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**Original Research Article**

# Is antegrade K-wire pinning better than retrograde pinning for distal radius fracture? A comparative study

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## ABSTRACT

**Background:** The treatment of distal end radius has undergone tremendous changes over the years due to better understanding of the fracture anatomy, mechanism of injury and development of newer techniques and implants. The objective of treatment of distal end radius fracture is to restore the anatomy and to obtain early function. Percutaneous pinning is a minimally invasive technique to maintain the reduction and prevent re-displacement of the fracture fragments. Sato et al. introduced a technique of fixation for the unstable extra-articular distal radial fractures by manual reduction and antegrade intra-medullary pinning.
**Methods:** A retrospective study with a sample size of 30, where 15 of the selected patients had undergone antegrade fixation and the rest 15 had undergone retrograde fixation.
**Results:** Patients were evaluated for functional and radiological outcomes after a mean follow up of one year. No statistically significant difference was found between the two methods.
**Conclusions:** Both the procedures were effective in managing the distal radius fracture with preservation of fracture hematoma. However soft tissue complications were less in antegrade pinning as compared to retrograde.

**Keywords:** Distal radius, Extra articular fracture, Antegrade pinning, Retrograde pinning

## INTRODUCTION

Fractures of distal end radius are one of the most common injuries seen in emergency room accounting for one-sixth of all fractures.[1-3] As wrist plays an important role for the day-to-day function of human activities, injuries to it would be devastating for the individual. With better understanding of anatomy, bio-mechanics and injury mechanism trend has been shifted to restore anatomy and obtain early function. The treatment option of distal end radius fracture includes closed reduction and cast immobilisation, percutaneous K-wire fixation (retrograde or antegrade), volar or dorsal plates. Percutaneous pinning is a minimally invasive technique to maintain the reduction and prevent re-displacement of the fracture fragments.[4,5] Many complications have been reported after retrograde pinning for distal radial fractures, including skin and soft tissue irritation, radial sensory nerve injury and extensor tendons injury, pain, algodystrophy, pin tract infection especially when left outside the skin and loss of reduction.[6-8]

Antegrade intramedullary fixation introduced by Sato et al, is a minimally invasive technique where distal radius fracture is reduced by manual traction and K-wire is passed intramedullary in the antegrade direction.[9] This procedure is beneficial in maintaining the distal radial angulation with less soft tissue complications. A retrospective study

was conducted to evaluate the functional and radiological outcome of management of unstable distal radial fractures by closed manipulation antegrade intra-medullary K-wire fixation vs retrograde K-wire.

## METHODS

A retrospective study with record of patients treated for distal end radius fractures who had undergone retrograde cross K-wires and antegrade intramedullary K-wires at Topiwala National Medical College and BYL Nair Hospital-Mumbai in one year from December 2019 to December 2020. Thus, a sample size of 30 patients who had undergone the above procedures were collected.

Inclusion criteria of the study were: extra articular fractures, and Frykmann type 1 and type 2 fractures.

Exclusion criteria were: intra articular fractures, open fractures, fractures with neurovascular compromise, and communited fractures.

The functional and radiological outcome were assessed at the end of one year.

An unpaired T-test was used to compare the differences in the mean of the two different groups of patients and to determine if the difference is significant or not.

As the study was retrospective, ethics committee approval was not required.

### *The surgical procedure*

Routine clinical examination, pre op radiological and blood investigations were done. Procedure was performed under regional block, general anaesthesia with arm tourniquet and the fracture was reduced under C-arm guidance and fixed using K-wires accordingly.

*Retrograde K-wire*

After sterile surgical painting and draping, a 1 cm incision was made over the tip pf the radial styloid. The radial styloid was exposed by blunt dissection and great care is taken not to injure the superficial branch of radial nerve or the tendons of the first and third extensor compartment. The drill guide was introduced between the tips of the soft tissue spreader.

After checking the reduction under image intensifier, the K-wire was introduced carefully with a power drill. The K-wire should just penetrate the opposite cortex of the radial shaft.

A second incision was made between the fourth and fifth extensor compartments. Blunt dissection to the bone is carried out. Under image intensifier, the K-wire was introduced from the dorsoulnar rim of the radius into to the anterior cortex of radial shaft.

The reduction and position of the wires were checked under image intensifier. The K-wires were bent and cut off outside the skin and these wires were cleaned and covered with antiseptic soaked sponge pieces. After surgery below elbow slab was applied.

*Antegrade intramedullary K-wire*

After sterile surgical painting and draping an incision of around 3 cm was made on the dorsoradial aspect of the mid radius 10-12 cm proximal to radial styloid. The extensor carpi radialis brevis and extensor digitorum communis muscles were separated and cortex of radius dorsal to pronator muscle insertion is exposed. A slanting hole was made in the dorsal radius, at first drill 3.5 mm drill bit is directed perpendicularly to the bone and then obliquely at an angle 45-60 degree with care to avoid penetration to far cortex. Pre bent blunt (tip cut) 2 K-wires (1.5 mm) were introduced through these holes. The pre bent blunt K-wire were inserted with T handled chuck. At first the K-wire was directed radially and once it reached the fracture site the distal fragment was manipulated with traction and counter traction. Once the reduction was acceptable under image intensifier the K-wire was passed through the fracture site until the K-wire rests against the radial styloid subchondral bone. Another K-wire was passed and directed towards the ulnar side of the distal fragment. The proximal end of the K-wire was bent cut off and buried in the subcutaneous tissue. After surgery below elbow slab was applied.

### *Post-operative protocol*

In the post op period strict limb elevation was given for 3 days and limb was immobilised with below elbow slab. Active finger movements were encouraged as soon as the effect of anaesthesia wore out. Elbow and shoulder mobilisation was encouraged for the patient. Pin site were inspected and dressing was done at post-operative day 3. Patient was then discharged with below elbow slab if pin sites and mobilisation were satisfactory.

### *Study parameters*

The parameters of the study are mentioned in Tables 1 and 2.

**Table 1: Radiological scoring system proposed by Stewart et al.[10]**

| Parameters | Scoring | | | |
|---|---|---|---|---|
| **Final dorsal tilt (°)** | Neutral /volar | 1-10 | 11-14 | 15+ |
| **Loss of ulnar variance (mm)** | 0-3 | 4-6 | 7-11 | 12+ |
| **Loss of radial inclination (°)** | 0-4 | 5-9 | 10-14 | 15+ |
| **Score for each** | 0 | 1 | 2 | 4 |

Grades: 0 excellent, 1-3 good, 4-6 fair, 7-12 poor.

**Table 2: Functional assessment by clinical scoring system of Green and O'Brein modified by Cooney.[11,12]**

| Items and findings | Score (points) |
|---|---|
| **Pain** | |
| None | 25 |
| Mild, occasional | 20 |
| Moderate, tolerable | 15 |
| Severe or intolerable | 0 |
| **Functional status** | |
| Returned to regular employment | 25 |
| Restricted employment | 20 |
| Able to work but unemployed | 15 |
| Unable to work because of pain | 0 |
| **Range of motion** | |
| Full | 25 |
| 75-99% of normal | 15 |
| 50-74% of normal | 10 |
| 25-49% of normal | 5 |
| Less than 25% of normal | 0 |
| **Or evaluating dorsiflexion-palmar flexion arc of injured hand** | |
| 120° or more | 25 |
| 91-119° | 15 |
| 61-90° | 10 |
| 31-60° | 5 |
| 30° or less | 0 |
| **Grip strength** | |
| Normal | 25 |
| 75-99% of normal | 15 |
| 50-74% of normal | 10 |
| 25-49% of normal | 5 |
| 0-24% of normal | 0 |

Results: excellent 90-100, good 80-89, fair 65-79, poor <65

## RESULTS

15 patients had undergone antegrade K-wire fixation and other 15 patients with retrograde K-wire fixation (Figure 1).

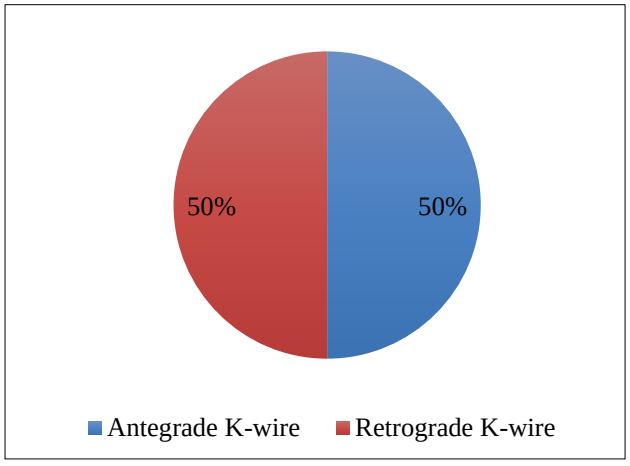


**Figure 1: Distribution of patients according to groups.**

Majority of the patients were in 41-50-year group. Mean age at surgery was 46.5 years overall (Figure 2).

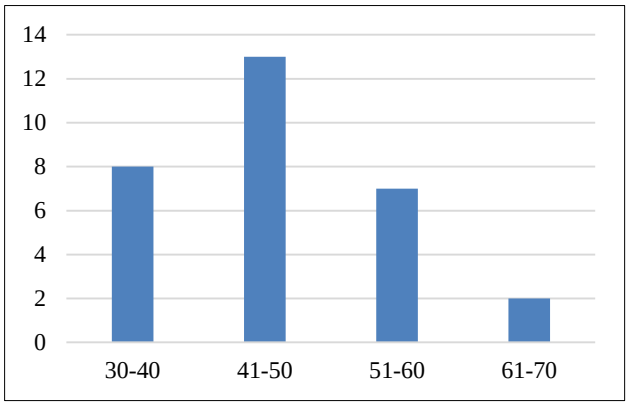


**Figure 2: Distribution according to age.**

The patients were predominantly males (56.6%) with dominant limb being most common involvement (60%).

Most patients had Frykmann type 2 fracture (66.6%) with fall being the mode of trauma in most patients (53.4%) (Figure 3).

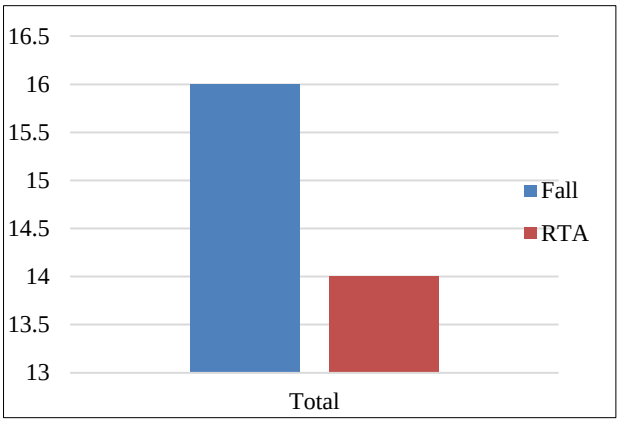


**Figure 3: Distribution of patients according to mode of trauma.**

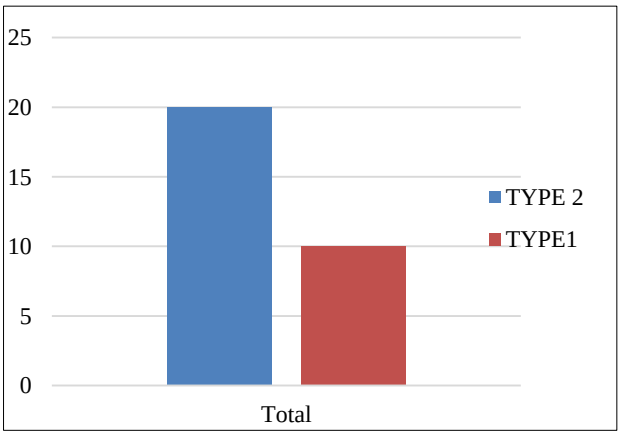


**Figure 4: Distribution of patients according to Frykmann classification.**

***Association between radiological scores and type of surgery***

The antegrade K-wire had excellent radiological score in 66.7%, whereas retrograde K-wire had 53.3% excellent score. But was no statistically significant association seen between radiological score and the groups (p=0.748), showing that the radiological outcome was not dependent on the type of surgery (Figure 5).

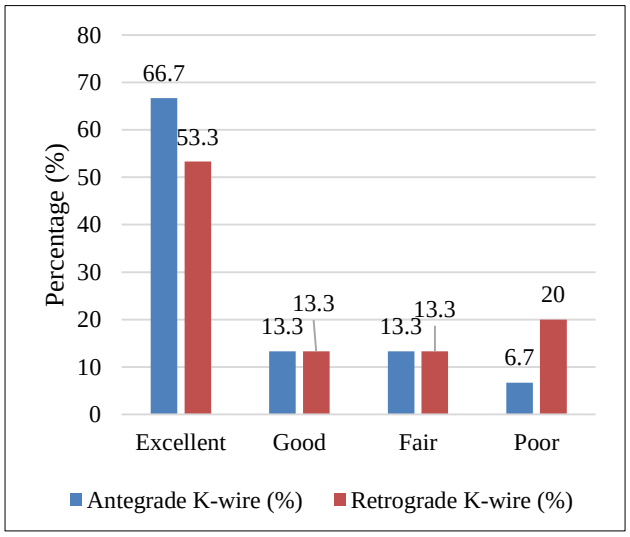


**Figure 5: Comparison of radiological outcome between the groups.**

***Association between functional scores and type of surgery***

There was no statistically significant association seen between functional score and the groups (p=0.875) at the end of 6 months, showing that the functional outcome was not dependent on the type of surgery (Figure 6).

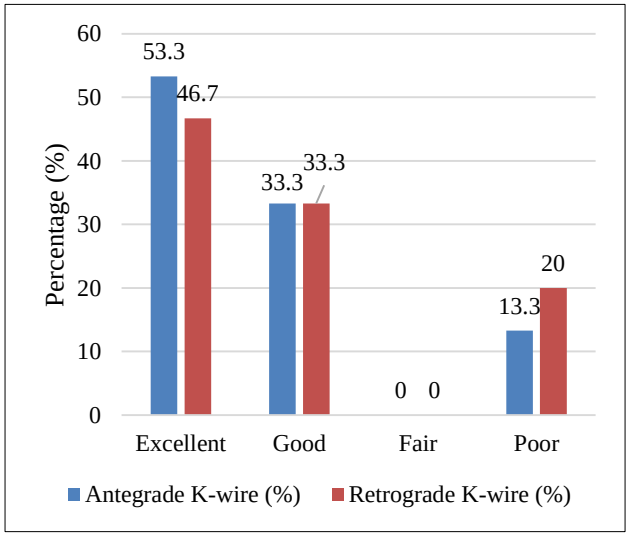


**Figure 6: Comparison of functional outcome between the groups.**

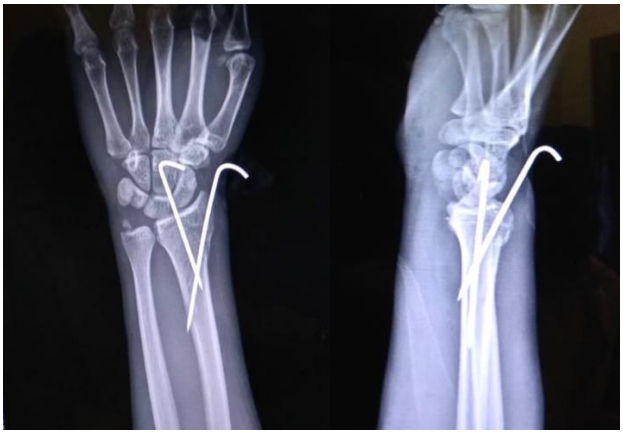

**Figure 7: X-ray wrist AP and lateral with retrograde K-wire.**

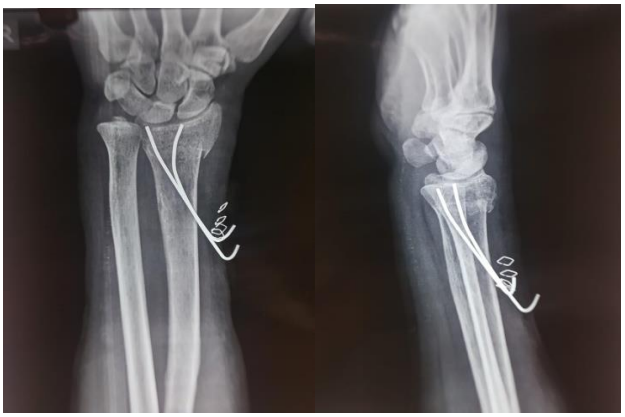

**Figure 8: X-ray wrist AP and lateral with antegrade K-wires.**

## DISCUSSION

Distal end radius fractures are one of the commonest fractures encountered by an orthopaedist. The fracture pattern can vary from minimally displaced stable fractures to comminuted intraarticular fractures. Management of intra articular fractures requires articular reduction and stabilization. The extra articular stable distal end radius fractures are most commonly managed by closed reduction and plaster cast or by closed reduction and pinning.

The disadvantage of closed reduction and plaster is the loss of reduction and malunion. Closed reduction and pinning prevent loss of reduction and malunion. There are numerous techniques described for closed reduction and pinning of distal end radius fractures like cross K-wire, antegrade K-wire, and Kapandji technique.

In this study we compared the functional and radiological outcome of distal end radius fractures treated by two different methods of pinning, retrograde cross K-wire and antegrade K-wire.

Our study comprised of 30 patients with 17 being male and 13 females with male percentage being 56.4%. The higher

incidence of male could be attributed to highly active work group, increased outdoor activity.

Majority of the patients in the study were in the age group 41-50 with mean age being 46.5 years, which is comparable to other studies published earlier where mean age group was 48 years.[13]

Dominant side was more involved compared to non-dominant side, with dominant being 60%.

Majority of the patients had fall as mode of trauma (53.4%). This could be due to an older mean age group of study where a low energy trauma (fall) is more frequent in causing Frykmann type 1 and type 2 fracture on the outset of osteoporotic bone.

Sezai et al conducted a study of 34 patients with distal end radius fracture treated with cross K-wire and concluded that this is a reliable method in treating simple distal end radius fracture.[14]

Mostafa et al conducted a study of 28 patients with distal end radius fractures treated with antegrade K-wire and concluded that it is an effective technique for stabilization and prevention of secondary displacement of distal radius fracture.[15] In this study it was also concluded that soft tissue complications like pin tract infection, pin loosening, tendon injury were comparatively lower than of other studies using retrograde pinning.

In our study there was one case of pin loosening in antegrade K-wire and 4 cases of pin tract infection in retrograde K-wire. The pin loosing did not result in loss of reduction. The pin tract infection settled with antibiotics and fracture progressed to healing.

The complication rate was 6% in antegrade K-wire which is comparable to 4% in Mostafa et al compared to retrograde K-wire of 26%.[15]

The mean dorsal tilt in our study treated with antegrade K-wire group was 3.33 and in retrograde K-wire group was 5.67. The lesser dorsal tilt in antegrade K-wire group with respect to retrograde K-wire group is comparable with that of other studies and indicated that this technique could prevent dorsal tilt. But the dorsal tilt difference in both groups was found to be statistically not significant.

The ulnar variance and radial shortening in both groups when compared was found to be statistically not significant.

There was no statistically significant association seen between radiological score and the groups, showing that radiological outcome was not dependent on the type of surgery.

There was no statistically significant association seen between functional score and the groups.

The limitation of our study is small sample size.

## CONCLUSION

Both antegrade K-wire and retrograde K-wire procedures are an effective treatment for extra articular distal end radius fractures without any statistically significant difference in radiological and functional outcome. Both the procedures have shorter duration of procedure with preservation of fracture hematoma. These procedures are only suitable for patients with extra articular fractures. Since most of the surgeons are familiar with retrograde K-wire technique, in this study we would like to conclude that antegrade K-wire technique is an useful and safe alternative to retrograde technique for distal radius fractures and is associated with less soft tissue complications compared to retrograde K-wire technique.

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*Ethical approval: The study was approved by the institutional ethics committee*

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