

Functional Outcome Analysis of Fixation of Distal Radius Fractures using 'Five Pin Technique'

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ABSTRACT

Introduction: Distal radius fractures are the most common fractures of the upper extremity. The commonest mode of injury is a fall on outstretched hand. Closed reduction and percutaneous pinning with 'The five pin technique' improves the reliability of fixation. Current study aimed to assess the clinical and functional outcome of fixation of distal radius fractures using the five pin technique

Material and Methods: 30 patients with fracture of distal radius were subjected to history taking, thorough clinical examination with analysis of pre operative and post operative radiographs.

Results: Functional outcome – Quick DASH scoring. Score of less than 10 in 14 patients, 11-15 score in 7 patients, 16-20 score in 6 patients, and more than 20 score in 3 patients.

Conclusion: "The five pin technique" is a versatile tool which provides functional outcomes better than conventional K wire fixation and comparable to volar plating as seen in our study.

Keywords: Distal Radius fractures, Five Pin Technique.

INTRODUCTION

Distal radius fractures are the most common fractures of the upper extremity seen in clinical practice. The commonest mode of injury is a fall on outstretched hand although it is not uncommon in high-energy trauma patients. Distal radius fractures have been a subject of ongoing discussion for over two hundred years. Ponteau¹, a French surgeon described the fracture pattern earlier but, Abraham Colles² is widely credited for the description of the most common type of distal radius fracture. In 1854, Smith³ claimed that a fall on the back of a flexed wrist results in palmar displaced distal radius fractures.

Closed reduction and casting has been the most commonly employed treatment modality but the subsequent malunion and distal radio-ulnar joint subluxation results in poor radiological and functional outcomes. Although many treatment modalities are available there is no consensus on the optimum treatment of these injuries.

In 1908, Lambotte⁴ described a single pin placement from the radial styloid to stabilise the distal radius fracture. In 1976, Kapandji⁵ first described the intra focal pinning with two pins. In 1989 and 1991, John M. Rayhack⁶ described the ulnar-radial pinning for stabilisation of distal radio-ulnar joint after reduction by ligamentotaxis and manipulation of distal fragment. In 2010 Ashok K Shyam et al⁷ studied 65 comminuted distal radius fractures and compared the outcome with K-wire fixation and ligamentotaxis. They

concluded that both methods worked well with good clinical and functional outcomes. In 2015, Shuang-Le Zong et al⁸ in a meta-analysis for dorsally displaced fractures comparing the volar locking plate and K-wire fixation concluded that the DASH scores although significantly different at 3 and 6 months post-operatively, at 1 year were comparable. In 2015, Tubeuf et al⁹ concluded from the Distal Radius Acute Fracture Fixation Trial (DRAFFT) that compared to the volar locking plate, K-wire fixation is a cost saving intervention and has similar health benefits.

Closed reduction and percutaneous pinning is one of the standard treatments for management of distal radius fractures and its modification 'The five pin technique' improves the reliability of fixation thus combining the advantages of non-invasiveness as in casting and stability achieved comparable to open reduction and plating.

Study aimed to assess the clinical and functional outcome of fixation of distal radius fractures using the five pin technique in 30 patients managed in our institute, Karnataka Institute of Medical Sciences, Hubballi, Karnataka over a period of 1 year from July 2016 to July 2017 retrospectively and prospectively.

Applied Anatomy

Mechanism of Injury

Six deformities occur which are impaction, lateral displacement, lateral rotation, dorsal displacement, dorsal rotation and supination.

Associated Injuries

- 1) Triangular fibro cartilage complex (TFCC) injury may be associated with an ulna styloid fracture.¹⁰
- 2) Interosseous ligament injury-Scapholunate and lunotriquetral are the predominant interosseous ligament injuries associated.^{11,12}

Classification - Frykman¹³

Type 1 - Extra-articular without ulna fracture.

Type 2 - Extra-articular with ulna fracture.

Type 3 - Intra-articular radiocarpal without ulna fracture.

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Type 4 - Intra-articular radiocarpal with ulna fracture.

Type 5 - Intra-articular DRUJ without ulna fracture.

Type 6 - Intra-articular DRUJ with ulna fracture.

Type 7 - Intra-articular radiocarpal and DRUJ without ulna fracture.

Type 8 - Intra-articular radiocarpal and DRUJ with ulna fracture.

Methods of Surgical Intervention

Closed reduction and percutaneous pinning

Percutaneous pinning following closed reduction is generally useful for fractures that are unstable after closed reduction such as fractures with metaphyseal comminution and intra-articular extension.¹⁴ After achieving anatomic reduction by closed means the fracture is stabilised with K-wires. This technique for fixation of distal radius fractures is relatively simple and inexpensive. The major disadvantages however with conventional crossed pin configuration of percutaneous pinning is the need for cast immobilisation and the oblique orientation of pins which do not prevent the collapse that occurs at the fracture site.

Common complications that occur after percutaneous pinning are:

- 1) Superficial pin site infection.¹⁵
- 2) Extensor tendon tethering.
- 3) Pin migration and
- 4) Nerve injury.

Kapandji intrafocal pinning

This technique of intrafocal pinning is used to prevent displacement of fracture fragments proximally and dorsally thereby acting as a buttress. The pins are inserted into the fracture site both dorsally and radially and then levered up and directed into the proximal intact cortex.¹⁶

Other treatment modalities available are

Spanning external fixator.

Augmented external fixation¹⁷ with supplemental K wire fixation

Non spanning external fixator

Volar locking plates.

Dorsal locking plates.

The five pin technique

The five pin technique for fixation of distal radius fractures is a modification of the existing closed reduction and K wire fixation technique. The technique involves closed reduction followed by internal fixation with 5 K wires (figure-4).

Advantages of the 5 pin technique.

- 1) Superior to routine K wire fixation - provides a more stable fixation by providing rotational stability.
- 2) Early mobilisation - as it provides a stable fixation.
- 3) Non invasiveness - as it is a closed procedure.
- 4) Technically less demanding - compared to a plate fixation.
- 5) Cost saving intervention- compared to the volar locking plating with similar health benefits as concluded by the DRAFFT.
- 6) Fewer complications.

Principles and Mechanism

The routine K wire fixation provides coronal and sagittal plane stability but fails to provide rotational stability as the wires converge and cross at a point at or near the fracture.

Therefore, however many pins we apply across the fracture they function as a single pin making the fracture rotationally unstable.

To overcome this drawback of closed pinning technique we add two radio ulnar pins to transfix the distal radio ulnar joint and provide rotational stability.

The added advantage in doing this is that the radial length is kept constant during union. As the distal radius is notorious for late collapse which is an important influencing factor for a poorer outcome, this technique effectively counters it leading onto a better functional outcome.

Fracture reduction and the 5 pin technique.

Patient positioning - The patient is positioned supine with the shoulder abducted to 90 degrees, elbow flexed to 90 degrees, forearm pronated and wrist in neutral position.

Closed reduction - Performed using Charnley's method and checked under image intensifier to confirm acceptable reduction and proceed with fixation.

Fixation using five pin technique - Fixation in the following order is done after acceptable reduction is confirmed on image intensifier:

- 1) Radial styloid pin - From lateral to medial direction.
- 2) Lister's tubercle pin - From dorsal to volar and lateral to medial direction.
- 3) Distal radio ulnar pin - Just below articular surface in ulno-radial direction.
- 4) Medial corner pin - From dorsal to volar and medial to lateral direction.
- 5) Proximal radio-ulnar pin - 5 cm from wrist joint and in ulno-radial direction.

Implants used (figure-5)

1.8 and 2 mm smooth K wires

Double cortical purchase recommended

Intrafocal pins accepted.

MATERIALS AND METHODS

After the ethical clearance was obtained from the Ethical committee of KIMS Hubballi, 30 patients with fracture of distal radius who were admitted at the emergency department and subsequently underwent five pin fixation and also those who had come to the out patient department for follow up after surgery at Karnataka Institute of Medical Sciences, Hubballi, Karnataka were studied between July 2016 and July 2017. The patients were subjected to history taking, thorough clinical examination with analysis of pre operative and post operative radiographs. The radiographic analysis includes evaluation of standard antero-posterior and lateral views of X rays of the wrist joint of bilateral upper limbs.

Inclusion criteria

- 1) Age greater than 20 years.
- 2) Patients with displaced intra articular and extra articular

fractures of the distal radius.

Exclusion criteria

- 1) Age lesser than 20 years.
- 2) Patients with Barton's fracture (isolated dorsal or volar lip fractures of the distal radius with subluxation of the carpus).
- 3) Patients with compound fracture.
- 4) Patients with associated ipsilateral upper limb trauma.

Post operatively the patients were assessed based on the functional outcome, which was done using the quick DASH scoring system. The quick DASH scoring system is a 9 item self-report questionnaire which is the shortened and modified version of the Disability of the Arm, Shoulder and Hand (DASH) scoring system.

RESULTS

30 patients with fracture of the distal radius were studied both prospectively and retrospectively at Karnataka Institute of Medical Sciences, Hubballi, Karnataka from July 2016 to July 2017.

The mean age of the patients at the time of presentation of the fracture was 45 years with the youngest patient being 21 years and the oldest patient being 75 years.

Sex Distribution-There were 21 male (70%) and 9 female (30%) patients.

Fracture type distribution- Frykman's type 1 (4), type 2 (8), type 3 (2), type 4 (2), type 5 (2), type 6 (4), type 7(4), type 8 (4).

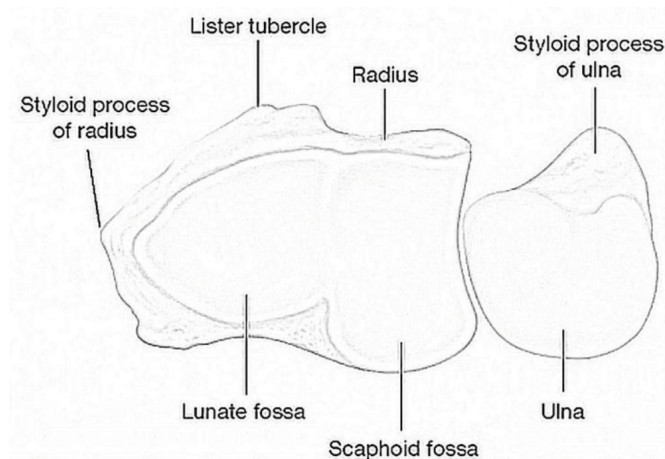


Figure-1:



Figure-2:

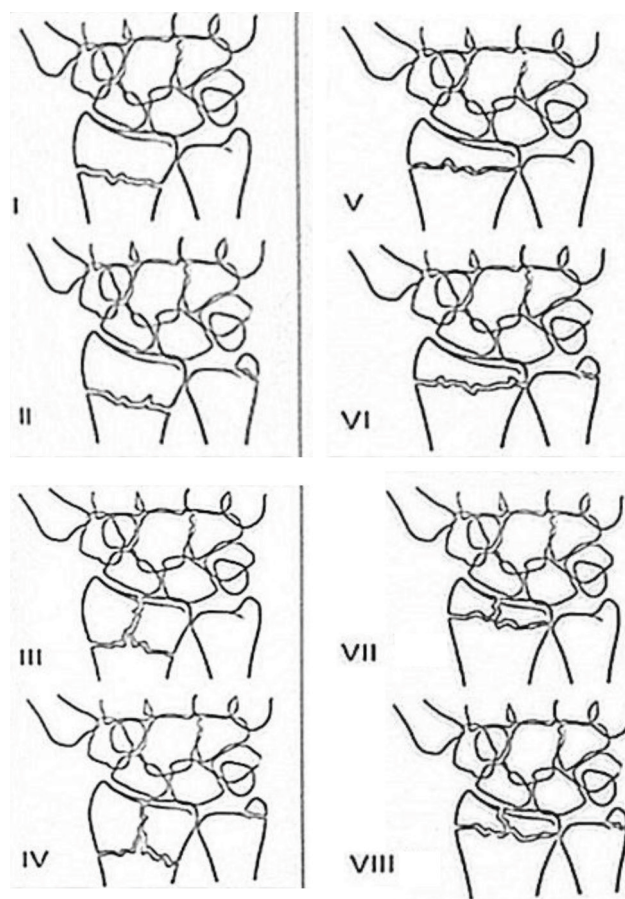


Figure-3:



Figure-4:

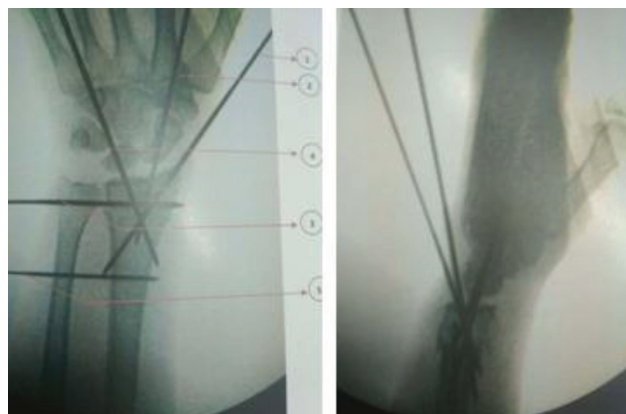


Figure-5:

Time to surgery- 16 patients were operated in less than 1 week, 9 patients in 1 to 2 weeks and 5 patients by 2-3 weeks

Functional outcome – Quick DASH scoring. Score of less than 10 in 14 patients, 11-15 score in 7 patients, 16-20 score in 6 patients, and more than 20 score in 3 patients. The scores were found to be excellent or good in most cases (lower scores) and comparable to volar plate fixation as found in other studies.

Complications –superficial pin tract infection, extensor tendon tethering, late fracture collapse and malunion.

DISCUSSION

Distal radius fractures are one of the most commonly encountered fractures in clinical practice. These fractures can cause the patient significant distress and disability if treated inadequately. The debate over the optimal treatment for distal radius fractures only sparks more questions than answers with the options ranging from conventional cast immobilisation to column specific plating. Therefore, as we are forced to draw a balance we have resorted to combining the advantages of age old casting and invasive plating by using the five pin technique which is a modification of the existing closed reduction and pinning method.

Closed reduction and cast immobilisation although simple and convenient leads on to a high rate of disabling stiffness and late fracture collapse eventually leading onto a poor functional outcome. Open reduction and plating although provides an opportunity to reduce the fracture anatomically comes with own set of complications related to the invasiveness of the procedure.

The goals of managing distal radius fractures are anatomic reduction, fracture stability, early mobilisation, pain free range of movements and minimal complications. All the afore mentioned goals can be achieved using the five pin technique for fixation of distal radius fractures.

The five pin technique carries the advantages of early mobilisation. This is because the radio ulnar pins and the pins across the fracture site provide stability enough to permit early mobilisation leading onto lesser stiffness post-operatively.

Another significant advantage the five pin technique provides is in its versatility. Distal radius fractures occur in innumerable patterns hence it is important to individualize treatment. This technique helps us achieve a much desired fragment specific fixation.

The DASH scores in the study by Brennan et al comparing K wire fixation vs volar plating was 13.12 vs 11.25.¹⁸

The DASH scores in our study were excellent or good in most cases. The average DASH score being 12.68 which is comparable to volar plating and better than conventional K wire fixation as seen from other studies.⁸

On analysis of patients with fair or poor DASH scores, one case presented late making anatomic restoration not possible, one case had poor anatomic reduction leading onto residual dorsal tilt, other cases had either severe metaphyseal or articular comminution leading onto late fracture collapse and malunion.

Complications were encountered in the form of superficial pin site infections, deformity and fracture collapse and extensor tendon tethering. The superficial pin site infections settled with removal of infected pins and oral antibiotics and cases with extensor tendon tethering also resolved with removal of offending pins. The deformity and fracture collapse though not always, led to a poorer functional outcome.

Although the study series is small and further research is essential to provide directions for treatment, it is safe to conclude that the five pin technique is a technically less demanding, non-invasive and an effective way of treating both displaced intra and extra articular distal radius fractures without severe articular or metaphyseal comminution. The cases with delayed presentations and severe comminution certainly need open reduction and a more stable fixation in the form of plating.

CONCLUSION

"The five pin technique" is a minimally invasive and effective means of treating displaced intra and extra articular fractures without severe articular and metaphyseal comminution.

In conclusion, the five pin technique is a versatile tool which provides functional outcomes better than conventional K wire fixation and comparable to volar plating as seen in our study. However further studies with a larger series are needed to provide future directions.

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