

## **“Evaluation of Results of external fixation of unstable intra-articular distal radius fractures augmented with K wires”**

**<sup>1</sup>Dr. Sunil V. Patil\* , <sup>2</sup>Dr. Shrikant B. Deshpande, <sup>3</sup>Dr. Nagesh P.Naik**

<sup>1</sup>Associate Professor. Bharati Vidyapeeth Deemed University Medical College & Hospital, Sangli

<sup>2</sup>Associate Professor. Bharati Vidyapeeth Deemed University Medical College & Hospital, Sangli

<sup>3</sup>Professor. Bharati Vidyapeeth Deemed University Medical College & Hospital, Sangli

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### **ABSTRACT:**

**Introduction:** The present study was planned to assess results of the use of the external fixator and per cutaneous K wires in the treatment of intra-articular fractures of the distal radius .

**Material & Methods :** Thirty two patients with these fractures have been treated at our hospital between 2005 and 2010 with the use of external fixator augmented with K wires.. The patients were assessed at least one year post-operatively after a course of physiotherapy. Results were assessed with subjective and objective methods ( goniometric measurement of movements and radiographic assessment). Complications : Included early finger stiffness, pin-tract infections.

**Discussion:** Use K wire to secure radial styloid fragment as a lateral buttress, elevate and fix lunate fossa fragment, add supplementary bone grafting in appropriate cases demonstrated precise articular restoration and overall satisfactory results.

**Results:** The majority of patients (65%) had either good or excellent results, based on objective and subjective criteria.

**Keywords:** distal radius fracture, external fixator , K wire.

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### **INTRODUCTION:**

Unstable intra-articular fractures of the distal radius are associated with a high incidence of morbidity and complications as a result of the disruption of the articular surface of the distal radius and peri-articular soft-tissue. These are typically high-energy injuries occurring in the young or middle-aged population who are economically active. Effective treatment with minimal complications and early return to work are the main goals in the management of these patients. Non-operative treatment with reduction and casting has a high incidence of loss of reduction during the phase of fracture healing. There have been other methods of reducing and maintaining the reduction of the fracture published in the literature. Methods such as the pin and cast<sup>1</sup>percutaneous pinning<sup>2</sup>and open reduction with internal fixation<sup>3</sup>have been proposed. Recognition of this potential of displacement has led to the evolution of technique for augmentation of external fixation with percutaneous Kirschner(K-) wire fixation of the major articular fragments and when necessary, supportive bone grafting to maintain adequate articular elevation<sup>5</sup>. We present our experience with the use of hybrid combination using external fixator and percutaneous K wires in the treatment of these complex injuries.

### **Materials & Methods :**

32 cases of fracture distal end radius with age range from 25 to 75 years ( average age 58 years) were treated from Jan 2000 to Dec2005.by augmented external fixation and followed up for 1-2 years after operation (average, 1.6 years). All patients had sustained unstable intraarticular distal radius fractures (type C of AO classification<sup>4</sup>) consisting of a major

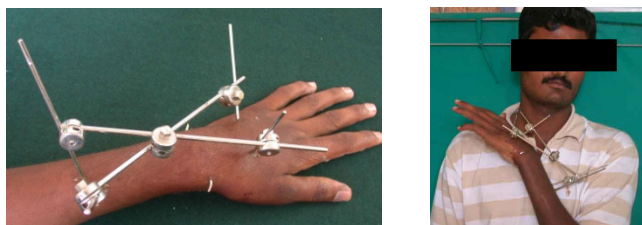
radial styloid fragment, lunate fossa fragment and significant dorsal and/or volar comminution. Three patients required bone grafting. Right side was more involved (21 cases). All cases were fresh and treated as emergency. None of the patients had compound fracture. Ten patients arrived late (after 2-3 days). Trauma surgery interval was average 2 days. The patients were operated and managed by one consultant orthopaedic surgeon at our hospital. Twelve of the fractures occurred as a result of road traffic accidents, 2 from industrial accidents and the remainder were due to home accidents

Surgical technique: Ten cases were operated under general anesthesia, while 22 cases were operated under regional anesthesia (brachial or axillary block). Two, one inch incisions, one centered approximately 10 cm proximal to radial styloid over the radial aspect of the forearm. The interval between brachioradialis and extensor carpi radialis longus was identified and sensory branch of radial nerve was carefully retracted at its emergence. Pins are inserted in center of radius under direct vision after prediilling. Distal pin insertion, likewise, was made under direct vision under image intensification in bases of second and third metacarpal bones. Thus a total of six cortices fixation of pin was achieved. Then external fixation device was applied and initial fracture reduction with restoration of overall length and radial tilt was achieved under image intensification control. Additional 2 mm distraction of radioscapholunate joint compared to midcarpal articulation was done to tension the dorsal and palmar ligaments during the period of immobilization (this allows rapid return of flexion/extension on removal of device.)

One 2 mm K wire was inserted through tip of radial styloid across major fracture site to engage ulnar cortex of shaft. The radial styloid thus secured acts as buttress. A second K wire was passed dorsally to elevate lunate fossa fragment to achieve congruity of distal articular surface. With this fragment held in reduced position, a third K wire was inserted percutaneously under image intensification control transversely from styloid fragment directly underneath the die punch fragment. Additional K wires were put as needed depending on degree of comminution. If significant lucency is noted under elevated bone fragment suggestive of insufficient bone stock, (usually seen with initial depression of 5 mm or more), bone grafting was done through dorsal approach.

All had plaster slab put in above elbow position for 4 weeks after which elbow was immobilized. Pin site dressing was done at every week. External fixator and K wires were removed at six weeks. Out of 128 fixator pins, 7 (5.5%) pins were loose enough to be removed by hand, but in no case this resulted in loss of fixation. Patients' radiographs were taken fortnightly for first six weeks, six week interval up to six months and then after every six months. All patients were evaluated at one year. They were interviewed with regards to their wrist function, residual pain and mobility.

*The grip strength assessment:* This was assessed by using the My-Gripper dynamometer. The contra-lateral limb was similarly assessed, both clinically and radiologically and the differences between the normal and affected limbs were compared. The combined evaluation according to the *Gartland and Werley demerit scoring system, as modified by Sarmiento et al (Annexure I)*<sup>6</sup> was used for the functional assessment of the wrist injuries.



**Fig 1a & 1b showing the patient with Exfix & K-wires In situ.**

**RESULTS:** Fifteen (47%) of our patients had some form of residual deformity. Seven(21%) had a prominent ulnar styloid, 5 (16%)had a residual dorsal tilt of the distal radius and 5(16%) had some degree of radial deviation. On a scale of 0 to 6 (0 being an excellent result as perceived by the patient with a painless and fully functional wrist), the average score was 2.5. The range of motion was assessed using a goniometer. A loss in the range of movement was recorded as being present if it was less than the proposed minimum range required for normal function (according to Gartland and Werley’s criteria). Eleven (34%) had, by definition, loss of dorsiflexion whilst four (12.5%) had loss of palmarflexion. Four patients (12.5%) had a loss of supination while none had loss of pronation. Twelve (37.5%) had significant loss of grip strength and 6 (18.75%) had residual pain in the distal radio-ulnar joint. However, we also noted the difference in the absolute values of the various clinical measurements as compared to the contralateral side and the results are shown in [Table I](#).

Table I – Loss in range of movement ( as compared to normal Side).

	Average loss of ROM in degrees	Range. ROM in degrees
Wrist Dorsiflexion	12	0-45
Wrist Palmarflexion	11.3	0-60
Supination	9.8	0-90
Pronation	1.54	0-20
Radial Deviation	7.2	0-30
Ulnar Deviation	8.3	0-25

Using the *modified Gartland and Werley demerit scoring system*, the average score in the study cohort was 7.22 (range 1 - 18). There were 21 (65%) patients who had either excellent or good results and 11 (35%) had fair results. We did not have any patient with a poor outcome.

The *radiological parameters of the injured and uninjured radii* are shown in TableII

	Mean Value (Injured Radii)	Mean Value (Normal Radii)	Mean loss ( Compared to normal side.)
Palmar tilt	9.8 (-15-25).	16.5	6.7
Radial angle	19.8 (10-30)	23.5	3.7
Radial Height	10.8mm (7-13)	11.3mm	1.5 mm

With regards to *articular congruity*, 27 (84.3%) had none or mild articular incongruity. The assessment of the radiographs at follow-up showed that the majority (69%) had mild *degenerative changes* in the wrist joint. The remaining (31%) did not have any radiological signs of degenerative change in the wrist joint.



Fig2a Showing Preop Xray,

Fig 2b showing Exfix & Kwires

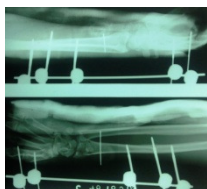


Fig 2c Postop

fig 2d Showing Xray after removing the Exfix & Kwires.



Fig 2e Showing Postop Results & ROM at wrist. After 3 months.

**DISCUSSION:**

Evolution of surgical technique from pins in plaster and improved fixation devices has helped reduce treatment related complications<sup>5</sup>The concept of continuous distraction (commonly known as ligamentotaxis) is the basis for the use of the external fixator in unstable distal radius fractures. With the distraction, the soft tissues surrounding the fracture help

mould the bony fragments and facilitate reduction. The external fixator has an advantage over conventional open reduction and plating when the fracture is comminuted. It restores skeletal length and maintains the reduction during the healing process.

The technique of applying the external fixator has been well described<sup>11</sup>. Limited open surgical approach combined with pins of adequate size can avoid bending and breakage. And provide appropriate bone purchase ; fixation to the radial shaft and six cortices of index and middle metacarpal allows pronation and supination while helping to minimize complications related to pin bone interface.<sup>12</sup>Adequate exposure allows precise placement of the pins under direct vision and this must be complemented with careful dissection and protection of the soft tissues during drilling, namely the extensor tendons and the superficial radial nerve. The skin at the pin-sites should be inspected and undue pressure on the skin edges should be relieved by extending the incision. By doing so, skin necrosis and subsequent infection can be prevented. We follow the AO recommendation in pre-stressing the pins and this has led to increased stability of the frame construct with less incidence of pin loosening in our study cohort. We did have elderly patients with osteoporotic bone in our study & Vaughan<sup>9</sup> reported a case in his study of pin loosening in an 82-year-old woman. However, the other 25 elderly patients in his cohort who were treated with the external fixator did not have any pin loosening. Although Grana and Kopta<sup>13</sup> suggested in their article that the external fixator be used only in young patients with good bone stock, Vaughan's study seems to suggest that it is safe to use this form of treatment in the elderly patient

With the use of the external fixator augmented with K wires, the radiological parameters of the injured radii though appear to be under-corrected ([Table II](#)). the average loss for each parameter is small; it is an indication that supplementary methods of fixation have been warranted either to improve reduction or to stabilize the fracture fragments. With respect to articular congruity, almost 85% had a step-off of 2 mm or less. With this result, we would have expected a low incidence of degenerative changes. However, at a mean of 90 weeks, 69% of our patients already had mild degenerative changes whilst the remainder did not have any degenerative change.

This may be explained by the disruption of the hyaline cartilage at the distal radius with subsequent healing with thinned-out hyaline or fibro-cartilage. At the time of evaluation, these mild degenerative changes on radiographs did not appear to affect the score significantly as most were not associated with pain. We found that dorsiflexion was the motion most greatly affected when compared to the normal side and pronation was the least. This preservation of pronation can be explained by the fact that distraction, fracture reduction and locking of the fixator were carried out with the forearm in a prone or semi-prone position.

The loss of dorsiflexion in about a third of our patients may be due to excessive palmar flexion during immobilization but this was difficult to assess on the post-operative lateral radiographs with the external fixator present. Seitz H<sup>14</sup> also mentions; an external fixation device providing adequate stability and clear fracture visualization in all planes simplifies the surgical technique and therefore minimizes potential device related complications. We have tried to improve the overall anatomical result with supplementary methods. There were 3 patients who had a medial "die punch"

fragment which did not reduce after distraction. There is much clinical data which has shown that incomplete reduction of severely impacted medial fragments will lead to residual radiocarpal incongruity and disruption of the distal radioulnar joint<sup>5,15</sup> In these patients, we reduced and stabilized the fragments using percutaneous Kirschner wires and bone grafting was done

Leung et al cited various advantages of primary bone grafting in these types of fractures which included faster healing rates and maintenance of articular congruity<sup>15</sup>. Addition of bone graft in appropriate cases has not resulted in increased complication rate, has provided superior overall results, and has demonstrated a maintenance of articular congruity by radiographic assessment. <sup>5</sup>Finger stiffness is the most common early complication in our study. which required rigorous physiotherapy. To minimize finger stiffness, a pitfall to avoid is to ensure that one does not impale the tendons. The distal pins should be inserted after flexing the second metacarpophalangeal joint to 90°. This brings the intrinsic muscles to maximal length and prevents tethering<sup>9</sup>.The importance of immediate post operative hand rehabilitation and patient education in activities of daily living and in pin site care cannot be overstated<sup>5</sup>

**CONCLUSION:** In our study, with careful assessment, good surgical technique and early augmentation using supplementary fixation methods ; unstable distal radius fractures can be effectively managed with a predictably good outcome using the external fixator. Although there were complications associated with this form of fracture fixation, we believe that the benefits outweigh the various potential problems and complications.

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