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## Functional and radiological outcome of unstable lower end radius fracture treated with percutaneous kirschner wires and cast in adults

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### Abstract

**Background:** Fracture of lower end of radius is common fracture in orthopaedic practice. No age is immune to this fracture but commonly seen in elderly population. Till date there is no consensus in management of this fracture. Variety of treatment is available in literature from casting to plating of this fracture. Minimal invasive technique of percutaneous k-wire fixation and cast is cost-effective with better functional end results.

**Material and method:** In this study, Frykman's classification system has been used to describe the fracture types. Frykman type II and IV were more common fracture pattern. All patients were treated with percutaneous multiple k wires and cast. Cast and k- wires were removed after six weeks.

**Results:** In this study thirty patients were treated by this technique. results were analysed according to Lindstrom's criteria for anatomical and functional end results. All patients had good to excellent functional results.

**Discussion:** Though this fracture is described since so many years, unsatisfactory results are also common. Percutaneous pinning is attempted to bridge the gap between conservative and more invasive procedures.

This fracture is commonly seen in elderly population. Co-morbid medical conditions are highly present in these people. So any invasive procedure is not without any risk. This minimal invasive procedure is gold standard in these age groups. In this study most of the patient had good functional end results.

**Conclusion:** Minimal invasive percutaneous Kirshner wire fixation is superior method of treatment for distal end radius fractures. There is very low incidence of complication and unsatisfactory results.

**Keywords:** Lower end of radius, Kirshner wire, cast

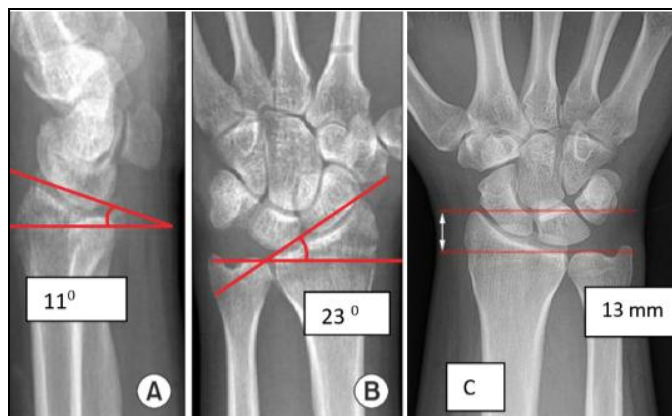
### Introduction

Lower end of Radius is expanded cancellous bone. It articulates distally with carpal bones and medially with ulnar head to form radio-carpal and inferior radio-ulnar joint, respectively [1]. Cortico-cancellous junction, 2.5cm from articular surface is weakest zone susceptible for fracture. Radial styloid is 13mm inferior to the level of ulnar styloid. Radial articular surface forms two angles with longitudinal axis in two planes called as Radial angle of 23 and Volar angle of 11 [2]. [fig-1]. Lower end Radius fracture account for one sixth of all fractures. This fracture is commonly seen in elderly people, especially in females. Common modality of injury is fall on outstretched hand. Postural instability due to aging and comorbid conditions also contribute to fall in elderly people.

There are many classification systems described in literature but in this study Frykman's system is used. It classifies the fracture in eight groups depending on associated fracture of ulnar styloid. In this study type II and IV are common fracture patterns<sup>7</sup>. [table-6]

There is no consensus about fracture description, treatment modality and outcome<sup>3</sup>. More invasive procedure like plating to conservative treatment of casting is described in literature<sup>4, 5, 6</sup>. In this study fair to excellent results achieved in all cases.

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**Fig 1:** (A) angulation, (B) radial inclination, (C) radial length

**Material and Methods**

In this study thirty patients were studied who were admitted in orthopaedic department of Bharati Hospital. Age group of patients was ranging from 35 to 65 years. Detailed clinic-radiological examination was done in all cases. All patient was treated with close reduction and percutaneous k wire fixation and below elbow cast after taking proper written consent.

In this study inclusion criteria were unstable lower end radius fracture with one or more of following findings, fracture with intra-articular extension, dorsal comminution, minimal metaphyseal comminution, dorsal angulation, and displaced fractures. Exclusion criteria were highly comminuted metaphyseal or intra-articular fractures, compound fracture and fractures in coronal plane with carpal subluxation.

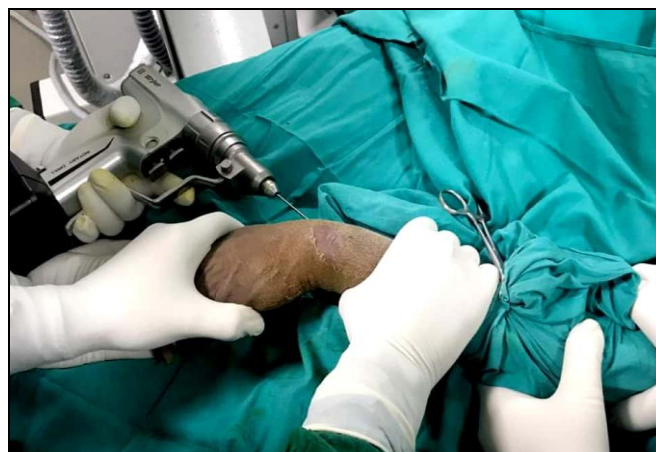
Material used are drill machine, soft cotton roll, Kirshner’s wires of various sizes, plaster bandages and c-arm.

**Technique**

After anaesthetic fitness, patient is taken in operation theatre. After short general anaesthesia, close reduction is done by traction-countertraction method with milking of fragments in minimal palmer flexion and ulnar deviation. Reduction is checked under c-arm. After confirmation in antero-posterior and lateral view, multiple wires are passed. Two wires passed one from radial styloid and other from just medial to lister’s tubercle in crossed fashion is a stable construct. If there is instability of distal radio-ulnar joint third wire can be passed transversely through joint to stabilise it. Stability is checked clinically and under c-arm. Then after bending and cutting of wires, below elbow cast is applied.



**Fig 2:** Instruments and materials used during percutaneous k- wire fixation and cast application



**Fig 3:** Percutaneous k-wire fixation technique

Radiological evaluation is done on immediate postop, one week, six weeks, twelve weeks. K` wires and plaster is removed at six weeks. Then physiotherapy is started for mobilisation of wrist, finger grip and supination –pronation movements.

Patient were assessed, which include subjective impression of patient, objective grading of function and deformity comparison of initial and final radiographs. Subjective factors are pain, functional limitation and occupational consideration. Objective examination include deformity, tenderness, radio-ulnar joint instability, range of movements and grip strength. Radiological evaluation includes radial length, dorsal angle, joint incongruity and radial collapse.

The subjective, objective and radiographic findings were quantified by Lindstrom`s criteria as anatomical and functional end results. The outcome of each fracture was graded as excellent, good, fair or poor.

**Table 1:** Lindstrom`s criteria for anatomical end results

Grade	Criteria
I	No deformity Dorsal angulation not exceeding Neutral position Radial shortening <3mm
II	Slight deformity Dorsal angulation 1to 10 degrees Radial shortening 3 to 6 mm
III	Moderate deformity Dorsal angulation 11 to 14 degrees Radial shortening 7 to 11 mm
IV	Severe deformity Dorsal angulation >15 degrees Radial shortening > 12 mm

**Table 2:** Lindstrom`s criteria for functional end results

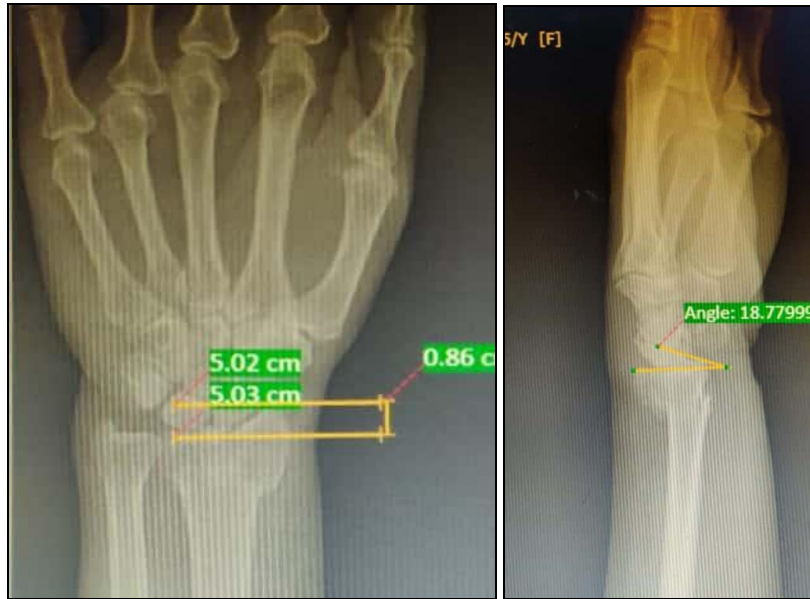
Result	criteria
Excellent	No deformity No residual disability Full wrist and forearm movements No loss of grip strength
Good	Minimal deformity Residual disability Loss of movement up to 20 degree Mild loss of grip strength
Fair	Moderate deformity Moderate disability Loss of movement up to 40 degree Moderate loss of grip strength
Poor	Gross deformity Gross disability Gross limitation of movements Severe loss of grip strength

**Results**

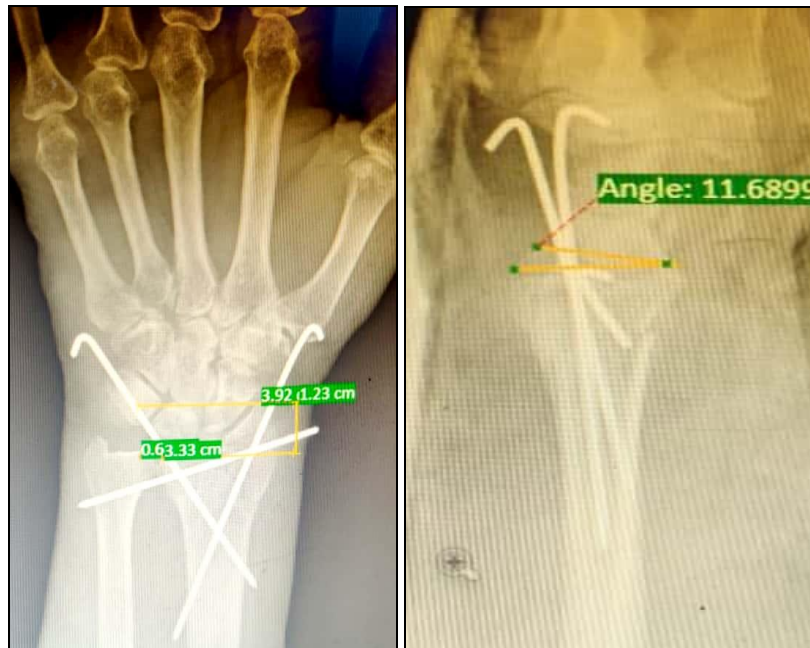
Thirty patients were included in the study. All patients were treated with close reduction and fixation with percutaneous multiple `k` wires and cast under suitable anaesthesia. Female patient was common about seventy percent in age group of 55 to 65 years. Right sided fracture was common in this study. We found satisfactory anatomical and excellent to good functional results as per Lindstrom`s criteria in eighty to ninety percent cases.

Any procedure is not without complication so in this study few complications encountered like superficial infection in

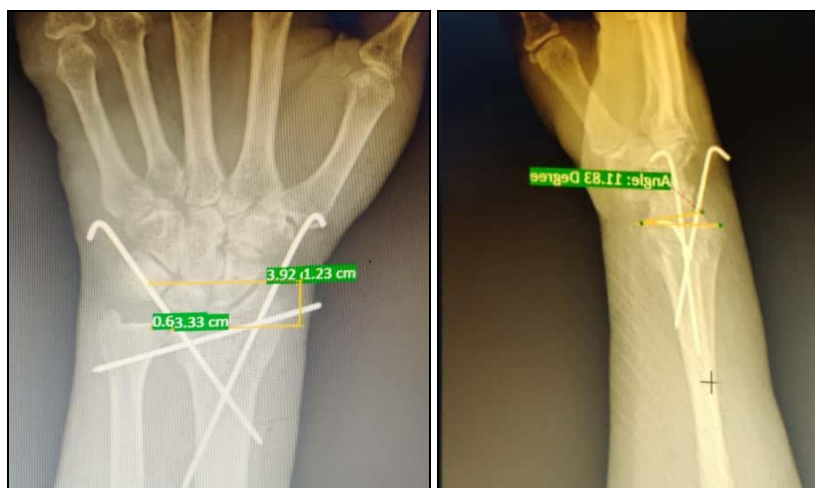
three patients, pin loosening in two patients and mild deformity in two patients. [table-4 and table-5]



**Fig 4:** Pre op-radial length, dorsal inclination

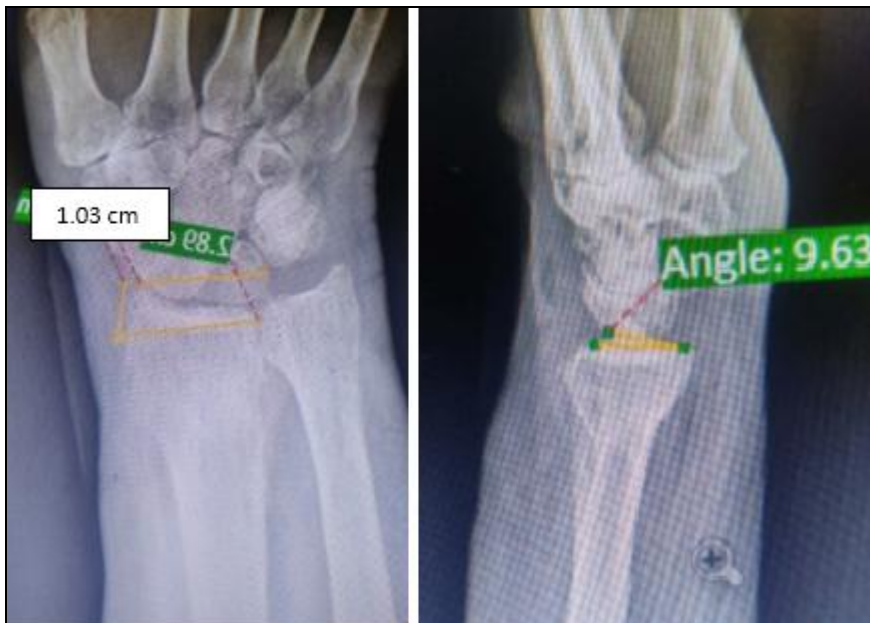


**Fig 5:** Post-operative:Radial length, palmar inclination



**Fig 6:** At 6 weeks: Radial length, palmar inclination.





**Fig 7:** AT 12 weeks: Radial length, palmar inclination



**Fig 8:** Functional evaluation at 12 weeks by supination: 65 degree, pronation: 68 degree dorsiflexion: 70 degree, palmar flexion: 70 degree.

**Table 3:** Radial length, inclination

Time of evaluation	Radial Length	Inclination
Pre op	0.86 cm	9.12 degree(Dorsal)
post op	1.23 cm	11.6 degree(palmar)
6 week	1.23 cm	11.83 degree (palmar)
12 weeks	1.03 cm	9.63 degree(palmar)

**Table 4:** Demography of patients

factors	Number of cases
<b>Sex</b>	
male	09
female	21
<b>Age</b>	
35-45	04
46-55	10
56-65	16
<b>Side</b>	

Right	19
Left	10
Both	01
<b>Injury</b>	
Fall on hand	18
Fall from height	04
RTA	08
<b>Associated injury</b>	
head injury	03
Fracture neck femur	01
Blunt abdomen	01
Fracture tibia	02
<b>Frykman types</b>	
Type - I	01
Type - II	08
Type - III	02
Type - IV	15
Type - V	02
Type - VI	02
Type - VII	00
Type - VIII	00

**Table 5:** Results: At end of 12 weeks.

factors	Number of cases
<b>Range of movements</b>	
<b>Palmer flexion.</b>	
60-65	09
66-75	21
<b>Dorsiflexion</b>	
65-68	19
69-74	11
<b>Pronation</b>	
63-65	05
66-70	25
<b>Supination</b>	
60-65	18
66-70	12
<b>Anatomical end results</b>	
<b>Satisfactory</b>	
Grade -I	24
Grade-II	03
<b>Unsatisfactory</b>	
Grade-III	03
Grade-IV	00
<b>Functional end results</b>	
Excellent	03
Good	27
Fair	00
Poor	00
<b>Loss of Radial length</b>	
2-2.4mm	26
2.5-7.2mm	04
<b>Volar angle</b>	
7-10	24
4-6	06
<b>Complications</b>	
Superficial infection	03
Pin loosening	02
Mild deformity	02

**Table 6:** Frykman`s classification

Fracture	No fracture ulnar styloid	Ulnar styloid fracture present
Extra articular	I	II
Intra articular.		
Radiocarpal joint-	III	IV
Radio ulnar joint-	V	VI
Radiocarpal and radioulnar joint-	VII	VIII

## Discussion

After so many years of description of this fracture, percentage of unsatisfactory results continues to be high. This fact stimulated growing interest and promoted new ideas regarding their optional management. Treatment modality should take care of both functional and anatomical end results [22, 23]. Close reduction and plaster immobilisation have its merits of cost-effectiveness and good for stable extraarticular fractures and low demand patients [28]. But it has high risk of loss of reduction, deformity, painful wrist with unstable DRUJ [26]. Open reduction and internal fixation has its merits of accurate reduction and stable fixation but demerits of open surgery and loss of fixation in comminuted fractures [24, 20, 27]. Percutaneous pinning and cast are an attempt to bridge the therapeutic gap between invasive procedure like plating and pure cast alone [15, 19]. Lower end radius fractures are classified by radiological pattern and mechanism of injury. In this study Frykman's classification has been used for fracture types [7]. This is pure radiological classification according to fracture pattern. Frykman type IV was common pattern [7]. In this series number of females were more than males. [table-4] In this study right sided fracture were common than left side with common mode of injury was 'fall on outstretched hand' [13]. 2 mm 'Kirschner' wires were used for fixation of fracture. Below elbow cast with wrist in neutral position was applied. This minimises risk of neurovascular complication associated with maximally flexed wrist in cast alone cases [12, 16]. Patients were started with range of movement exercises for fingers, elbow, and shoulder immediately as pain tolerated. Patient were followed for 12 weeks. Follow up check x-ray were taken at 3 weeks, 6 weeks, and 12 weeks. Consolidation of fracture occurs at 12 weeks [8]. Thereafter late collapse is uncommon [14]. Anatomical and functional assessment done at each visit based on Lindstrom's criteria. No procedure is immune to complication.

Chapman in his study reported complications of radial shortening, pin tract infection, pin loosening and neurosensory complications [25] Hochwald and associates reported 9% extensor tendon injury, 32% superficial nerve injury and pin tract infection as complication of this technique [24]. Thus various methods of percutaneous pin fixation of lower end radius fracture described till date in literature have pin tract infection and loss of reduction as common complication [11, 18]. But in this study all patient had excellent to good functional results at the end of 12 weeks and 80% patient had grade 1 anatomical end results. Average radial shortening was 3.1mm in this study which is in well acceptable limit.

This technique is cost effective as removal of 'k' wire is done as outpatient procedure [9, 10]. Multiple 'k' wire fixation gives stronger construct [12, 21]. Rayhack in his study showed that Transulnar pinning is more stiff technique [17].

## Conclusion

Percutaneous fixation of lower end radius fractures with multiple 'k' wires is cost-effective, easy, and less invasive method. It is effective in maintaining reduction and stability of distal radioulnar joint during healing of fracture. Also cast gives additional support to the fixation in maintaining reduction. Overall, in this study showed 90% good functional and anatomical end results. So, except in severely osteoporotic patients, all other patient can be effectively treated by this technique.

**Conflict of interest:** No

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