, PN Parikh. Department Of Orthopedics, LG Hospital, Ahmedabad.