Original Research Article

Results of technique of intrafocal pinning in the management of distal radius fractures

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Abstract

Background: The most common fractures that orthopedic surgeons intervene is a distal end of the radius fracture. Restoration of disrupted radial anatomy, early hand mobilization, maintenance of accurate and stable reduction are required for good functional results in unstable distal radius fractures. Intra focal pinning is defined as the insertion of pins into the fracture site that can be used to lever the displaced distal fragment into position. **Aim:** To assess the outcome of intra focal pinning in distal radius fractures in terms of functional recovery and radiological union. To assess the complications associated with the procedure. **Methodology:** The present prospective study conducted between May 2013 and September 2019.Patients who presented with an extra articular fracture of distal radial metaphysis were treated at the department of Orthopaedic Surgery of Aarupadai Veedu Medical College and Hospital and those who were available for follow up were included into the study. 30 patients were included for the study and followed up for a period of 6 months. Based on the criteria patients with distal radius fracture were selected for the study. The surgery was performed either under regional anaesthesia. Reduction was carried out under c-arm guidance and intrafocal pinning was undertaken with 2 Kirschner wires as described by Kapandji. A short arm cast was applied post operatively in each case. The patients were discharged home when their symptoms allowed finger free movements. They were seen at ortho OPD at 4 weeks, when the cast was changed, to remove the wires and for check radiographs. The k wires and plaster were removed at 4 weeks. The range of movement of the wrist and forearm were measured and compared to the normal contralateral side. The functional outcome was scored at each visit using mayo wrist score. **Conclusion:** The radiological parameters were assessed for pre reduction, post reduction, 4weeks and at 3 months. The use of this technique achieves restoration of hand and wrist function through the restoration of alignment and articular surface congruity. From our study, we conclude that Kapandji technique is a simple, cheap, minimally invasive and effective method for the treatment of unstable extra articular distal radius fractures, with good functional results.

Keywords: Distal radius, Kapandji, Intrafocal, pinning

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INTRODUCTION

Fractures of distal end of the radius are the most common fractures that orthopaedic surgeons have to treat. Fracture pattern extends from simple extraarticular to highly communited intraarticular fractures. Nearly 16% of all fractures that are treated in emergency departments involve the distal end of the radius[1].It comprises 75% of all forearm fractures[2].The fractures of distal end radius have bimodal age distribution with the young adults and elderly populations being the most affected [3]. Until 19th century disability due to malunited distal radius fracture was accepted and considered stable. The patient used to get accustomed to the deformity residual limitation of movement, weakness of griping wrist and hand. With changing trend of management and the unacceptability of deformity by patients, a near normal function of wrist had to be achieved. Also closed reduction and external fixation by means of ligamentotaxis to realign fracture

displacement, open reduction and internal fixation by different approach such as dorsal approach and volar approach. Intrafocal pinning is defined as the insertion of pins into the fracture site that can be used to lever the displaced distal fragment into position. Once adequate reduction is achieved, the pins are driven into the metaphysis of the proximal fragment of the radius. The pins act to buttress the distal fragments while maintaining fracture reduction.

MATERIALS AND METHODS

Source of Data

The present prospective study conducted between May 2013 and September 2019.Patients who presented with an extra articular fracture of distal radial metaphysis were treated at the department of Orthopaedic Surgery of Aarupadai Veedu Medical College and Hospital and those who were available for follow up were enrolled into the study. 30 patients were enrolled for the study and follow up for a period of 1 year. Approval was obtained from the ethical committee and informed consent was obtained from all patients.

Method

Closed Reduction And Percutaneous Pinning

Inclusion Criteria

- Adults with extra-articular fractures.
- Unstable fracture
    - Radiological-significant deformity in the presence of comminution of the dorsal fragment.
    - Failure to maintain reduction of the fracture post reduction while the patient was still under general anaesthesia.
    - A fracture that displaced in cast.
- Patient willing for treatment and giving informed written consent.

Exclusion Criteria

- Multiple trauma or other injuries.
- Open fractures.
- Neurovascular injuries.
- Associated musculoskel*et al.* injuries to same arm.
- Inflammatory arthritis.
- Patients who lost for follow up.
- Patients having dementia and psychiatric illness

Implants

1. Kirschner wire of various sizes
2. Hand drill / power drill
3. T handle

Figure 1: Implants

Surgical Procedure:

The patients undergoing pinning had general / regional anaesthesia**.** Closed reduction and percutaneous pinning with K wire is done with patient in supine position. A small incision is made at the site of pin insertion. Kirschner wires are used as the intrafocal pins. The pins required to correct the radial inclination are driven into the radial cortex. The pins are then levered to redirect them proximally before driving them across the opposite cortex in both the posterior-anterior plane and in the lateral plane. Dorsal rotation is corrected. Three or four pins are usually required. Loss of radial inclination and/or radial translation are corrected with one to three Kirschner wires using one pin placed between the first and second compartment, one just dorsal to the second compartment, and one placed in the Lister's tubercle, taking care to avoid the extensor pollicis longus. The Kirschner wires are cut under the skin. A short arm cast was applied post operatively in each case. The patients were discharged home when their symptoms allowed finger free movements. They were seen at ortho OPD at four weeks, when the cast was changed, to remove the wires and for check radiographs. They were subsequently referred to physiotherapist for physiotherapy.

Figure 2: Post op radiograph

Assessment Of Outcome

Standard antero-posterior and lateral radiographs of the wrist were taken with forearm in neutral rotation. The volar tilt of the distal radius expressed as number of degrees from neutral position, the radial length and radial inclination were then measured. The radiological parameters were

assessed for pre reduction, post reduction,4 weeks, 3 months and at 6 months. All patients were discharged after assessment of radiographs. The wires and plaster were removed at 4 weeks. The functional outcome was assessed. The range of movement of the wrist and forearm were measured and compared to the normal contralateral side. The ability to perform activities of daily living was scored at each visit using Mayo wrist scoring.

Movements Of The Wrist: Wrist is a biaxial ellipsoidal joint. The main movements at the wrist are executed through transverse and antero-posterior axis. Palmar flexion and dorsi flexion are affected through transverse axis. Adduction (ulna deviation) and abduction (radial deviation) through artero posterior axis. A combination of these movements with pronation and supination allows circumduction of hand. Ulnar deviation and radial deviation are possible due to slight projection of styloid process, ulnar deviation is more than radial deviation. Radial deviation is checked by ulnar collateral ligament and by contact of lunate bone with the radial styloid process.

Range Of Movements Of Wrist:

Movements	Range
Dorsi flexion	*0-75*
Palmar flexion	*0-75*
Abduction(radial deviation)	*0-20*
Abduction(ulna deviation)	*0-35*

Pronation and supination take place at inferior radio ulna joints,Normal ranges are Pronation 0-75^0 and Supination 0-80^0

Mechanism Of Injury

It occurs most often from fall on the outstretched hand. Although the exact mechanism of fracture is not clear, generally the sharp fracture on the palmar aspect of the radial metaphyseal area. Distal radius fractures that have a shear or compression component produce intraarticular fracture that are more unstable than the bending metaphyseal extraarticular fractures, concommitant ligamentous injuries are therefore to be expected.

RADIOGRAPHS:

The standard series of PA and lateral x-ray views were used to visualize a suspected fracture of the distal radius.

PA View

The following were assessed

(a) radial length
(b) extent of metaphyseal comminution, and
(c) ulnar styloid fracture location (tip/waist/base).

Lateral View

The following were assessed

(a) dorsal/palmar tilt,
(b) extent of metaphyseal comminution,
(c) carpal alignment,
(d) displacement of the volar cortex, and
(e) position of the DRUJ(distal radioulnar joint)

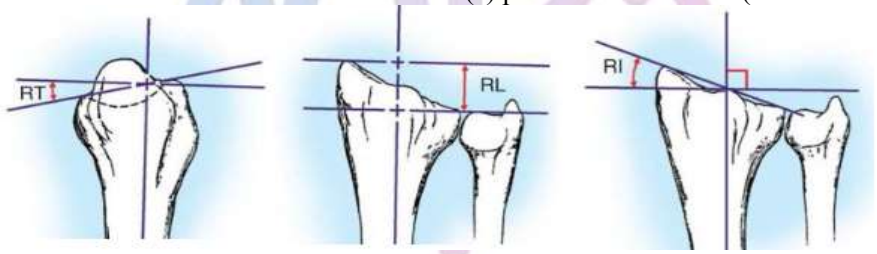


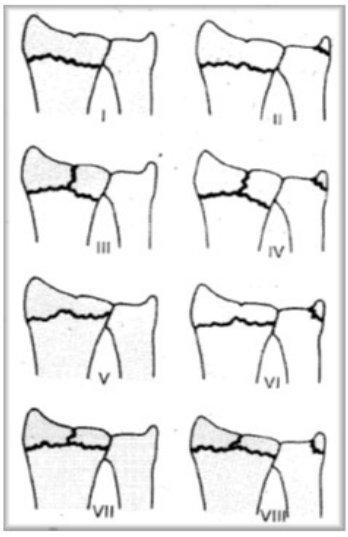
Figure 3: Normal average distal radial angles. Radial inclination (RI; average 22 degrees). Radial length (RL; average 12 mm). Radial tilt (RT; average 11 degrees volar).

CLASSIFICATION

Frykman Classification (1967)

It served as a reasonable method of recognition of different fracture types[6]

Fractures	Distal ulnar fractures	
	Absent	Present
Extra articular	I	II
Intra articular involving distal radio-carpal joint	III	IV
Intra articular involving distal radio-ulnar joint	V	VI
Intraarticular, involving both distal radioulnar and radiocarpal joint	VII	VIII



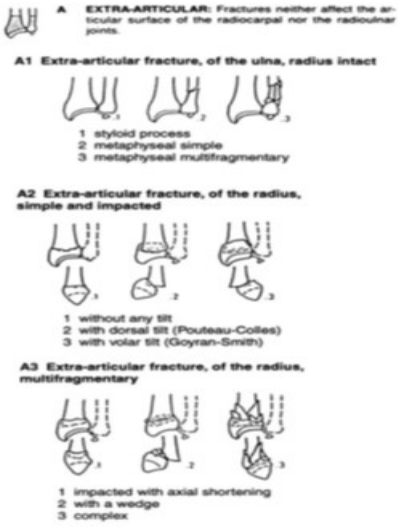


Figure 4: Frykman Classification; **Figure 5:** AO Classification

AO Classification

The most detailed classification date is the AO[9] system, which is recognized in order of increasing severity of the osseous and articular lesion.

Type A- Extra-articular
B- Partial artrticular
C- Complete articular
Each type is again divided into 3 subgroups.
A1 - Extraarticular ulna,radius intact
A2 - Extraarticular radius,ulna intact
A3 - Extraarticular,multifragmentary radius fracture
B1 - Sagittal
B2 - Dorsal rim(Barton's)
B3 - Volar rim (Reverse Barton's)
C1 - Simple articular and metaphyseal fractures
C2 - Simple articular with complex metaphyseal fractures
C3 - Complex articular and complex metaphyseal fractures

RESULTS

Age Distribution

The age of the patients ranged from 21 to 67 years with a mean age of 42.03 years. The maximum incidence of the injury was observed during 3rd and 2ndecade of life.

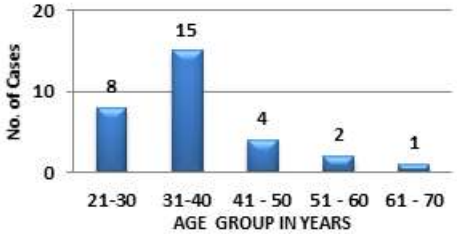


Chart 1: Bar Diagram Showing Age Distribution

Sex Distribution

Out of 30 patients, 19 patients were male and 11 patients were female. So the incidence was significantly higher in male. The male and female ratio is 2:1.

Side Distribution

Right wrist was involved in 23 cases while the left wrist was involved in 07 cases.

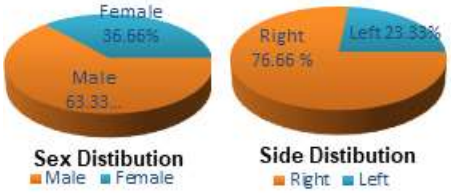


Chart 2: Pie Chart Showing Sex and Side Distribution

Mode of Injury Distribution

18 (60%) cases attained fracture due to motor vehicle accident, 10 (33.3%) cases attained fracture due to fall and 2 (6.6%) attained fracture due to other causes. MVA is the most common mode of injury followed by fall with an out-stretched hand.

Table 1: Complications

Pin tract infection	**2**	**6.66**
K-wire loosening	1	3.33
Loss of reduction	1	3.33
Radiocarpal arthritis	2	6.66
Total	**6**	**20**

Mean Radiological Measurements

Table 2: Radial Length

	Mean Difference (I-J)	Std. error	P-value
Post op K- wiring with closed reduction	1.258	.299	HS
4th week K- wiring with closed reduction	2.288	.308	HS
3 months K- wiring with closed reduction	1.936	.287	HS

Table 3: Radial Inclination

	Mean Difference (I-J)	Std. error	P-value
Post op K- wiring with closed reduction	1.911	.213	HS
4th week K- wiring with closed reduction	3.557	.185	HS
3 months K- wiring with closed reduction	2.991	.216	HS

Table 4: Volar Tilt

	Mean Difference (I-J)	Std. error	P-value
Post op K- wiring with closed reduction	-3.616	.370	HS
4th week K- wiring with closed reduction	-5.636	.419	HS
3 months K- wiring with closed reduction	-5.449	.414	HS

The radiological parameters were assessed for pre reduction, post reduction, 4weeks and at 3 months. There was a significant difference in all the three parameters i.e volar tilt, radial length and radial inclination between both the groups at the end of 3 months.

MAYO WRIST SCORING:

The evaluation of the results was done six months after the intervention, and in our study, we used the "Mayo wrist score" system for evaluation of the function of the wrist with analysis of several parameters: mobility, the strength of grip, level of satisfaction and pain. At final follow up, 9 patients had excellent, 19 had good and 2 had fair results. Hence, 93.33% patient had either excellent or good results.

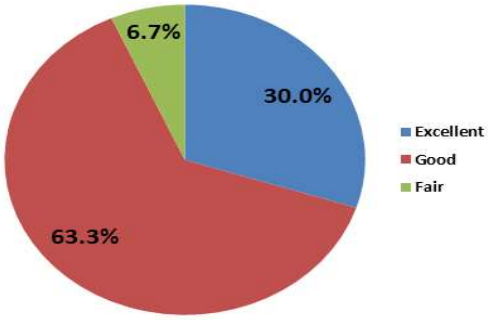


Figure 5:

CASE ILLUSTRATIONS
CASE 1:

Figure 6: Pre Operative X-Ray**; Figure 7:** Post Operative X-Ray

4th WEEK FOLLOW UP

Supination **Pronation**

Palmar Flexion **Dorsi Flexion**

Figure 8: Movements of Wrist

DISCUSSION

Intrafocal pinning of distal radius fractures was described first by Kapandji[4] in 1976. It is indicated in unstable distal radius fractures without significant intra-articular displacement. It provides the surgeon with a simple and effective, minimally invasive method of improving alignment and stability of unstable fractures[5]. In the present series 88% of patients were below 50 yrs as compared to 56% in Bradway series and 55% in Jupiter series. The average age in our study is 38.46 years which is comparable to the studies of John K. Bradway[11] (1989), Jesse B. Jupiter[12] (1996) and Harish Kapoor[13] (2000), who had an average age of 40 years, 43 years and 39 years respectively. In our study, distal radial fracture was more common in the 3rd and 2nddecade . In the present study, more numbers of the patients had fracture of right radius as evident in table. Ratio of right to left was 3:1.The series of Jesse B. Jupiter[12] (1996) and Harish Kapoor[13] (2000) had increased involvement of the right wrist. But John K. Bradway[11] (1989) had equal involvement of both wrist in their study. Louis Catalano III[14] (1997) had increased involvement of the left wrist in their series. We believe that the side of involvement of the limb is a matter of chance. Road traffic accident was the most common mode of injury in the present series as seen in table. John K. Bradway[11] (1989) reported fall on the outstretched hand as the most common mode of injury. Jesse B. Jupiter[12] (1996) and Harish Kapoor[13] (2000) also reported road traffic accident as common mode of injury in their series. Our observation is consistent with literature. Intraarticular fractures can affect the range of motion at the joint their restoration is important to achieve good results.Physiotherapy and rehabilitation are required and have to be planned carefully. In the present study the average of movements at the affected wrist are palmar flexion 43.7^0, dorsiflexion 54^0, ulnar deviation 21.1^0, radial deviation 13.1^0, supination 72.6^0 and pronation 71.6^0. The range of motion is slightly lesser but are comparable to other studies .Supination and pronation seems to be affected less . This probably is due to the result of less education and less vigorous physiotherapy in Indian patients and our series included mostly young adults with high energy trauma and intraarticular involvement. In any surgical procedure there are chances of complications , fractures of lower end of the radius are not an exception .Complications was seen in 6(20%) patients as from table 5.In the present series 2(6%) patient had pin tract infection which was controlled with appropriate antibiotics based on culture and sensitivity report. There was 1 (3%) case of loosening of K wire. 1(3%) patient who initially had fixation with K wire there was loss of reduction and was reoperated with external fixation and K wire augmentation 4 days later. 2(6%) patients developed radiocarpal arthritis grade 1 as described by Knirk and Jupite[12]. The complications in our series is higher than Kapoor series and is lower thanBradway and Jupiter serie. Bradway and Jupiter had longer follow up and included late complications which is not seen in our case and hence lower complication rate.Long term follow up is required to assess late complications. We considered immobilization of fracture for 4 weeks to be adequate and no significant displacement occurred in between. We found statistically significant differences in radiological parameters between the two groups which was similar to the results found by Azzopardi[15]. But standardizing lateral views of wrist can be difficult, and the magnitude of difference found were within errors of measurement. In our study we assessed functional outcome by Mayo scoring system other studies used Mayo wrist score by Azzopardi[15] and ADL(activities of daily living) by Wong[16] were used. The improvement in functional outcome and range of movement in patients treated by supplementary wires was not statistically significant. This supports opinion of McQueen[17] that k-wires do no gain sufficient purchase in osteopenic bone in elderly patients to maintain anatomical reduction of fracture and to improve function.

CONCLUSION

From our study it was found that Kapandji percutaneous pinning technique,achieved good correction of the initial deformity. The recurrence of the dorsal angular deformity was probably due to dorsal comminution and the subsequent loss of the dorsal buttress.Kapandji technique is a simple, cheap, minimally invasive and effective method for the treatment of unstable extra articular distal radius fractures, with good functional results. It should not be used alone for patients with severe osteopenia, marked dorsal radial comminution, and an associated distal metadiaphyseal ulna fracture and in patients with both volar and dorsal comminution of the distal radius.

REFERENCES

1. Ruch David S “Fractures of the distal Radius and Ulna”, Chapter 26 in Rockwood and Green’s Fractures in Adults, Philadelphia: Lippincott Williams and Wikins; 2006. 7thEd: 829-831pg.
2. The rationale for precise management of distal radius fractures, clinical orthopaedics of North America, April 1993, Volume 24, Number 2, pg 205
3. Fernandez DL, Palmer AK. Fractures of the distal radius. In: Green DP,Hotchkiss RN, Pederson WC, editors. “*Green's operative hand surgery*” 6th ed New York: Churchill Livingston; 2010. p 929–85
4. Kapandji A.Intra-focal pinning of fractures of the distal end of the radius 10 years later. Ann Chir Main. 1987; 6:57-63.
5. Hughston JD: Fracture of the distal radial shaft, mistakes in management. J Bone Joint Surge. 1957,39A:177-181

6. Rockwood Charles A. Jr., David P. Green: Fractures in adults , 5 Edition , Volume 1
7. Gray's anatomy , 39 edition, chapter 52 , forearm , chapter 53 , wrist and hand.
8. B.D. Chaurasia's 4 edition, volume1, chapter9 forearm and hand pg99-139
9. AO manual for external fixator for distal end radius.
10. Ruch David S "Fractures of the distal Radius and Ulna", Chapter 26 in Rockwood and Green's Fractures in Adults, Philadelphia: Lippincott Williams and Wikins; 2006. 7th Ed: 829-831pg.
11. Bradway JK, Amadio PC, Cooney WP III. Open reduction and internal fixation of displaced, Comminuted intra-articular fractures of the distal end of the radius. J Bone Joint Surg 1989; 71-A (6): 839-847.
12. Jupiter JB, Knirk JL. Intra-articular fracture of the distal end of the radius. J Bone Joint Surg 1991; 73-A: 461-69.
13. Catalano LW III, Cole RJ, Gelberman RH, Evanoff BA, Gilula LA, Borrelli J Jr. Displaced intra-articular fractures of the distal aspect of the radius. J Bone Joint Surg 1997; 79-A (9): 1290-1302.
14. Kapoor H, Agarwal A, Dhaon BK. Displaced intra-articular fractures of distal radius: A comparative evaluation of results following closed reduction, external fixation and open reduction with internal fixation. Injury 2000; 31(2): 75-79.
15. Azzopardi. T, Ehrendorfer. S, Coulton. T, Abela. M: Aprospective randomised study of immobilisation in a cast versus supplementary percutaneous pinning. J Bone Joint Surg Br June 2005; vol. 87-B no. 6: 837
16. Wong TC, Chiu CY, Tsang WL, Leung WY, Yam SK, Yeung SH: Casting versus percutaneous pinning for extraarticular fractures of the distal radius in an elderly Chinese population. J Hand Surg Eur Vol.2010 Mar;35(3):202-8
17. McQueen MM. Redisplaced unstable fractures of the distal radius: a randomised prospective study of bridging versus non-bridging external fixation. J Bone Joint Surg[Br] 1998;80-B:665-9.

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