Research Article

A study to check use of additional transulnar k-wire in percutaneous cross k-wire pinning fixation of distal end radius fractures

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Abstract

Introduction: Distal radius fractures are the most common type of orthopedic fracture. Some surgeons advocate treatment by manipulation and plaster immobilization. Many recommend operative intervention as the only methods to obtain anatomical reduction. In most displaced fractures of the radius, loss of reduction is likely to occur unless accurate management is provided. Inadequate fixation might result in gradual shortening at the fracture site during the healing process, even with excellent reduction. This article describes a technique that combines percutaneous cross Kirschner wire pinning fixation with additional transulnar k-wire for better stabilization of fracture fragments. **Materials and Methods:** This study includes 60 patients who were treated with percutaneous k-wire fixation for distal end radius fracture. They were divided in two groups. First group include 30 patients with cross pinning percutaneous k-wires while other group include 30 patients with additional transulnar k-wire in cross pinning k-wire fixation. The radial height, palmar tilt, radial inclination were measured pre-operatively and post-operatively in plain radiographs. Intraarticular fractures, pediatric fractures, associated other forearm fractures were excluded in study. Above elbow cast is applied immediate post op till 3 weeks, followed by below elbow cast for 3 weeks. K-wires and cast were removed after 6 weeks. The patients were followed up at 3, 6, 10, 14 weeks period .Clinical, radiological and functional reviews were performed at periodic intervals. **Results:** There was a significant difference from pre and post-operative values of radial height, palmar tilt, radial inclination in the cross pinning with additional transulnar patient group as compare to only cross pinning group. Additional transulnar k- wire was better at maintaining palmar tilt and radial height. **Conclusion:** Percutaneous fixation by additional transulnar k- wire fixation technique is an effective method to maintain the reduction, prevent radial collapse during healing, and to maintain the stability of the distal radioulnar joint even when the fracture is grossly comminuted or unstable.

Keywords: transulnar k-wire.

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INTRODUCTION

Distal radius fractures are the most common type of orthopedic fracture. Some surgeons advocate treatment by manipulation and plaster immobilization[1]. Many recommend operative intervention as the only methods to obtain anatomical reduction, and some have proposed that the best functional result will only be achieved by obtaining as near an anatomical radiographic result as possible[2]. Although a study by most authors suggests that radial shortening more than 4 mm and radial dorsal angulation of more than 11° would reduce range of motion of the wrist. Furthermore, wrist pain was the most complaint among those patients[3,4,2]. In most displaced fractures of the radius, loss of reduction is likely to occur unless accurate management is provided to prevent repeat displacement. Inadequate fixation might result in gradual shortening at the fracture site during the healing process, even with excellent reduction. Percutaneous pinning and casting are simple procedures familiar to most surgeons. Percutaneous pins to provide additional stability is one of the earliest forms of internal fixation.[5,6,7] Depalma[7]

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described ulnaradial pinning drilled at a 45° angle, 4 cm proximal to ulnar styloid, from ulna into radial styloid. Stein[8] described the use of an additional dorsal pin, an additional 2-mm pin across the radioulnar joint was also used[9], Kapandji[10] described double intrafocal pining (2-mm) into the fracture surface, and Rayhack[11] described ulnaradial pinning with fixation of distal radioulnar joint.

MATERIALS AND METHODS

This study includes sixty patients with closed distal radius fractures who were treated with percutaneous K-wire fixation. Age group for study was 18-65 years. All open fractures, comminuted intra-articular fractures, fractures with volar deviation (Smith's type), previous fracture in the region and presence of simultaneous neurological or vascular lesions or other fractures in upper extremities were excluded from study. Preoperative radiographs were assessed for fracture pattern, degree of comminution, and articular fragmentation. All patients were scheduled for operative treatment under appropriate anesthesia. An accurate reduction in the fracture was the first step in the treatment plan. A neutral position of the wrist was desirable. With a dorsally displaced fracture, the reduction was performed by pushing the distal fragment distally and palmarly while holding the proximal fragment with the fingers around the forearm. The goal was to convert the dorsal angulation to a neutral position as well as to regain radial height. Image intensification fluoroscopy was used to assist the reduction and to assess the accuracy of the reduction. In first study group (n=30), after achieving acceptable reduction of the fracture, two cross pin percutaneous K-wires were inserted with the wrist in traction to maintain the reduction. While the other study group (n=30), after achieving acceptable reduction of the fracture, two cross pin percutaneous K-wires were inserted with additional transulnar k-wire from ulnar styloid processes to radius. A 1.8mm Kirschner wire is passed, from distal ulna, through the inferior radioulnar joint parallel to wrist joint line to stabilize the distal radioulnar joint. The ends of the wires were bent at a right angle and then cut short outside the skin. Sponge padding with an occlusive dressing was applied to prevent skin irritation. After fixation, for both study groups, the arm was immobilized in above elbow cast for 3 weeks, followed by below elbow cast for another 3 weeks. The patients underwent follow-up at our outpatient clinic at 3-weeks intervals. The healing of the fracture was assessed both clinically and radiographically at each follow-up. Usually, by 6 weeks, clinical and radiographic examination demonstrated progression of fracture healing. The percutaneous wires and plaster were usually removed after 6 weeks of immobilization on an outpatient basis without local anesthesia. Instruction about active assisted wrist motion was demonstrated to the patient.

EVALUATION OF OUTCOME

The patients were followed up at 3, 6, 10, 14 weeks period .Clinical, radiological and functional reviews were performed at periodic intervals. The radial height, palmar tilt, radial inclination were measured pre-operatively and post-operatively and subsequent follow-up in plain radiographs. The treatment complications were recorded. Wrist function was evaluated using Solgaard's modification[12] of the scoring system described by Gartland and Werley[13]. The functional outcome was easy to evaluate with simple instruments in this scoring system. The residual deformity and the subjective evaluation were recorded in the same way as the original scoring system. The range of motion was measured using a goniometer to measure dorsal and volar flexion, radial and ulnar deviation, and supination and pronation, and the sum was calculated as the percentage of the unaffected wrist. The final results of the patients with excellent and good functional outcome were considered satisfactory. **RADIOLOGICAL:** Radiological assessment was done in terms of radial height, palmar tilt, radial inclination and the results were graded according to the ***Sarmiento's modification of Lind Strom Criteria***[14]. These parameters were assessed during the follow up of the patient to assess the quality of reduction and the ability of the technique to maintain the reduction.

SarmientoS Modification Of Lind Storm Criteria

	Deformity	Residual Dorsal Tilt	Radial Shortening	Loss Of Radial Inclination
Excellent	No Or Insignificant	0^0	< 3 Mm	$< 5^0$
Good	Slight	1^0 To 10^0	3 To 6 Mm	5^0 To 9^0
Fair	Moderate	11 To 14	7 To 11 Mm	10^0 To 14^0
Poor	Severe	Atleast 15^0	Atleast 12 Mm	$>14^0$

CLINICAL AND FUNCTIONAL

Functional evaluation of the patients was done at the last follow up according to the ***demerit point system of Gartland and Werley] with Sarmiento et al's modification.***

RESIDUAL DEFORMITY	
Prominent Ulnar Styloid	1
Residual Dorsal Tilt	2
Radial Deviation of Hand	2 to 3
Point Range	0 to 3
SUBJECTIVE EVALUATION	
Excellent: no pain, disability or limitation of motion	0
Good: Occasional pain, slight limitation of motion, no disability	2
Fair: Occasional pain, some limitation of motion, feeling of weakness in wrist, no particular disability if careful, activities slightly restricted	4
Poor : Pain, limitation of motion, disability, activities more or less markedly restricted	6
Point Range	0 to 6
OBJECTIVE EVALUATION*	
Loss of Dorsiflexion	5
Loss of Ulnar Deviation	3
Loss of Supination	2
Loss of Palmar Flexion	1
Loss of Radial Deviation	1
Loss of Circumduction	1
Loss of Pronation	2
Pain in Distal Radioulnar Joint	1
Grip Strength – 60% or less of opposite side	1
Point Range	0 to 5
COMPLICATIONS	
Arthritic Change	
Minimum	1
Minimum with Pain	3
Moderate	2
Moderate with pain	4
Severe	3
Severe with pain	5
Nerve Complications (Median)	1 to 3
Poor Finger Functions Due to Cast	1 to 2
Point Range	0 to 5
END RESULT POINT RANGES	
Excellent	0 to 2
Good	3 to 8
Fair	9 to 20
Poor	21 and Above

RESULT

All of the fractures healed in our study group. Most of the patients returned to their preinjury activity level. The mean age of the study participants was 37 years. Females were more commonly affected (56.67%) in both the groups. Non-dominant side was more commonly involved than the dominant side 56.67% in 3-pin group and 53.54% in 2-pin group. The mean volar tilt in the cross pinning group is 12.1 degrees whereas the mean of the tranulnar k-wire group is 11.82 degrees. The mean radial inclination in the cross pinning group is 18.56 degrees whereas it is 20degrees in transulnar k-wire group. The mean radial height in the cross pinning group is 9.4 mm, whereas it is better in transulnar k-wire group e.g.10.41 mm. The Mean value of Modified Gartland and Werley Total Demerit Score was 4.52 for cross pinning group whereas it was 2.31 for the transulnar k-wire group. Two patients developed pin tract infection in the cross pinning k-wire group whereas 4 patients developed pin tract infection in the tranulnar k-wire group, which resolved with antibiotics and dressings. The results indicated that transulnar k-wire group can provide adequate stability during the time of fracture healing. At the time of removal of plaster and percutaneous K-wires, the average radial height was 9.92 mm (range=5–17 mm), and the volar tilt was 3.93° (range=−8.3–12°).

Table 1: Showing pre and post of values of palmar tilt, radial height and radial inclination in both the groups

	Cross pinning only			Cross pinning with transulnar k-wires		
	palmar tilt(in˚)	Radial height(mm)	Radial inclination(in˚)	palmar tilt(in˚)	Radial height(mm)	Radial inclination(in˚)
Pre op values	15	8.4	16.46	14.9	8.28	16.56
Post op values	12.1	9.4	18.53	11.92	10.41	20.06

Table 2: Shows results as per demerit point system of Gartland and Werley] with Sarmiento *et al*'s modification

K-wire construct used	Results – Number (%)			
	Excellent	good	fair	Poor
Cross pinning only	7 (23.34%)	11 (36.67%)	7 (23.34%)	5 (16.67%)
Cross pinning with transulnar k-wires	13 (43.34%)	14 (46.67%)	2 (6.67%)	1 (3.34%)

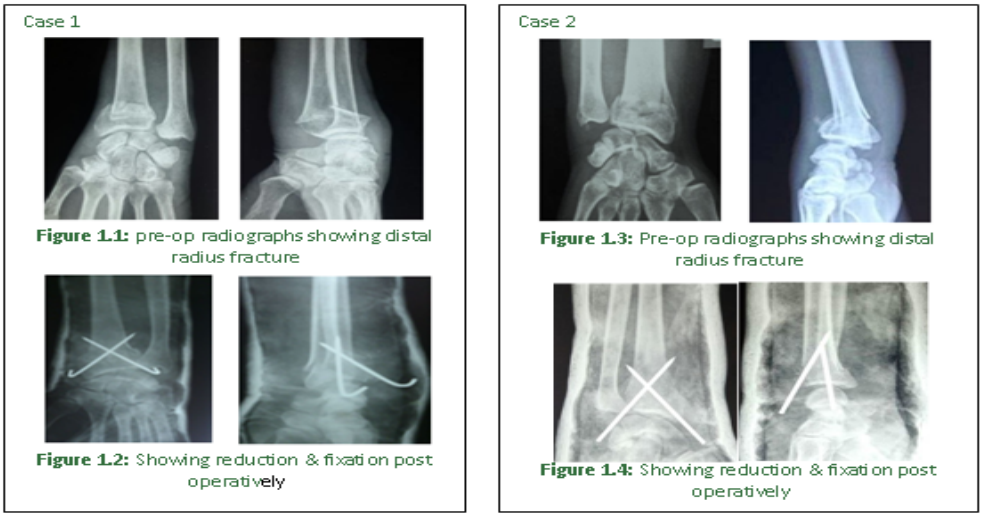

Figure 1: Cases of cross pinning k-wire fixation pre and post operative radiograph (anteroposterior and lateral views)

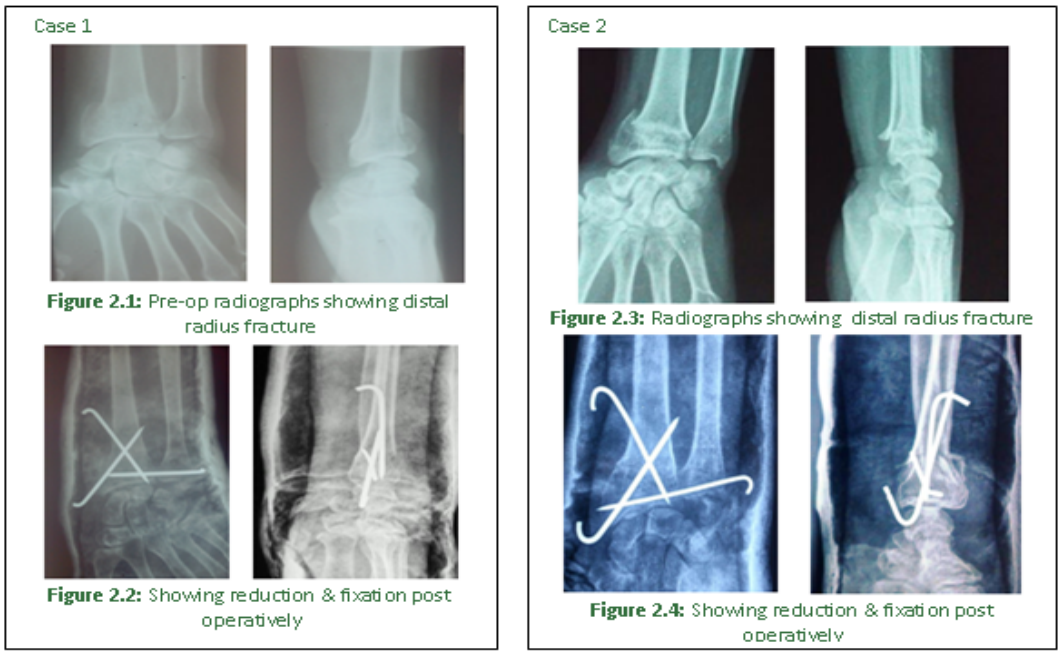

Figure 2: Cases of additional transulnar k-wire with cross pinning k-wire fixation pre and post operative radiograph (anteroposterior and lateral views)

DISCUSSION

Distal radius fracture is a common injury. The importance of anatomic reduction has been demonstrated by clinical studies as well as by laboratory assessment of force and stress loading across the radiocarpal joint[15,16]. In fractures with articular surface displacement greater than2 mm, radial shortening greater than 5 mm, or dorsal angulation more than 20°, suboptimal results have been reported in previously published studies[15,17]. Therefore, every effect should be made to restore normal length, alignment, and articular surface congruency of the distal radius. An accurate reduction in the fracture is the first step in the treatment of the distal radius fracture. After anatomic reduction in the fracture is achieved, many methods are available to maintain alignment and prevent repeat displacement. The methods of immobilization include casting, percutaneous pinning, external fixation, internal fixation with plate, or internal fixation combined with external fixation depending on the different types of fractures. Every method has its advantages and some limitations. The most common traditional treatment of distal radius fractures in osteoporotic patients is closed reduction and cast immobilization. Three-point fixation with a well-fitted cast is essential for adequate immobilization. However, extreme flexion should be avoided because carpal tunnel pressure will be increased. This is associated with increased wrist flexion and ulnar deviation when the distal fracture was immobilized with a cast. Although cast immobilization alone avoids surgery and complications related to pin placement and pin removal, casts cannot maintain distraction to correct length or control the rotation of the distal fragment when comminution is present[18]. Loss of reduction usually happens after 2 weeks of casting despite a perfect initial anatomic reduction[4]. Gartland and, Werley obtained a 68.3% satisfactory result, and Sarmiento *et al*. reported an 82% satisfactory result treated with the casting technique[14]. Spira and Weigl reported a 51.4% unsatisfactory result with reduction and use of cast in the treatment of comminuted fracture of distal radius with articular involvement[20]. Closed reduction and percutaneous pinning relies on intrafocal manipulation and pinning or manual traction, reduction, and pinning, to hold the fracture in an appropriate anatomic alignment. Clancey reported a 96.4% satisfactory result in 30 patients treated with percutaneous pinning if the articular surface of the radius was not comminuted into more than two fragments. External fixation has been popular for the treatment of displaced fractures of distal radius, and the radial length and dorsal tilt have improved significantly with this method[21,22,23]. External fixation can be supplemented with percutaneous wires through the radial styloid for certain intra-articular fractures. Combined internal and external fixation is a technique that attempts to maximize the advantageous features of each of its two components while minimizing their disadvantages. Seitz *et al*. reported a 92% satisfactory result in 51 patients treated with augmented external fixation using K-wires to reduce and fix unstable fragments[24]. The external fixator could maintain radial length more efficiently than the percutaneous pinning and casting group, but volar tilt was not generally restored[21]. Pin tract infection is another problem that should be concerned. The additional transulnar k-wire technique is a combination of percutaneous cross pinning,and k-wire for distal radio ulnar joint . The potential biological advantage is that it prevents collapse of radial height. Adjacent soft tissue supports structures, including tendons and the joint capsule. After closed reduction in our study patients, the fractures were fixed directly with percutaneous K-wires. Because K-wire fixation seldom provide sufficient stability to allow for early motion and often necessitate use of a cast or splint, the addition of transulnar k-wire into cross two K-wires increase stability of the fracture fixation. Extreme wrist flexion and ulnar deviation could be avoided with this technique. Extreme wrist flexion might cause potentially uncorrectable wrist stiffness and also is associated with an increased risk for median nerve compression resulting in carpal tunnel syndrome[21]

CONCLUSION

In conclusion, percutaneous pinning incorporated with transulnar k-wire fixation is an excellent technique for fractures in cases with severe comminution of the distal radius. The technique involves a minimal procedure that provides anatomic reduction, fracture fixation, and maintenance of reduction with an adequate method of immobilization. It does not require highly skilled personnel or sophisticated tools for application .this technique is an effective method to maintain the reduction, prevent radial collapse during healing, and to maintain the stability of the distal radioulnar joint even when the fracture is grossly comminuted or unstable.

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