Int J Clin Exp Med 2013;6(2):133-139
www.ijcem.com /ISSN:1940-5901/IJCEM1210007

Original Article

A prospective comparison between Kapandji and percutaneous extra-focal fixation in extra articular distal radius fractures

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Received October 21, 2012; Accepted December 3, 2012; Epub January 26, 2013; Published February 6, 2013

Abstract: Introduction: there are multiple methods of distal radius fractures treatments. Of these, percutaneous wire insertion has yielded popular acceptance. These percutaneous wire insertions can be done through many different ways with their own advantages and disadvantages. One of these methods is Kapandji method and because of its inherent stability in biomechanical examinations we suppose that we can begin the range of motion sooner than other methods with the hope of better outcome. Patients and methods: From 2010 to 2012 we studied 45 patients, of these 23 went under extra-focal technique and 22 went under Kapandji technique. After Kapandji we immobilized the limb in splint for 4 weeks and started partial motion thereafter and in the extra-focal group we immobilized them in for 6 weeks in long arm casts. Results: After 3 months and 6 months we assess the Gartland and Warley score and find 39% and 73% excellent and good result in extra-focal and 45% and 86% excellent and good result in Kapandji group after 3 and 6 months, respectively. Although there were about 0.22 mm collapse in both groups, here were no statistically significant differences in functional score or radiologic and anatomic parameters between groups. Conclusion: we have find Kapandji technique a suitable method of distal radius fracture fixation in cases with no articular involvement and we think it is better to immobilize the limb for at least 6 weeks after Kapandji fixation, in order to better control the pain.

Keywords: Extra articular distal radius, Kapandji technique, extra-focal technique

Introduction

Distal radius fracture is the most common fracture of the upper extremity [1], and there is very disagreement on its classification, treatment, functional and radiologic outcome.

Distal radius fractures has met different kind of managements such as conservative treatment that first Colle's describes [2], close reduction and cast immobilization [3-5], external fixation [6-9], close reduction and percutaneous fixation with Kirschner wires [10-13] and open reduction and internal fixation [14-16].

Since their introductions, there were lots of 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 of treatment still is a matter of debate. For example when use some kind of fixation like percutaneous fixation with Kirschner wires in order to protect the fracture from further displacement till the time of bone healing , that is a concern in close reduction and cast immobilization [17], there is conflicting data regarding the perfect methods of wire fixation.

Close reduction and percutaneous fixation has the advantage of minor operation in contrast to open reduction and internal fixation, protect the reduction from further displacement as we may see in close reduction and cast immobilization [17] and it costs much less than plates that is used for open reductions. Percutaneous wire fixation has its own complications like pin site infections, pin breakage, tendon and nerve injury during wire insertion, but has much less complications as we may see in open reduction and internal fixation technique [18].

Among various techniques of wire insertions, there are two distinct method; insertion of wire through the fracture sites and insertion across the fracture sites. The former in which two or three wire are inserted through fracture sites and cross the opposite cortex, was first described by Kapandji in 1976 and since then various modification has been introduced [19-24]. 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 has became more popular [13].

Kapandji technique has some theoristical and biomechanical advantages upon the extra-focal techniques. Of these is that the fixation in the Kapandji method is dynamic in contrast to extra-focal fixations in which it is more static and its configuration is much biomechanically stable [25]. Although Kapandji method may lead to collapse of fracture site because of its dynamic fixation that is not confirmed to has significant difference among other methods of wire insertions, but it also may lead to soon and rigid fixation and better functional outcome because of less immobilization.

There are few literature that compare the radiologic and functional outcomes of various techniques. Our purpose in this prospective study is to define and compare the functional and radiological result of extra-focal and Kapandji pinning methods.

Patients and methods

This prospective study was performed on 45 patients with extra-articular distal radius fractures. Of these 23 were treated with extra-focal pinning technique and 22 were treated with Kapandji technique. The exclusion criteria were comminuted fractures, open fractures, multiple fractures and intra-articular extension. All patients were skeletally mature and there were no age limit. We randomly selected the method of fixation. Of 23 patients in the extra-focal fixation technique, 11 (47.8%) were male and 12 (52.2%) were female and in the Kapandji group 14 (63.6%) were male and 8 (36.4%) were female. Of the 23 patients in the extra-focal group 4 (17.4%) were left hand dominant and 19 (82.6%) were right hand dominant and in 56.52% the fracture was at dominant hand. Of the 22 patients in the Kapandji group 2 (9.1%) were left hand dominant and 20 (90.9) were right hand dominant and in 54.54% the fracture was at dominant hand. Mean age in the extra-focal group was 49.52±22.46 (SD) (17-82) and in the Kapandji group was 42.68±20.53 (SD) (18-84).

Technique

The extra-focal technique was performed through general or local anaesthesia, there after close reduction was achieved by traction and counter traction with caution to avoid preterm flexion and with palpation of the overall shape of the bone and correction of any step that was remained. Then with proper flexion the reduction was achieved in all cases. Then with use of fluoroscope the fractures alignments were checked and if they were acceptable then we advanced through fixation. First, we make 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 and third wire was inserted through third-fourth and fourth-fifth extensor compartment, respectively. After third wire insertion, we again checked the fracture alignments and if there were accepted then bent wires out of skin and cut them. Long arm cast were applied after proper dressing. We visited the patients at 2 weeks, 4 weeks, 6 weeks, 3 months and 6 months and we dismiss the cast and removed the wires at 6 weeks, the time in which we started the routine physiotherapy.

The Kapandji method was performed again under general or local anaesthesia, the reduction was achieved the same as extra-focal method, but wires were inserted differently. 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 fracture site with caution not to damage the radial nerve and tendons. Then the wire was angled 45 degree obliquely proximally and was drilled to the opposite cortex. Second and third wires inserted through third-forth and forth-fifth extensor compartment, respectively (**Figure 1**). We did not hesitate to use the wire to reduce the fracture where was needed. Again we checked the fracture and the overall align-

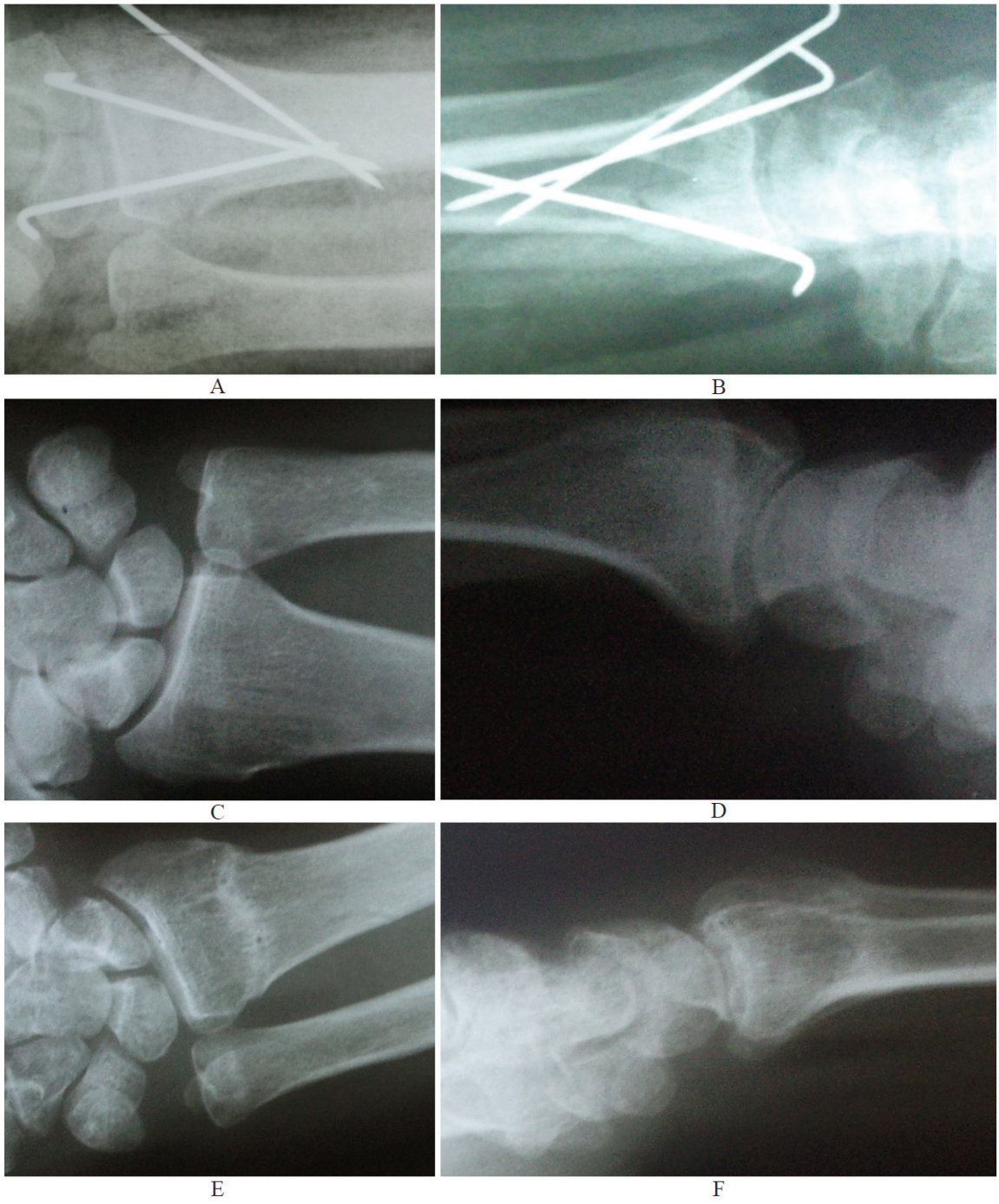

Figure 1. A 56 years old man who with fracture of left distal radius. Fixation with Kapandji method AP (A) and Lat (B). the opposite distal radius AP (C) and Lat (D) were taken for comparison. 6 months after operation AP (E) and Lat (F). although there is some radiographic signs of delayed union exists, as the patient was smoker, but the patient was pain free and had full range of motion.

ments with fluoroscope and if there were any concern about the malalignment, then we removed the wires and started with reduction again. We did not have problems in reductions and fixations in our patients and there were no need to change the technique in any of them. We immobilized the upper limb for about 28 days with sugar-tongue splint then we mobilize the limb 2-3 times daily for about 5 min and instruct the patients to move their hand through

Table 1. Radiologic parameters in kapandji and extra-focal technique both at fractured and non-fractured side

	Kapandji	Extra-focal
Fracture side ulnar variance	.64	.43
Non fracture side ulnar variance	.86	.65
Fracture side palmar tilt	12.41	10.61
Non fractured side palmar tilt	14.86	14.61
Fractured side radial length	14.95	14.43
Non fractured side radial length	17.73	16.39
Fractured side radial inclination	19.91	22.04
Non fracture side radial inclination	23.36	25.83

the range of motion till the pain let them to do so and again use their splint for other 14 days. After 45 days we removed the wires and splint and started the routine physiotherapy.

In both groups we try 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. We checked distal radioulnar joint stability and do proper treatment whenever was needed.

We visited the patients at two, four, six weeks after surgery and check for wires dressing and removed the wires under local anaesthesia after six weeks.

Functional assessment was performed 3 and 6 month after surgery using Gartland and Warley [26] score and radiologic assessment was performed after 6 month. Grip assessment of fracture side and the opposite side was performed after 6 month with Jamar device. We examined the patients after 6 month for reflex sympathetic dystrophy (RSD). We used student t-test to compare the means of groups and analysis the data.

Results

Forty five patients were selected for this study from 2010 to 2012 who had extra-articular distal radius fracture. Of these, 23 were selected for extra-focal pinning method and 22 for Kapandji technique. We had no complication through operation and there were no need to change our plan and go through open reduction. Close reduction was achieved thoroughly and there were no wire breakage.

Functional assessment after 3 months using Gartland and Warley showed that the mean score in the extra-focal group was 10.00 (SD 6.10) and in the Kapandji group was 9.82(SD 5.90). Although there were better score in the Kapandji group, but it wasn't statistically significant. After 6 months the functional score become 6.78 and 4.45 in the extra-focal and Kapandji group respectively and again there were no statistically significant difference.

After 3 and 6 months we had 39% and 73% excellent and good results in the extra-focal group, respectively. In the Kapandji group there were 45% excellent and good results after 3 months and 86% after 6 months.

Assessing the radiologic data showed that there were no statically significant difference between two groups in any of radiologic parameters. Mean ulnar variance of fractured side was 0.43 mm and 0.64 mm and the opposite side was 0.65mm and 0.86 mm in the extra-focal group and Kapandji group, respectively. Interestingly we have find 0.22 mm of collapse in both groups. Fractured side palmar tilt was 12.41 and 10.61 in the extra-focal and Kapandji group respectively. Radiologic parameters are summarized in the **Table 1**.

When assessing ulnar variance data from opposite side with the fractured side we found that there were statically significant difference between fractured and non-fractured side, 0.76 and 0.53 respectively ($p<0.01$).

Grip assessment showed that means grip force were 15.04 kg/cm in the extra-focal group and 16.68 kg/cm in the Kapandji group after 6 months and there were not statistically significant. But there were significant difference

between fractured side and the opposite sides grip force (15.84 vs 27.33) ($p<0.01$).

Discussion

When we are faced with distal radius fracture it is not as easy as the diagnosis to select the best treatment method in all cases, but there is supporting data that the conservative treatment will cause higher incidence of RSD and worse anatomic outcomes [27]. One of the first methods of fixation was done by Lambotte in 1908 that used 1 or 2 wire to fix the fracture through radial styloid. Although the results were poor and revealed unsatisfaction in keeping the radial height but it did begin a long way of multiple methods of fixations that has lasted till now. The concept of cross wire fixation was introduced by Stein and Katz in 1975, who fixed the fracture with one wire through radius styloid and one through radius ulnar and dorsal cortex into volar cortex [28]. That method could save the radial angle in 100%, and radial length in 98.14%. Kapandji described a technique in which he inserted wires inside the fracture side and drilled to the opposite cortex instead of primary wiring method [29] but he did not report his results. Epinete in 1982 reported his series results with Kapandji technique in which there were 84% excellent and good result [30]. Another study that assess the Kapandji technique was from Greating and Bishop in 1993 in Mayo Clinic in which they reported 84.6% excellent and good Mayo Clinic wrist score and also they advocated usage of this technique in fractures in which there is no volar cortex comminution or joint involvement. We also agree with them in which when there is joint involvement it is hard to reduce and even harder to keep the reduction by Kapandji method but we believe that volar cortex comminution unless we can reduce the fracture properly and apply immobilization with cast, would not lead to loss of reduction and that was what we also see in our series. Palmar tilt were preserved better in the Kapandji group (12.41) than the extra-focal group (10.61) also it was not statistically significant but it may be because of the buttress effect of the second and third wire on the distal fragment.

As mentioned above there is some compression effect in the Kapandji method in contrast to extra-focal method and there is concern about lose of radial length and ulnar variance because of this effect, but our study shows that despite some amount of depression in the length and ulnar variance but there were no significant difference between two groups. Nonetheless there were significant differences between ulnar variance between fractured side and the opposite side that showed both techniques could not save the radial length properly.

Although functional score due to Gartland and Warley was better in the Kapandji group in contrast to extra-focal group both at the 3 months and 6 months after surgery but the difference was not statistically significant. It showed that beginning the motion before sufficient union has been occurred may cause excessive pain and may restrict the motion and therefore reduce the benefits of motion beginnings. Further than ease of use and ease of technique of Kapandji that we experienced during our study rather than extra-focal technique, we also noted that the number of fluoroscopic image shoot and the time of surgery were significantly decreased when we use the Kapandji technique.

In 1994 a comparative study between Kapandji technique and trans-radial wire technique, pain and RSD were more common in the Kapandji group but the range of motion was better in the Kapandji group till six weeks and after that became insignificant [31]. There were loss of reduction and increasing in radial shortening during the first three post operative months. They reported that the clinical results after two years became same between groups. In our series we find four RSD in Kapandji group and two in extra-focal pinning technique.

It seems that radial length is the most important radiologic and anatomic parameters that define the clinical outcome [32] and it seems that any technique that maintain the radial length may end in better functional result [28].

In our series we fail to show that Kapandji technique because of early motion will end to better functional outcome. One of the reasons that may play a role is that in the Kapandji group despite better stability of fixation, pain in the premature beginning of range of motion limits the patients compliance and this may be responsible for identical functional scores were seen between groups. We recommend at least

6 weeks of immobilization whether the technique is used.

Kapandji technique is proper method in extra-articular distal radius fracture and its reproducibility and ease make Kapandji a choice in these settings.

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