



## Percutaneous pinning for non-comminuted extra-articular fractures of distal radius

<b>Dr. Akhil Joshi</b>	Resident in MGM medical college and Hospital, kamothe, Navi Mumbai
<b>Dr. Akshay mahajan</b>	Asst. Professor in MGM medical college and Hospital, kamothe, Navi Mumbai
<b>Dr. Alfven Vieira</b>	Professor & HOD department of Orthopaedics, MGM medical college and Hospital, Kamothe, Navi Mumbai

### ABSTRACT

**Background:** Various treatment modalities have been described for the treatment of extra-articular distal radius fractures each with its own merits and demerits. Most of the work done with percutaneous pinning has shown a significant residual stiffness of the hand and wrist. Our technique involves percutaneous pinning of the fracture and immobilization in neutral position of the wrist for three weeks. This study's aim was to examine the functional outcome of percutaneous K-wiring of these extra-articular distal radius fractures with immobilization in neutral position of the wrist. **Materials and Methods:** This is a prospective study of 32 patients aged between 18 and 70 years with extra-articular distal radius fracture. Patients were treated with closed reduction and percutaneous pinning using two or three K-wires. A below- elbow plaster of paris/dorsoradial slab was applied in neutral position of the wrist for 3 weeks. At the end of 3 weeks, the slab was removed and wrist physiotherapy started. The radiographs were taken postoperatively, at 3 weeks, 6 weeks and 6 months. The functional evaluation of the patients was done at 6 months follow-up. We used Sarmiento's modification of Lindstrom criteria and Gartland and Werley's criteria for evaluation of results. **Results:** Excellent to good results were seen in 93.75% of the cases while 6.25% had fair results. The complications observed were pin loosening (n=13), pin tract infection (n=2), malunion (n=2), wrist joint stiffness (n=2), reduced grip strength (n=2) and injury to the superficial radial nerve (n=1). **Conclusion:** Percutaneous pinning followed by immobilization of the wrist in neutral position is a simple and effective method to maintain reduction and prevent stiffness of wrist and hand.

### KEYWORDS

Extraarticular distal radius fracture, immobilization with wrist in neutral position, percutaneous pinning.

### Introduction

Fractures of the distal radius represent one-sixth of all fractures treated in emergency department.<sup>[1]</sup> Closed reduction and cast immobilization has been the mainstay of treatment of these fractures, but invariably it results in malunion, poor functional and cosmetic outcome.<sup>[2]</sup> Restoration and maintenance of anatomy correlates well with function. The residual deformity of the wrist as a result of malunion is unsightly. It adversely affects wrist motion and hand function by interfering with the mechanical advantage of the extrinsic hand musculature.<sup>[3],[4],[5]</sup> In many cases there is weakness of handgrip and return to preinjury activity level becomes impossible. Closed reduction and cast immobilization<sup>[6],[7]</sup> often leads to collapse of the radius. Percutaneous K-wire fixation provides additional stability and is one of the earliest forms of internal fixation.<sup>[8],[9],[10]</sup> Depalma described ulno-radial pinning drilled at 45° angle, 4 cm proximal to ulnar styloid. Kapandji<sup>[11]</sup> described double intrafocal pinning into the fracture surface and Rayhack<sup>[12]</sup> described ulno-radial pinning with fixation of distal radioulnar joint. Bridging external fixators<sup>[13],[14]</sup> and ligamentotaxis indirectly reduce the fracture. Ruch et al,<sup>[15]</sup> and many others described open reduction and internal fixation of distal radius fracture. Doi et al. recommended it for comminuted intra-articular fractures.<sup>[16]</sup> Most of the work done with percutaneous pinning emphasizes that there is significant residual stiffness of the hand and wrist.<sup>[17],[18]</sup> The acute palmar flexed position of the wrist during the postoperative immobilization period was blamed as the main reason for stiffness.<sup>[19]</sup> This study was conducted to examine the functional outcome of non comminuted extra-articular distal end radius fractures treated with closed reduction and percutaneous K-wire fixation with immobilization in neutral position of the wrist and early physiotherapy.

### Materials and Methods

Thirty two consecutive patients with extra-articular distal radius fractures were prospectively enrolled for the study between January 2006 and March 2010. 18 patients were male and 14 were female. The mean age of patients was 41.4 years (range 18-70 years). In 21 patients, the fracture involved the dominant hand. Only patients with non comminuted extra-articular distal radius fractures were included in the study. All patients with intra-

articular distal radius fractures, comminuted distal end radius fractures, presenting later than 2 weeks of injury, patients in whom ulnar shaft was not intact, polytrauma patients, patients with open fractures and patients with open fractures were excluded. Out of the 32 patients enrolled for the study, none of them were lost to follow-up. The mode of trauma was a simple fall on the outstretched hand in 21 patients and a sports-related injury in 11 patients. All were closed fractures. Fractures were classified according to the AO classification, using the preoperative anteroposterior and lateral roentgenogram [Figure 1]. All 32 patients had AO type A2 fractures. Additionally radial length, palmar tilt and radial angulation were measured.

### Operative procedure

Closed reduction of the fracture was achieved by longitudinal traction and direct pressure over the displaced fragment under anesthesia. Hyperextension or flexion manoeuvres to disimpact the fragments were not recommended. Reduction was checked under image intensifier in both anteroposterior and lateral planes. As an assistant held the wrist with fracture in the reduced position, the first K-wire of 1.5-2.0 mm was inserted from the dorsolateral aspect of the distal radius fragment across the fracture and into the proximal fragment under image intensifier guidance. A second K-wire was passed from the dorsomedial aspect of the distal fragment across the fracture into the proximal fragment. After checking the stability of the fracture under image intensifier, if required, a third K-wire was passed from dorsolateral aspect from distal to proximal fragment. The wires were drilled to engage the opposite cortex. K-wires were bent at a right angle and cut short outside the skin for easy removal. A sterile dressing including sponge padding was applied to prevent skin irritation. With the wrist in the neutral position, a dorsoradial below elbow plaster of Paris slab was applied up to the knuckles. Postoperative radiographs are obtained in the anteroposterior and lateral planes.

Postoperatively, the limb was kept elevated for 24 hours. Active finger, shoulder and elbow mobilization was started at the earliest. Patients were discharged 24 hours post surgery after ensuring good distal circulation of fingers. At 3 weeks follow-up, X-rays were taken, both in the anteroposterior and lateral planes to check

the position of the fracture. The slab was removed and active finger, wrist exercises and forearm pronation and supination exercises were started. Handgrip was improved by using soft ball exercises. At 6 weeks, anteroposterior and lateral view radiographs were repeated. K-wires were then removed without anaesthesia. Wrist physiotherapy and handgrip exercises were continued for another 2 to 4 weeks. Results were evaluated clinically and radiologically at 6 months using Sarmiento's modification of Lindstrom criteria<sup>[20]</sup>.

### Results.

All fractures healed. Restoration of anatomy was excellent in 21 patients (65.63%) and 9 patients (28.13%) had a good anatomical outcome while 2 (6.25%) had fair results. Preoperative radiographic assessment showed that the average radial height was 2.56 mm (range 1-4 mm) and volar tilt was -12.31° (range 8 to -18 o). Assessment of postoperative radiographs revealed that the average radial height was 10.44 mm (range 8-14 mm) and volar tilt was 11.13 o (range 8-16 o) on the immediate postoperative X-rays. At the time of pin removal at 6 weeks, radial height was 9.34 mm (range 5-13 mm) and volar tilt 10.03° (range 4-16 o). The radial height was 7.53 mm (range 2-12 mm) and volar tilt 8.56 o (range -2 - 16°), at 6 month follow-up. Functionally, 26 patients (81.25%) had excellent hand function. 4 patients (12.5%) had good results; 2 patients (6.25%) who had residual displacement and joint stiffness had a fair outcome.

Pin loosening was encountered in 13 cases. Pin tract infection (n=2), malunion in (n=2), joint stiffness (n=2), reduced grip strength (n=2) and paresthesia in the distribution of superficial radial nerve (n=1) were the other complications observed. Reflex sympathetic dystrophy was not encountered. Post-traumatic arthritis of wrist, subluxation of distal radio-ulnar joint and penetration of vessel were not seen.

### 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 studies.<sup>[22][23]</sup> In fractures with articular displacement greater than 2 mm, radial shortening greater than 5 mm or dorsal angulation greater than 20°, suboptimal results have been reported in previously published studies.<sup>[21]</sup> Accurate reduction of the fracture is the first step in the treatment of distal radial fractures. Many options are available to maintain this initial reduction. The most common traditional method is closed reduction and cast immobilization, but this often fails to prevent early radial collapse and is associated with a high risk of malunion, joint stiffness and painful wrist. Hence, this method is for low-demand elderly patients.<sup>[24][25]</sup> External fixators can maintain radial length and radial inclination by ligamentotaxis, but cannot effectively maintain palmar tilt.<sup>[26]</sup> Also complication rates as high as 60% have been reported with the use of external fixators.<sup>[27]</sup> These mainly include pin loosening, pin tract infection, reflex sympathetic dystrophy, radial sensory neuritis and delayed union. Thus, external fixators are better avoided in noncomminuted extra-articular distal radial fractures.<sup>[28]</sup> Open reduction and internal fixation<sup>[15]</sup> and arthroscopic reduction<sup>[16]</sup> techniques should be reserved for partial and complex intra-articular distal radius fractures. Percutaneous pinning with K-wires was first recommended by Green<sup>[29]</sup> as a simple and inexpensive procedure. Various techniques of percutaneous pinning are available. Most studies attribute poor results of this technique to radial shortening, wrist stiffness and reflex sympathetic dystrophy.<sup>[17][18]</sup> The authors are of the view that wrist stiffness and reflex sympathetic dystrophy occur because of the palmar-flexed position of the wrist in which postoperative immobilization of the fracture is done. Prolonged immobilization of the wrist for greater than 3 weeks increases the magnitude of the problem. Hence we developed our protocol for the treatment of extra-articular distal radius fractures. Fracture reduction was achieved by longitudinal traction and direct pressure over the displaced fragment followed by percutaneous pinning. Instead of circumferential cast, dorso-radial plaster of Paris slab was applied in neutral position of the wrist. Active finger mobilization was started immediately. In our

study we did not encounter reflex sympathetic dystrophy while 2 cases had wrist stiffness which required mobilization exercises under the supervision of physiotherapist. Significant radial shortening was observed in 2 cases only. Radial shortening remains the main displacement in distal end radius fractures, especially intra-articular and comminuted fractures.<sup>[30]</sup> In our opinion, percutaneous pinning maintains radial length adequately in extra-articular distal radial fractures. Two cases in our series had pin tract infection, but this was superficial and did not necessitate early removal of the pins. The infection subsided with removal of the pins at 6 weeks in both the cases. These 2 patients also had malunion with significant radial shortening, wrist joint stiffness and reduced grip strength. The functional result obtained in these patients at the end of follow-up period was fair. Loosening of one of the K-wires was observed in 13 cases at the time of removal of the pins, but it did not jeopardize the fracture alignment. Circumferential cast for additional immobilization was not necessary. One case had injury to sensory branch of radial nerve. This can be avoided by using a limited incision for lateral pin insertion. In conclusion, percutaneous pinning and immobilization of the fracture with wrist immobilized in neutral position for 3 weeks and early physiotherapy is a simple procedure for extra-articular noncomminuted distal radius fractures. It provides anatomic fracture reduction and fixation and allows earlier rehabilitation without jeopardizing the fracture alignment.

### References.

- Bucholz RW, Heckman JD, Brown CM. Rockwood and Green's Fractures in Adults. Vol. 1. Philadelphia: Lippincott Williams and Wilkins; 2006. p. 910.
- Goffton W, Liew A. Distal radius fractures: Nonoperative and percutaneous pinning treatment options. *Orthop Clin North Am* 2007;38:175-85.
- Fernandez DL, Jupiter JB. Fractures of the distal radius: A practical approach to management. New York, NY: Springer-Verlag; 1996.
- Fernandez DL. Correction of post-traumatic wrist deformity in adults by osteotomy, bone grafting and internal fixation. *J Bone Joint Surg Am* 1982;64:1164-78.
- Fernandez DL. Radial osteotomy and Bowers arthroplasty for malunited fractures of the distal end of radius. *J Bone Joint Surg Am* 1988;70:1538-51.
- Slagel BE, Luenam S, Pichora DR. Management of post traumatic malunion of fractures of distal radius. *Orthop Clin North Am* 2007;38:203-16.
- Arora J, Kapoor H, Malik A, Bansal M. Closed reduction and plaster cast immobilization Vs external fixation in comminuted intra-articular fractures of distal radius. *Indian J Orthop* 2004;38:113-7.
- Castaing J. Recent fractures of the inferior extremity of the radius in the adult. *Rev Chir Orthop French* 1964;50:582-696.
- Mah ET, Atkinson RN. Percutaneous Kirschner wire stabilization following closed reduction of Colles' fracture. *J Hand Surg Br* 1992;17:55-62.
- DePalma A. Comminuted fractures of the distal end of the radius treated by ulnar pinning. *J Bone Joint Surg Am* 1952;34:651-62.
- Kapandji A. Internal fixation by double intrafocal pinning: Functional treatment of non-articular fractures of the distal radius [French]. *Ann Chir Main* 1987;6:57.
- Rayhack J, Langworthy J, Belsore L. Transulnar percutaneous pinning of displaced distal radius fractures: A preliminary report. *J Orthop Trauma* 1989;3:107.
- Edwards GS Jr. Intra-articular fractures of the distal part of the radius treated with the small AO external fixators. *J Bone Joint Surg Am* 1991;73:1241-50.
- Nagi ON, Dhillon MS, Aggarwal S, Deogaonkar KJ. External fixators for intra-articular distal radius fractures. *Indian J Orthop* 2004;38:19-22.
- Ruch DS, Ginn TA. Open reduction and internal fixation of distal radius fractures. *Op Tech Orthop* 2000;13:138-43.
- Doi K, Hattori Y, Otsuka K, Abe Y, Yamamoto H. Intra-articular fractures of the distal aspect of the radius: Arthroscopically assisted reduction compared with open reduction and internal fixation. *J Bone Joint Surg Am* 1999;81:1093-110.
- Field J, Atkins RM. Algodystrophy is an early feature after Colles' fracture. What are the implications? *J Hand Surg Br* 1997;22:178-82.
- Atkins RM, Duckworth T, Kanis JA. Features of Algodystrophy after Colles' fracture. *J Bone Joint Surg Br* 1990;72:105-10.
- Rajan S, Jain S, Ray A, Bhargava P. Radiological and functional outcome in extra-articular fractures of lower end radius treated conservatively with respect to its position of immobilization. *Indian J Orthop* 2008;42:201-22.
- Sarmiento A, Pratt GW, Berry NC, Sinclair WF. Colles' fractures, functional bracing in supination. *J Bone Joint Surg Am* 1975;57:311-7.
- Gartland JJ Jr, Werley CW. Evaluation of healed Colles' fracture. *J Bone Joint Surg Am* 1951;33:895-907.
- Knirk JL, Jupiter JB. Intra-articular fractures of the distal end of the radius in young adults. *J Bone Joint Surg Am* 1986;68:647-59.
- Trumble TE, Schmitt SR, Vedder NB. Factors affecting functional outcome of displaced intra-articular distal radius fractures. *J Hand Surg Am* 1994;19:325-40.
- Jupiter JB, Ring D, Weitzel PP. Surgical treatment of redisplaced fracture of the distal radius in patients older than 60 years. *J Hand Surg Am* 2002;27:714-23.
- Ark J, Jupiter JB. The rationale for precise management of distal radius fractures. *Orthop Clin N Am* 1993;24:205-10.
- Chan BK, Leong LC, Low CO, See HF. The use of external fixators in treatment of intra-articular fractures of the distal radius. *Singapore Med J* 1999;40:420-4.
- Gausepohl T, Pennig D, Mader K. Principles of external fixation and supplementary technique in distal radius fractures. *Injury* 2000;31:56-70.
- Sanders RA, Keppel FL, Waldrop JL. External fixation of distal radial fractures: Results and complications. *J Hand Surg Am* 1991;16:385-91.
- Green DP. Pins and plaster treatment of comminuted fractures of distal end radius. *J Bone Joint Surg Am* 1975;57:304-10.
- Lenoble E, Dumontier C, Goutallier D, Apoll A. Fractures of distal end radius. *J Bone Joint Surg Br* 1995;77:562-7.