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Original Research Article

The Kapandji pinning: Technique of closed reduction for distal end radius fracture in adults

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ABSTRACT

Background: Fractures of the distal end of radius are characterized by varying degrees of comminution with volar or dorsal displacement, articular depression and angulation of major fragments with or without involvement of joints. The technique that has been discussed most frequently is the intrafocal (Kapandji) technique. Initially the technique was described using two pins for unstable extra-articular fractures in younger adults. The indications have since been expanded to include fractures with minimally displaced intra-articular fragments and use of third pin dorsoulnarly.
Materials and Methods: 40 adults with distal radius fracture admitted to Sanjay Gandhi institute of trauma and orthopaedics. All patients will be evaluated at 4, 6 weeks intervals and once at 3 months post operatively and final outcome assessments at 3 months. For functional evaluation, the modified Gartland and Werley demerit point system. The results were evaluated as per Sarmiento's Modification of Lindstrom criteria.
Result: Restoration of anatomy was excellent in 71.8% (28.75) and 23.75% (9.5) had good anatomical outcome while 3.75% (1.5) had fair results. 40(n=sample size) were included in the study to analyse the articular angles. The mean value of radial inclination was 20.471 standard deviation 1.26, palmar tilt with mean value of 8.725 with standard deviation of 0.678 and radial length with mean of 10.625 with standard deviation of 1.169. The complication observed was 3 pintract infection. All patients achieved full wrist flexion and extension and forearm rotation. Mean time to achieve full wrist. ROM after immobilization was 2 weeks.

1. Introduction

Distal radius fractures are typically the result of falls on outstretched hands or high-energy trauma in younger patients and low-energy falls from sitting or standing in osteopenic patients.[1] Among these techniques, the intrafocal (Kapandji) technique.[2] has been extensively reported and discussed. Initially described by Aldalbert Kapandji in 1976, the technique involved using two pins for unstable extra-articular fractures in younger adults.[3] Over time, the indications for this technique have expanded to include fractures with minimally displaced intra-articular fragments and elderly patients, with the addition of a third dorsoulnar pin.

The goals of the Kapandji technique, as outlined by Kapandji himself, aim to achieve optimal bone fusion, prevent secondary collapse and to start immediate functional rehabilitation without the need for plaster cast, and signifies a straightforward surgical method. Studies, such as the one conducted by Peyroux et al., have demonstrated the efficacy of the Kapandji intrafocal pinning technique in treating distal radius fractures.[4] Their research supported the use of a third dorsal to volar pin in fractures with significant dorsal comminution.In subsequent years,

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Kapandji and others further refined the technique. In 1987, Kapandji discussed the use of a third dorsal to volar posteromedial pin for complex fractures involving multiple fragments or articular surface involvement. Additionally, in 1995, Hoel and Kapandji introduced two additional anterior approaches to the intrafocal pinning technique to address volar displaced fractures.[5] These advancements have contributed to the versatility and effectiveness of the Kapandji technique in managing distal radius fractures.

The objectives of our study are as follows:

1. To analyze the efficacy and outcomes of minimally invasive surgical techniques in the management of distal radius fractures.
2. To evaluate the impact of intrafocal pinning on articular angles in distal radius fractures.

2. Materials and Methods

The study comprised 40 clinically diagnosed cases of distal radius fracture, all of whom were attending the outpatient department of orthopaedics at the Sanjay Gandhi Institute of Trauma and Orthopaedics in Bangalore. The research aimed to include patients with distal radius fractures, conducting both clinical and radiological investigations to determine suitability for surgery.

Functional evaluation was performed using the modified Gartland and Werley[6] demerit point system. Anatomical results were assessed based on the criteria outlined in Sarmiento's Modification of Lindstrom criteria.[7]

Measurements including radial tilt (RT), volar tilt (VT), radial length (RL), and ulnar variance (UV) were taken at three key points: upon presentation, immediately after pinning, and during final follow-up.

To establish normal values, measurements from radiographs of the opposite wrist were utilized. In cases where radiographs of the opposite wrist were unavailable (e.g., bilateral wrist fractures), normal average values of RT (23°), VT (11°), and RL (12 mm) were employed as substitutes.

2.1. Complications

1. Median nerve neuropathy[8]
2. Extensor pollicis tendon rupture
3. Radiocarpal arthritis and malunion
4. Extensor carpi ulnaris tendon entrapment
5. Comple regional pain syndrome

2.2. Distal radioulnar joint reduction criteria[9]

Radiographic sign that indicates DRUJ instability, is

1. Widening of the distal radioulnar joint on the AP view or radioulnar distance by 6mm or more on lateral view
2. Ulnar styloid process fracture,
3. Ulnar collateral ligaments avulsion fracture at the ulnar facet
4. Radial shortening of 5mm and
5. Less than 15° of radial inclination
6. Dorsal angulation of more than 15 degree of the distal radius
7. Lateral view shows subluxaed ulna

2.3. Advantages and disadvantages of pinning

Advantages of percutaneous pin[10]

1. No periosteal stripping with minimal soft tissue disruption making biological advantage.
2. Stable fixation thus preventing fracture displacements and collapse.
3. Less disturbance to fracture haematoma and chances of infection.
4. Kapandji pinning can be used as a joy stick to manipulate and reduce fractures

2.4. Disadvantages

1. Injury to sensory branch of radial nerve
2. Compartment syndrome and cast disease if cast is too tight
3. Pin tract infection and loosening

2.5. Operative procedure

Anaesthesia - Under supraclavicular block anaesthesia,

Position – supine position with wrist over the arm table.

All steps are done under strict aseptic precautions and complete draping.

Figure 1: The preoperative anteroposterior and lateral X-rays of distal end radius fracture

2.6. Step 1

The primary step involves reducing the fractured fragments through closed reduction. This is achieved by utilizing a traction and counter-traction technique, which diminishes

impaction and aligns distal fragments. Flexing the distal fragment in the anteroposterior direction reduces angulation to a neutral position and corrects mediolateral displacements. Subsequently, the position is meticulously verified using fluoroscopy to ensure alignment meets acceptable standards.

2.7. Step 2

The final corrected position should have maintained radial length and radial inclination and this position is maintained before K wire application.

2.8. Step 3

After verification of the reduction position, Kirschner wires, typically sized at 1.8 or 2 mm, are inserted from lateral to medial, commencing at the base of the radial styloid process. These wires traverse the fracture site and grasp the opposite cortex, with an assistant ensuring traction and reduction maintenance. Typically, power drills are employed for the insertion of Kirschner wires rather than hand drills.

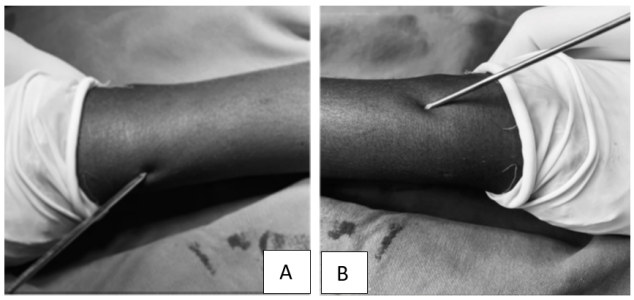

Figure 2: Entry point for 1^{st} K wire (**A**) and 2^{nd} K Wire (**B**)

2.9. Step 4

Another k wire is inserted from the sigmoid notch starting dorsal cortex to the palmar cortex and to be sure that the k wire enters opposite intact volar cortex. And additional k – wires may be inserted from dorsal to volar to maintain stability.

2.10. Step 5

The reduction is checked under c – arm and the k –wires are bent at around 90 degree with k wire bender and cut with k wire cutter. Pin site sterile dressings and good adequate padding done with and plaster is then applied.

2.11. Postoperative protocol

Patients undergo regular follow-up appointments at our hospital, occurring at 2-week and 4-week intervals, to monitor for any signs of pin site loosening or infection until pin removal. X-rays are taken every 2 weeks to assess radiological union progress. Additionally, patients are clinically evaluated for evidence of union, wrist movement capabilities, and other radiological parameters. Plaster of Paris and percutaneous K-wires are typically removed after 6 weeks of immobilization, following stringent aseptic protocols.[11]

Figure 3: An X-ray of the anteroposterior and lateral presentation after the fixation, 4 weeks and 3 months

After removal, patients begin active and passive motion exercises and rehabilitation to restore wrist function. Physical therapy continues until patients regain normal activities and achieve satisfactory hand grip strength. Plasters are usually removed over the course of 6 weeks, with many patients transitioning to splints for added protection as needed.[12]

3. Results

A prospective observational study was conducted on Forty patients to analyse the articular angles in both extraarticular and intraarticular distal radius fractures followed by kapandji intrafocal pinning.

All fractures healed well. Restoration of anatomy was excellent in 71.8% (28.75) and 23.75% (9.5) had good anatomical outcome while 3.75% (1.5) had fair results. 40 (n= sample size) were included in the study to analyse the articular angles. The mean value of radial inclination was 20.471 standard deviation 1.26, palmar tilt with mean value of 8.725 with standard deviation of 0.678 and radial length with mean of 10.625 with standard deviation of 1.169 all the above radiological parameters shows significant P-value (<0.005). The complication observed was 3 pin tract infection.

Table 1: Results of demerits point system of Gartland and Werley

	Score	No. of cases
Excellent	0-2	33
Good	3-8	6
Fair	9-20	1
Poor	21 & above	0

Table 2: Results of Sarmiento's modification of lindstorm criteria

	Residual deformity	Loss of palmar tilt	Radial shortening	Loss of radial deviation
Excellent	33	9	37	36
Good	6	27	3	2
Fair	0	4	0	2
Poor	0	0	0	0

3.1. Side predominately affected

Among 40 patients results showed that 23 had injury on right wrist dominant hand and the remaining 17 had sustained injury on the non dominant left hand. All the patient included in our study had right-handed dominance.

3.2. Mechanism of injury

In our study series, the predominant mechanism of injury was low velocity trauma, with the majority of patients experiencing falls on outstretched hands. Specifically, 37 patients sustained injuries due to falls on outstretched hands, while 3 patients were involved in road traffic accidents.

Table 3: Articular surface involvement

Fracture pattern	Total no of cases	Percentage involved compared to total sample
Extra articular fractures	32	80%
Intraarticular fractures	8	20%

In our study group of 40 patients, of the women had extra- articular metaphyseal fractures with dorsal displacement and only 8 with articular involvement.

Table 4: Complications

Complications	No of cases	% involved
Pin Tract Infection	3	7.5%

All the fractures have healed fully (Figure 4). All of the patients achieved full flexion and extension of the wrist.

Figure 4:

4. Discussion

The primary objective of our research is to facilitate early functional restoration of wrist mobility, enabling swift resumption of daily activities, and achieving anatomical alignment through a straightforward day care surgical approach. Percutaneous pinning and plaster emerge as a minimally invasive alternative to conventional surgical interventions. Patient selection adhered rigorously to predefined inclusion and exclusion criteria, resulting in a sample size of 40 individuals. The Kapandji technique, pioneered in 1976 for intrafocal pinning of distal radius fractures, served as a cornerstone. Comparative analysis of our findings with existing literature and publications is elaborated upon below.

Results from our investigation indicate that 23 patients sustained injuries to their dominant right wrists, while the remaining 17 patients incurred injuries to their non-dominant left wrists. This aligns closely with findings by AK Das et al, where 21 patients had injuries to the dominant hand and 11 to the non-dominant hand.[13] Conversely, Uzzaman KS (2008) observed no significant difference in the side of involvement.[14] Cherian Jacob's (2014) cohort study reported 8 cases on the right side and 7 on the left, consistent with the dominant hand involvement highlighted in our study.[15]

Regarding the mechanism of injury, 37 patients experienced falls on outstretched hands, while the rest involved self-falls or were victims of violence from road traffic accidents. Cherian Jacob (2014) noted that most injuries resulted from low-velocity falls during household activities or high-velocity accidents. This concurs with our study's emphasis on low-velocity falls as the primary cause of injury.[16]

In terms of fracture classification and articular involvement, our study predominantly observed the 2R3A3 fracture pattern with extra-articular involvement in 32 patients and intra-articular involvement, primarily type 2RB1, in 7 patients. This mirrors findings from other studies, such as Cherian Jacob's (2014) cohort study and Uzzaman ks's (2008) research, where type A fractures were common. This underscores the predominance of extra-articular fractures in percutaneous pinning procedures, as evidenced in our study.

Surgical and plaster complications were minimal in our study, with only a few cases of pin tract infection and reduced range of functional movements. Similar complications were reported in studies by T. Azzopardi and AK Das et al., indicating consistency across different research cohorts.

Regarding functional outcomes, the majority of our patients demonstrated excellent hand function, with only a small percentage experiencing fair outcomes due to residual displacement and joint stiffness. This is consistent with findings from Cherian Jacob's (2014) study and AK

Das et al's research, further supporting the efficacy of the Kapandji pinning technique in achieving favorable functional outcomes. According to Gehrmann et al., their study on the functional outcome of distal radius comminuted fractures treated with percutaneous pinning revealed favorable results. Specifically, their findings suggested that the management of distal radius fractures with K-wires in elderly patients led to a positive functional outcome.[17]

5. Conclusion

Distal radius fractures commonly result from low-velocity falls, particularly in osteopenic patients, with the majority being extra-articular displaced fractures typical of Colle's fractures. Our study, involving 40 patients managed with the Kapandji pinning technique, the effectiveness of this approach in treating distal radius fractures outcomes are comparable to standard methods involving closed reduction and percutaneous pinning.

6. Summary

40 patients with distal radius fracture were managed by kapandji pinning technique and was analysed of distal radial articular angles in patients attending Sanjay Gandhi institute of trauma and orthopaedics. Out of 40 patients 23 patients had injury to right dominant hand and 17 had injury to left non dominant hand. 32 patients had extraarticular injury while 8 patients had intraarticular injury. All the patients were operated under regional anaesthesia or general anaesthesia with 3 k-wires, begins with a lateral k wire. The wire is inserted into a fracture gap and raised. A second wire dorsal to volar, centred about the 3rd metacarpal axis. A third wire between the fourth and fifth extensor compartment in volar to dorsal manner. Patients were followed on 2nd, 4th and 6th week. Pin tract infection was reported in 3 patients at final follow-up by 'The Gartland & Werley Criteria for Functional Outcome' 33 patients had Excellent result, 6 had Good result 1 had Fair result. The results of our study are comparable with standard studies of Distal Radius Fractures treated with Closed Reduction and Percutaneous Pinning.

7. Source of Funding

None.

8. Conflict of Interest

None.

References

1. Merchan EC, Breton AF, Galindo E, Painado JF, Beltran J. Plaster cast versus Clyburn external fixation for fractures of the distal radius in patients under 45 years of age. *Orthop Rev*. 1992;21(10):1203–9.
2. Kapandji IA. Internal fixation by double intrafocal plate: Functional treatment of non-articular fractures of the lower end of the radius. *Ann Chir*. 1976;30(11-12):903–8.
3. Rayhack J. The history and evolution of percutaneous pinning of displaced distal radius fractures. *Orthop Clin North Am*. 1993;24(2):287–300.
4. Peyroux LM, Dunaud JL, Caron M, Slamia IB, Kharrat M. The Kapandji technique and its evolution in the treatment of fractures of the distal end of the radius. Report on a series of 159 cases. *Ann Chir Main*. 1987;6(2):109–22.
5. Hoel G, Kapandji AI. Osteosynthesis using intra-focal pins of anteriorly dislocatedfractures of the inferior radial epiphysis. *Ann Chir Main Memb Super*. 1995;14(3):156–7.
6. Strohm PC, Muller CA, Boll T, Pfister U. Two procedures for Kirschner wireosteosynthesis of distal radial fractures. A randomized trial. *J Bone Joint Surg Am*. 2004;86(12):2621–8.
7. Walton NP, Brammar TJ, Hutichson J, Raj D, Coleman NP. Treatment of unstable distal radial fractures by intrafocal, intramedullary K-wires. *Injury*. 2001;32(5):383–9.
8. Canale ST, Beaty JH. Campbell's Operative Orthopaedics. Elsevier Health Sciences; 2012. p. 3006–3007.
9. Gartland JJ, Werley CW. Evaluation of healed Colles' fractures. *J Bone Joint Surg Am*. 1951;33A(4):895–907.
10. Kapandji AI, Epinette JA. Colles' fractures: treatment by double intrafocal wirefixation. In: Razemon JP, Fisk GR, editors. The Wrist. New York: Churchill Livingstone; 1988. p. 65–73.
11. Depalma AF. Comminuted fractures of the distal end of the radius treated by ulnarpinning. *J Bone Joint Surg Am*. 1952;24(3):651–62.
12. Trumble TE, Schmitt SR, Vedder NB. Factors affecting functional outcome ofdisplaced intra-articular distal radius fractures. *J Hand Surg Am*. 1994;19(2):325–40.
13. Das AK, Sundaram N. Percutaneous pinning for non comminuted extra articularfractures of distal radius. *Indian J Orthop*. 2011;45(5):422–6.
14. Uzzaman KS, Awal KA, Alam MK. Closed Reduction and Percutaneous Kirschner Wire Fixation Combined with Plaster Cast versus Conventional Plaster Cast immobilization in the Treatment of Colles' Fracture – A Prospective Randomized Comparative Study. *J Dhaka Med Coll*. 2008;17(2):98–105.
15. Jacob C, Anoop R, Philip NT. Functional and Radiological Outcomes of Distal Radius Fractures Treated with Closed Reduction and Percutaneous Five Pin Technique – A Prospective Cohort Study. *Int J Recent Trends in Sci Technol*. 2014;10(3):430–3.
16. Azzopardi T, Ehrendorfer S, Coulton T, Abela M. Unstable extra-articular fractures of the distal radius: a prospective, randomised study of immobilisation in a cast versus supplementary percutaneous pinning. *J Bone Joint Surg Br*. 2005;87(6):837–40.
17. Gehrmann SV, Windolf J, Kaufmann RA. Distal Radius FractureManagement in Elderly Patients: A Literature Review. *J Hand Surg Am*. 2008;33(3):421–9.

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