

Study Between Kapandji Technique of Intrafocal Pinning and Extrafocal Pinning Technique for Extraarticular Fracture Distal End of Radius

Hrishikesh Kumar Bakode^{1*}, Sanjeev Kumar¹, Nilachakra Sahu², Qamar E Alam Khan², Sachidanand Kodge² and Prashant Bhutani²

^{1,2} Department of Orthopaedic Hindu Rao Hospital and N.D.M.C. Medical College, Delhi, India.

*Corresponding Author: Dr. Sanjeev Kumar, Department of Orthopaedic Hindu Rao Hospital and NDMC Medical College and Hindu Rao Hospital, Delhi, India.

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Abstract

Introduction: Extraarticular fractures distal end of radius are the most common fractures treated accounting for one sixth of all fractures, for which percutaneous k-wire insertion has yielded popular acceptance. K-wire insertions can be done through many different ways. One of these methods is Kapandji intrafocal pinning method and other is percutaneous k-wire extrafocal pinning method. K-wire fixation is simple, minimally invasive, inexpensive with minimum facilities showing significant improvements in dorsal angulation, radial length, radial inclination & range of movements.

Material and method: 52 patients are studied from 2020 to 2021, out of which 26 cases were treated by kapandji intrafocal pinning and another 26 cases were treated by percutaneous k-wire extrafocal pinning. The results were evaluated and compared both clinically and radiologically.

Result: Functional score due to Gartland and Werley score and range of movements was slightly better in the Kapandji intrafocal pinning group both at the 3 months and 6 months after surgery. Volar tilt was preserved better in the Kapandji intrafocal pinning group. There was concern about loss of radial length due to some compression effect in Kapandji intrafocal pinning group, but both techniques saved the radial length properly.

Conclusion: We concluded that kapandji intrafocal pinning has got a slight good score, also volar tilt was preserved slightly better in kapandji pinning group, so one can choose this method for fixation of fracture distal end of radius to get satisfactory functional outcome and achieve good result.

Keywords: Extraarticular fracture distal end of radius, Kapandji intrafocal Pinning technique, Percutaneous k wire extrafocal pinning technique.

Introduction

Colles' fracture was first described by Abraham Colle of Dublin in Ireland in 1814, after whom it is named. Fracture of distal radius has been associated with a long history since first description by Punctan in 1783 and Colles' in 1814. When Sir Abraham Colle had discovered the fracture at first, it lacked characteristics of a typical feature like crepitus abnormal mobility. He recognized high incidence of residual deformity when injury had healed and noted the cases in which the reduction could be carried out and marked propensity for the deformity to recur. Colles' noted in original article that "one consolation remains, that the limb at some remote period will again enjoy perfect freedom in all its motions and be completely exempt from pain."¹

Until 19th century due to malunited fracture of distal end of radius disability was accepted and considered stable. The patient used to get accustomed to the deformity with residual limitation of movement, weak grip strength in wrist and hand. With changing trend of management of fracture and the unacceptability of deformity by patients, a near normal function of wrist had to be achieved.

As orthopaedic surgeons, in dealing fractures, by and large is guided by radiological appearances to certain extent, we could not accept severely displaced, collapsed and dorsally tilted fractures of distal radius.

Distal radius fracture is the most common fracture of the upper extremity², and there is very disagreement on its classification, treatment, functional and radiologic outcome.

Extraarticular fracture distal end of radius has met different kind of managements such as conservative treatment that first Colle's describes¹, close reduction and cast immobilization³⁻⁵, external fixation⁶⁻⁹, close reduction and percutaneous pinning fixation with K-wires¹⁰⁻¹³ and open reduction and internal fixation of fracture¹⁴⁻¹⁶.

There are a lot of treatment modalities of distal radius fracture which includes closed reduction and casting; closed reduction and percutaneous pinning by different methods such as Kapandji intrafocal pinning, trans-radial styloid pinning, pinning via the Lister's tubercle and insertion of pin from ulnar side or trans-ulnar pinning. 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, volar approach on combined by different kinds of implants such as screws, plate and screws and locking plate. Locking plate is most favoured by orthopaedic surgeon mainly because of its biological fixation principle and acts as an internal-external fixation which allows patients to have faster mobilization, exercise of wrist and early return to preinjury status.

Since their introduction, there were many studies to find out the advantages of one upon the others and although among these methods of treatment some has known advantages among others but the gold standard method and best mode of treatment still is a matter of debate. For example when use some kind of fixation like percutaneous k wire fixation in order to protect the fracture from further displacement till the time of bone healing, that is a concern in close reduction and cast immobilization¹⁷, there is conflicting data regarding the perfect methods of wire fixation.

Close reduction and percutaneous k-wire fixation has the advantage in contrast to open reduction and internal fixation, protect the reduction from further displacement as we may see in close reduction and plaster cast immobilization¹⁷ and it costs much less than plates that is used for open reductions. Fixation with Percutaneous k-wire has its own complications like pin track infections, pin loosening, tendon and nerve injury during k wire insertion, but has much less complications in comparison to techniques of open reduction and internal fixation¹⁸.

There are various techniques of k-wire insertions, in which two distinct techniques for comparison are insertion of k-wires through the fracture site and insertion of k-wire across the fracture site. two or three k-wires are inserted through the fracture sites in former technique and cross the opposite cortex to fix fracture and for better stability, was first described by Kapandji in 1976 and since then various methods and modification has been introduced¹⁹⁻²⁴. The later also is done through many different modifications, of these one in which two wire is inserted through radius styloid and one through lunate articular facet had become more popular¹³.

Kapandji intrafocal pinning technique has some theoretical and biomechanical advantages upon the extrafocal techniques. Because of fixation in the Kapandji technique is dynamic and much biomechanically stable²⁵ and it also may lead to early and rigid fixation and better functional outcome in contrast to extrafocal pinning fixations which is more static. Due to dynamic nature Kapandji intrafocal pinning method may lead to collapse of fracture fragment but it is not confirmed to have significant difference among other methods of wire insertions.

There are few literature that compare the radiologic and functional outcomes of various methods. Our purpose in this prospective study is to define and compare the functional and radiological result of Kapandji Intrafocal Pinning and Percutaneous K-wires Fixation an Extrafocal Technique for Extraarticular Fracture distal end of Radius.

Patients and Methods

This prospective comparative observational study consists of 26 male and 26 female patients with the age group of 18 to 55 years with mean age of 36 years. The exclusion criteria were compound #, comminuted #, pathological #, fractures having intra-articular extension and fractures with distal neurovascular deficit. All patients were skeletally mature and medically fit. The patients were randomly allocated to either kapandji intrafocal group or extrafocal percutaneous K-wire group.

26 patients treated by kapandji intrafocal group and other study group of 26 patients treated by extrafocal percutaneous K-wire group in 1 year study duration. Out of 26 patients 14 males (27%) and 12 females(23%) were included in Kapandji intrafocal pinning group, while those treated by Percutaneous k-wire extrafocal pinning group includes 12 males (23%) and 14 females (27%). In group treated by kapandji intrafocal pinning 14 patients (27%) had right distal radius fracture and 12 patients (23%) had left distal radius fracture. Whereas in group treated by percutaneous k-wire extrafocal pinning 16 patients (31%) had right distal radius fracture and 10 patients (19%) had left distal radius fracture. In this study we found the commonest fracture was Frykmann type I constituting about 86%.

Technique & Procedure

The Kapandji intrafocal pinning was performed under brachial block or local anaesthesia, the reduction was achieved by traction and countertraction and wires were inserted after making a stab wound within the first and second extensor compartment and mobilizing the under lying structures, first wire was inserted parallel and directly through the fracturesite with caution not to damage the radial nerve and tendons. Then the wire was angled 45 degrees obliquely proximally and was drilled to the opposite cortex. Second and third wires inserted through third-fourth and fourth-fifth extensor compartment, respectively (Figure 1). We used wires to reduce the fracture where was needed and checked reduction under c-arm image intensifier and found adequately. Plaster cast was applied after fixation for about 4 weeks then we mobilized the limb 3-4 times daily for about 5-10 min and instruct the patients to move their hand and wrist through the range of motion till the pain let them to do so and again use their plaster cast for other 2 weeks. After 6 weeks we removed the wires and plaster cast and started the routine physiotherapy.

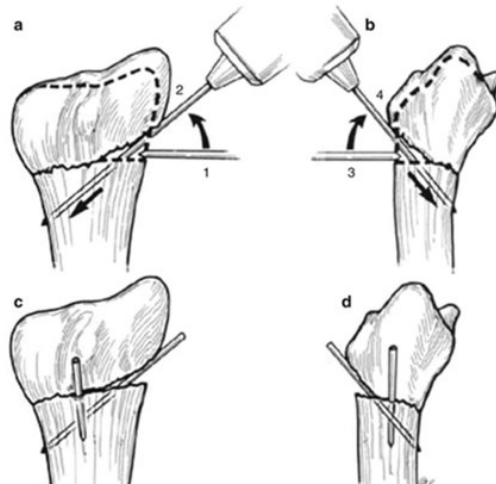
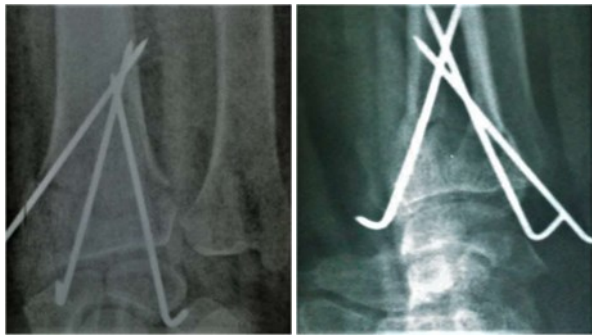


Figure 1: a) AP view and b) lateral view showing 1st intrafocal pin insertion (1,3) and then angled to 45 degree obliquely proximally (2,4) and drilled to opposite cortex. c) and d) showing fixation of wires to opposite cortex.

Case: Kapandji intrafocal pinning group

Pre-Operative Xray
Radiograph AP and Lateral
view





Post-Operative Xray Radiograph AP and Lateral view



3 months Post Op Follow up Xray Radiograph AP and Lateral view

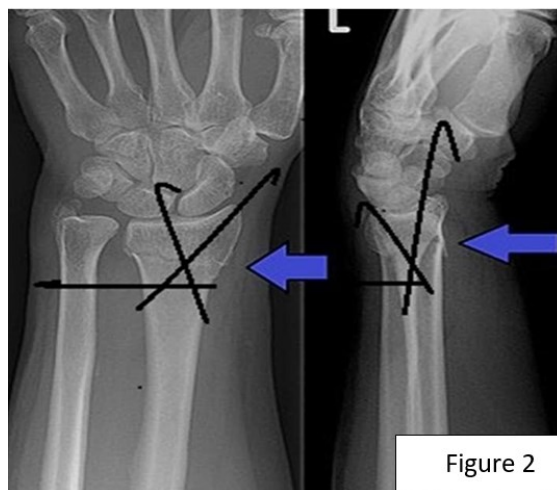


Figure 2

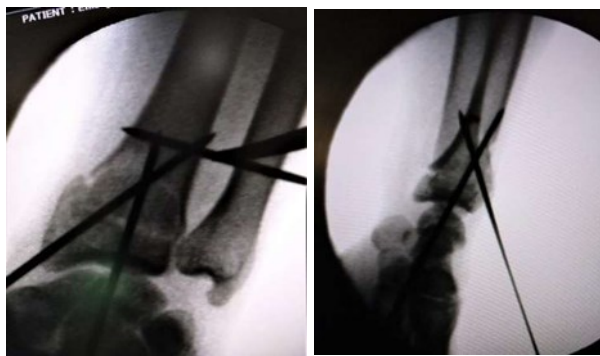
Figure 2: AP view and b) lateral view radiograph showing extrafocal pin insertion, 1st from radial styloid, 2nd from lister tubercle and 3rd for DRUJ (if required) and crossed the fracture site and fixed to opposite cortex.

The percutaneous k-wire extra-focal technique was also performed through brachial block, general or local anaesthesia, there after close reduction was achieved by traction and counter traction. Then with the help of c-arm image intensifier the fracture reduction was checked and if found acceptable then we advanced through fixation. Firstly, we made the first stab wound through first and second extensor compartment and after mobilization of underlying tendons and soft tissue we inserted the first wire through radial styloid and cross the fracture site and go through the opposite cortex about 1-2 mm. Second wire was inserted through third- fourth or fourth-fifth extensor compartment. After the wire insertion, we again checked the fracture alignments and checked for DRUJ disruption too, if DRUJ disruption then one k-wire also inserted from distal ulna to distal radius to fix it. If fracture reduction accepted then bent wires out of skin and cut them. and plaster cast were applied after proper dressing. We reviewed the patients at 2 weekly intervals then 6 weeks, 3 months and 6 months and we dismissed the cast and removed the wires at 6 weeks, after that we started the routine physiotherapy.

Case: Percutaneous k-wire extrafocal pinning group

Pre Operative Xray Radiograph AP and Lateral view





Immediate post op c-arm image AP view and Lateral view



3 months Post op Follow up Xray Radiograph AP and Lateral view

In both groups we tried to achieve anatomic reduction but we consider up to zero palmar tilt and 20 degree radial inclinations as an acceptable amount. Although we did not encounter any significant shortening during our reductions but we may accepted up to 5 mm shortenings. Wechecked distal radioulnar joint stability and did proper treatment whenever was needed.

We visited the patients at 2 weeks, 4 weeks, 6 weeks_ after surgery and checked for wires dressing and removed the wires under local anaesthesia after six weeks. Functional assessmentwas performed 6 weeks and 3 month and 6 months after surgery using Gartland and Warley score and radiologic assessment was performed pre Op, post Op, 6 weeks and at 3 months. Grip assessment of fracture side and the opposite side was performed after 3 months with dynamometer device. We examined the patients after 6 months for reflex sympatheticdystrophy (RSD). We used student t-test to compare the means of groups and analysis the data.

Results

There were 52 patients in the study, 26 in kapandji intrafocal pinning group and 26 inpercutaneous K-wire extrafocal pinning group in 1 year study.

The analysis of the mean age of patients was 37 years. Gender distribution in each group wereequal i.e. out of 52 cases 26 cases were males and 26 cases were females. The mechanism of injury in most cases was fall on out stretched hand (88%).

According to Gartland and Werley, 6 patients (11.5%) had excellent result, 11 patients (21%)had good results and 9 patients (17%) had fair results and no one patient had (0%) poor resultin kapandji intrafocal pinning group. and 5 patients (9.6%) had excellent result, 11 patients (21%) had good results and 10 patients (19%) had fair results and no one patient had (0%) poor result in percutaneous k-wire extrafocal pinning group. ($P>0.05$)

Functional assessment after 3 months using Gartland and Warley showed that the mean scorein the Kapandji intrafocal pinning group was 7.42 (SD 4.50) and in the percutaneous k-wire extrafocal pinning group was 7.88 (SD 4.54). Although it wasn't statistically significant. (P - Value 0.93 that is >0.05) but there were better score in the Kapandji intrafocal pinning group.

Range of movements was slight better in kapandji intrafocal pinning group in initial follow up, because in this method introduction of k-wires was through the fracture side and not a crossed the distal fragment. But later on there was no statistically significant difference in range of movements between both groups.

Radiological parameters were assessed for pre reduction, post reduction, 6 weeks and 3 months (Table-1). Post operatively mean Radial length was 12.23mm and 12.08mm, mean volar tilt was 9.19 degree and 8.46 degree ($p<0.05$) and mean radial inclination was 23.43mm and 23.58mm for kapandji intrafocal pinning group and percutaneous k-wire extrafocal pinning group respectively. At 6 weeks follow up mean Radial length was 11.73mm and 11.65mm, mean volar tilt was 9.12 degree and 8.31 ($p<0.05$) degree and mean radial inclination was 23.46mm and 23.58mm for kapandji intrafocal pinning group and percutaneous k-wire extrafocal pinning group respectively.

At 3 months follow up mean Radial length was 11.31mm and 11.35mm, mean volar tilt was 9.04 degree and 8.38 (p>0.05) degree and mean radial inclination was 23.38mm and 23.50mm for kapandji intrafocal pinning group and percutaneous k-wire extrafocal pinning group respectively. Shows that there was statistically significant difference between volar tilt at initial and 6 weeks follow up but at 3 months follow up there was no statistically significant difference in all three radiological parameters in both groups.

Table -1: Mean Radiological Measurements.

Radiological Measurements		Kapandji Intrafocal Pinning Group	Percutaneous K-Wire Extrafocal Pinning Group	p-value
Radial Length (mm)	preOp	5.92	5.92	1.000
	postOp	12.23	12.08	.668
	6 wks	11.73	11.65	.832
	3 mth	11.31	11.35	.907
Volar Tilt (degrees)	preOp	-5.69	-5.5	.911
	postOp	9.19	8.46	.046
	6 wks	9.12	8.31	.022
	3 mth	9.04	8.38	.057
Radial Inclination (degrees)	preOp	9.04	9.15	.947
	postOp	23.46	23.58	.703
	6 wks	23.46	23.58	.708
	3 mth	23.38	23.50	.707

Grip assessment was done using dynamometer and obtained means grip force were 16.13 kg/cm in the percutaneous k-wire extrafocal pinning group and 16.67 kg/cm in the Kapandji intrafocal pinning group after 3 months and that was also not statistically significant. (p>0.05) But found significant difference between fractured sides grip force and the opposite sides grip force (16.4 vs 27.7) (p<0.05).

Discussion

There are different treatment methods available for extraarticular fracture distal end of radius but it is not easy to select which one is better over another. Higher incidence of RSD and worst outcomes seen in various supporting¹⁰ data. In 1908 Lambotte used 1 or 2 k-wire and fix the fracture fragment through radial styloid process. Although result was poor and unsatisfactory in maintaining radial height but it begins long way and various method has come till now. In 1975 Stein⁴⁰ and Katz introduced a cross wire fixation concept who fixed the fracture of distal end of radius with 1 wire from radial styloid and another wire from ulnar side of radius from dorsal to volar cortex and saved the radial inclination and radial height significantly.

Kapandji described a method in which he introduced k-wire direct from fracture site and drilled to opposite cortex¹⁹. But could not report the result. In 1882 Epinete²⁴ reported series of cases with kapandji method and showed excellent and good result.

There are various studies with heterogeneous fractures with different age groups with different kind of treatments given by different scientists like Atkinson³⁴, Walton³², Clancey³⁶, Shankar⁴¹. Good result claimed by them but control trial was lacking. Prospective randomised trial conducted by Stoffelen and Broos¹⁰ compared close reduction and intrafocal pinning for extraarticular fracture distal end of radius and found no significant difference in outcome in both groups.

Besides of all that studies we also conducted a series of 52 cases and our purpose of study was to compare and evaluate the result of kapandji intrafocal pinning technique and percutaneous k-wire extrafocal pinning technique for extraarticular fracture distal end of radius with special reference to restoration of radial height, radial inclination and volar tilt of the distal end of radius with functional outcome and range of movements of wrist joint in both groups.

In our study there were 52 patients in the study, 26 in kapandji intrafocal pinning group and 26 in percutaneous K-wire extrafocal pinning group in 1 year study. The analysis of the mean age of patients was 37 years. Gender distribution in each group were equal i.e. out of 52 cases 26 cases were males and 26 cases were females. The mechanism of injury in most cases was fall on stretched hand (88%).

The mean age of patients treated by kapandji intrafocal pinning group was 36 years while those treated by percutaneous k-wire extrafocal pinning group was 38 years. (Range from 18 to 55 years)

Kapandji intrafocal pinning group include 14 males and 12 females, while those treated by Percutaneous k-wire extrafocal pinning group includes 12 males and 14 females.

In group treated by kapandji intrafocal pinning group 14 patients (27%) had right distal radius fracture and 12 patients (23%) had left distal radius fracture. Whereas in group treated by percutaneous k-wire extrafocal pinning group 16 patients (31%) had right distal radius fracture and 10 patients (19%) had left distal radius fracture.

In this study we found the commonest Frykman type I constituting about 86%.

In our study range of movements was slight better in kapandji intrafocal pinning group in initial follow up, because in this method introduction of k-wires was through the fracture side and not across the distal fragment. But later on there was no statistically significant difference in range of movements between both groups.

Radiological parameters were assessed for pre reduction, post reduction, 6 weeks and 3 months. Post operatively mean Radial length was 12.23mm and 12.08mm, mean volar tilt was 9.19 degree and 8.46 degree ($p < 0.05$) and mean radial inclination was 23.43mm and 23.58mm for kapandji intrafocal pinning group and percutaneous k-wire extrafocal pinning group respectively.

Mean Radial length at 6 weeks follow up was 11.73mm and 11.65mm, mean volar tilt was 9.12 degree and 8.31 ($p < 0.05$) degree and mean radial inclination was 23.46mm and 23.58mm for kapandji intrafocal pinning group and percutaneous k-wire extrafocal pinning group respectively.

Mean Radial length at 3 months follow up was 11.31mm and 11.35mm, mean volar tilt was 9.04 degree and 8.3 ($p > 0.05$) degree and mean radial inclination was 23.38mm and 23.50mm for kapandji intrafocal pinning group and percutaneous k-wire extrafocal pinning group respectively.

Achieved radial height and radial inclination was almost similar in both the groups although volar tilt was preserved better in kapandji intrafocal pinning group at initial and 6 weeks follow up, may be because of buttressing effect of k-wires on distal fragment but at 3 months follow up there was no statistically significant difference in all three radiological parameters in both groups. Also the number of c-arm shoot taken intraoperatively was lesser in kapandji pinning as compared to extrafocal pinning that saved time during surgery.

According to Gartland and Werley, 6 patients (11.5%) had excellent result, 11 patients (21%) had good results and 9 patients (17%) had fair results and no one patient had (0%) poor result in kapandji intrafocal pinning group and 5 patients (9.6%) had excellent result, 11 patients (21%) had good results and 10 patients (19%) had fair results and no one patient had (0%) poor result in percutaneous k-wire extrafocal pinning group. ($p > 0.05$)

As mentioned in various previous studies that there is compression effect seen and collapse of radial height in kapandji technique but in our study there was no significant difference in both the techniques that we used ($p > 0.05$) and the mean radial length obtained at 3 months follow up was 11.31mm and 11.35mm for kapandji intrafocal pinning group and percutaneous k-wire extrafocal pinning group respectively, shows that both the techniques could save the radial length properly.

A comparative study had done in 1994 between Kapandji technique and trans-radial wire technique, in which pain and RSD was more common in the Kapandji group but the range of motion was better till six weeks and became insignificant after that. In our study what we saw was early or premature beginning of range of motion caused pain and restriction of movements that's why we compared Range of movements at 6 weeks, 3 months and 6 months post op and found almost similar result in both the groups. Although pain and RSD were seen more in immediate follow up in 4% cases in kapandji intrafocal pinning group and 2% in percutaneous k-wire extrafocal pinning group but that was also not statistically significant and made no difference in further follow ups.

Functional score after 3 months using Gartland and Warley showed that the mean score in the Kapandji intrafocal pinning group was 7.42 (SD 4.50) and in the percutaneous k-wire extrafocal pinning group was 7.88 (SD 4.54). Although there were better score in the Kapandji intrafocal pinning group, but it wasn't statistically significant. ($p > 0.05$)

It seems that volar tilt and radial height are the most important anatomical and radiological parameters that defines the clinical outcome. Any technique that maintains all these parameters would result in good outcome.

Conclusion

So in our study we concluded that though kapandji intrafocal pinning has got slight good score, also volar tilt was preserved slight better in kapandji pinning group. So, one can choose this method for fixation of fracture although the difference was not much statistically significant between both the techniques ($p > 0.05$).

Conflict of Interest

The authors have no conflicts of interest to declare.

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