

STUDY OF FRACTURE PATTERNS OF DISTAL END RADIUS AND COMPARISON OF TREATMENT BETWEEN PERCUTANEOUS PINNING AND VOLAR LCP SYSTEM

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ABSTRACT

BACKGROUND

Distal radius fractures accounts for 16% of skeletal and 74% of forearm fractures. Prevalence is more among females, with progressive increase in age complications arises as osteopenia and osteoporosis become more prevalent. The most common trauma mechanism is falling over the outstretched hand. The characteristics of such fractures (trace location, possible joint involvement, comminution and degree of soft tissue injury) are directly related to the force of the trauma, wrist angle at the moment of the trauma and bone health. There is no uniform consensus on the definite choice of treatment. A randomised prospective and retrospective study was undertaken to compare closed reduction and k wire fixation and open reduction and internal fixation with volar LCP and evaluated in terms of functional outcome, the rate of nonunion, malunion and local complications in patients with distal end radius fractures.

MATERIALS AND METHODS

Patients with distal end radius fractures (AO type A2 A3 B1 C2 C3) in age group of 12 to 78 years were recruited and randomly allocated into two groups, consisting 30 patients each. Group 1 patients were treated surgically by open reduction and internal fixation with volar LCP with whereas patients of group 2 were managed with closed reduction and k wire fixation. Follow-up was done at 06 weeks, 03 months and 06 months 9 months, 15 months, 20 months, their radiographic assessment was done and other complications were evaluated. Finally, functional outcomes were assessed at final follow up visit using "Demerit point rating system" of Gartland & Werley.

RESULTS

In group 1, results were excellent in 63.3% (19) cases, good in 23.3% (7) cases, fair in 13.3% (4) cases whereas in group 2 results were excellent in 46.7% (14) cases, good in 23.3% (7) cases, fair in 23.3% (7), poor in 6.7% (2) cases as per Gartland & Werley score. In group 1, 2 patients developed superficial infections which was resolved with antibiotic and dressing whereas in group 2, patients developed pin tract infection leading to removal of k wire. In group 1 2 patients suffered from grade 1, 2 arthritis whereas in group 2 2 patients suffered from grade 2, 3 arthritis. Finally modified Gartland & Werley demerit score for group 1 was 3.67, whereas for group 2 was 6.5.

CONCLUSION

Open reduction and internal fixation with volar LCP gave superior results as compared to closed reduction and k wire fixation in management of distal end radius fractures in terms of union and function.

KEYWORDS

Distal End Radius, Fracture, k Wire, Volar LCP.

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BACKGROUND

Distal radius fractures account for up to 20% of all fractures treated in emergency departments.¹ many are not "completely exempt from pain" after treatment. Approximately distal radius fractures have an incidence of 1:10,000 people involving 16% of skeletal and 74% of forearm fractures². Incidence is more among females, with progressive increase in age complications arises as osteopenia and osteoporosis become more prevalent.² The most common trauma mechanism is falling over the outstretched hand.² The characteristics of such fractures (trace location, possible joint involvement, comminution and degree of soft tissue injury) are directly related to the force of the trauma, wrist angle at the moment of the trauma and bone health.²

Treatment should be planned logically after carefully assessing the extent of displacement, the degree of articular disruption, the stability and the reducibility of each fracture, as well as any concurrent injury to adjacent nerves, tendons or carpal bones. The optimal management requires an accurate restoration of skeletal anatomy by closed or open treatment, prompt recognition and repair of concomitant injuries and rehabilitation supervised by highly skilled therapists.

More than 1000 peer-reviewed studies have been published on the subject, yet there is no consensus on which treatment is superior or firm guidelines for treatment decisions. Ellis.J (1965)³ was one of the earliest to recommend open reduction and internal fixation of unstable smith's type-2 or volar Barton fracture. Melone Charles Jr. (1984 & 1986) is one of the proponents of open reduction of displaced intra articular fractures of distal radius. He has proved in his series that maximal functional recovery following such fracture is dependent to a great extent on accurate and stable restoration of articular surfaces.

Distal End Radius fracture is frequently comminuted & this is responsible for slipping of the reduction, which is a rather common late feature. It is observed, therefore, that this fracture possesses little or no stability following closed reduction & it goes on for gradual collapse.

The present study is intended to find out and assess both conceptual and practical guidance for precision treatment with an expectant favourable result.

Plating in DER fractures can be done by dorsal as well as volar approach but distal Volar Radius systems (Locking) are now increasingly popular. In this study volar approach was used.

MATERIALS AND METHODS

Study Design

It is a study of 60 cases presenting with Distal End Radius in M.G.M Medical College & L.S.K Hospital Kishanganj.

Inclusion Criteria

- Age - 12 to 78 years.
- Clinical & Radiological evidence of distal end radius fracture.
- Written informed consent.
- Cases presenting with two weeks of the injury.

Exclusion Criteria

- Below 12 years.
- Deformities.
- Compound fractures.
- Other fractures of the same limb.
- Patients undergoing radiotherapy or chemotherapy.
- Metabolic diseases associated with the skeletal system.

Study Period- June 2014 to October 2016.

Method of Study

A.O. classification was used for classification of fractures. Radiographic analysis including an assessment of the articular comminution and an extension of fragments into diaphysis was done.

Techniques Used

1. Percutaneous Pinning with K Wire and cast immobilization
2. Internal Fixation- Volar locking plate fixation.

In all the cases, conservative or operative management was done within 7 days of presentation.

Indications for Operative Management were⁻⁴

Displaced intra-articular fractures with (either of them)-

1. Post reduction radial shortening of >3 mm.
2. Post reduction >15 degrees of sagittal plane angulation (as measured from the anatomical volar tilted position).
3. Post reduction articular step of > 2 mm.

Predictors of Instability

La Fontaine et al. five factors that indicates instability-

1. Initial dorsal angulation of more than 20 degrees (volar tilt),
2. Dorsal metaphyseal comminution,
3. Intraarticular involvement,
4. An associated ulnar fracture, and
5. Patient age older than 60 years.

Other suggestive indications of instability include dorsal angulation, volar tilt comminution, and initial shortening.

Treatment Options

a) Pin & Plaster Technique.

Percutaneous pinning with kumi after closed reduction is helpful in distal radial fractures with metaphyseal instability or simpler intraarticular displacement. An anatomical

reduction must be done first, and then stability is achieved by the Kirschner wires.

Active finger and shoulder mobilization were given immediately. K-wires and plaster were remand after six weeks followed by active mobilization exercises of wrist, forearm, finger, elbow and shoulder with use of volar splint for two weeks in-between exercise period for better compliance.

b) Internal Fixation with Volar Locking Plate

Capo et al.¹ demonstrated the biomechanical superiority of volar plating over dorsal and radioulnar dual-column plating, and several clinical studies have indicated better functional outcome with volar plating over dorsal plating, external fixation and percutaneous pinning; however, a complication rate of approximately 15% also has been reported with volar plating, primarily problems with tendon ruptures and tenosynovitis from prominent screws. Active wrist flexion/extension/pronation/supination started after pain relief in most of cases within 2 days.

Scoring System

Finally, functional outcomes were assessed at final follow up visit using "Demerit point rating system" of Gartland & Werley.

The objective evaluation is based on the following ranges of motion as being the minimum for normal function.

Dorsiflexion 45°, Palmar flexion 30°, Radial and Ulnar deviation 15°, Pronation 50°, Supination 50°.

In addition radiographic analysis of the articular congruity, angular deviation of the radius, radial length and configuration of radioulnar joint was made. Patients were evaluated for carpal instability patterns and radioulnar instability or pain.

OBSERVATION AND RESULTS

The number of patients, classified according to A.O. type, in each treatment group are as follows-

Treatment Method	AO Classification	Number of Patients	Percentage
Percutaneous Pinning and Cast (30 pts.)	A2	13	50
	A3	8	
	B1	2	
	C1	2	
	C2	3	
	C3	2	
Internal fixation with volar LCP system. (30 pts.)	A2	4	50
	A3	3	
	B2	2	
	B3	2	
	C1	10	
	C2	7	
	C3	2	

Table 3. Selection of Treatment

A.O. Type versus Treatment Modality.

The most common fracture type treated by K-wiring was A2 type and Volar Plating was C1 type.

The most common fracture type in this study was A2 followed by C1 & A3.

Treatment	Follow up (Months)	Arthritis Grade	Volar Tilt Degree	Radial Angle Degree
K- wiring	14.80	0.17	4.43	15.83
Plating	15.33	0.10	3.76	17.00

Table 4. Follow-up Duration, Radiological Grade of Arthritis, Degree of Volar Tilt & Radial Angle; in Different Treatment Modalities

Number of patients having,
 Grade I arthritis: Plating: 1.
 K-wiring: 1
 Grade 2 arthritis: Plating: 1.
 Grade 3 arthritis: K-wiring: 1.

The mean volar tilt in plating group is 3.76 degrees and for k wiring is 4.43. The mean radial angle is highest in the plating group i.e. 17 degrees whereas it is lowest in K-wiring group i.e. 15.83 degrees.

Treatment	Residual Deformity	Subjective	Objective	Complications	Total Demerit Score
K- wiring	0.63	2.10	2.67	1.13	6.50
Plating	0.70	1.47	1.70	0.60	3.67

Table 5. Modified Gartland & Werley Scoring Groups (Mean value)

Mean value of Modified Gartland & Werley Total Demerit Score was 3.67 for the plating group whereas it was 6.5 for the K-wiring group.



Figure 1. X-ray Picture of Pin & Plaster Technique A. Pre-Op B. Post-Op

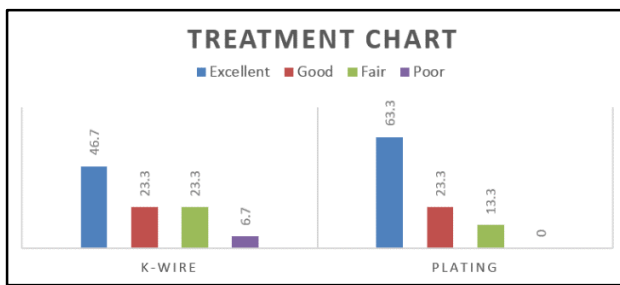


Figure 2. Graphical Representation of Modified Gartland & Werley Scoring Results in different treatment Groups

COMPLICATION

One patient developed pin tract infection in the k-wire group whereas 2 patients developed pin tract infection in the external fixator group. 2 patients in the Volar LCP

group developed superficial infection which resolved with antibiotics and dressings. In none of these cases, implant removal was necessitated due to infection. There were no patients with nerve injuries, tendon injuries and Volkmann’s ischaemic contracture. The cases of delayed compression neuropathy and delayed rupture of long tendons were not observed in the present study. No patient developed finger stiffness and early dystrophy.

63.3% excellent results were obtained in the plating group as compared to 46.7% in the k-wiring group. 6.7% poor results were obtained in the K-wiring group.

Overall, 33 patients had excellent result outcome, 14 patients had good, 11 patients had fair and 2 patients had poor result outcome, according to Modified Gartland & Werley Demerit Scoring System.



Figure 3. X-ray picture of Internal Fixation with Volar Locking Plate A. Pre-op B. Post-op

DISCUSSION

In our prospective study of 60 patients of lower end radius fractures, all patients were treated with any one of the 2 different modalities of treatment.

The demerit point system was chosen over other functional scoring systems as it takes into consideration not only objective evaluation but also the subjective parameters and complications associated with treatment like poor finger function, nerve complication and pain due to arthritis. Present series shows that functional outcome depends upon complete anatomical restoration of distal radius.

Indications for Operative Management were-

Displaced intra-articular fractures with (either of them)-

1. Post reduction articular step of >2 mm,
2. Post reduction radial shortening of >3 mm,
3. Post reduction >15 degrees of sagittal plane angulation (as measured from the anatomical volar tilted position).

The most suitable operative treatment was selected keeping in mind the fracture anatomy.

Trans-fixation with k-wire and immobilization in cast was done for non-articular displaced reducible but unstable fracture and articular displaced reducible and stable fractures (A.O.Type – A2, A3, B1, C1, C2, C3 in this study). In the present series, results were Excellent to good in 70%, fair in 23.3% and poor in 6.7% cases.

Internal fixation with volar LCP system was used in 30 patients (A.O.Type- A2, A3, B2, B3, C1, C2, C3). In the present series, results were excellent in 63.3%, good in 23.3%, fair in 13.3%.

For fixation of distal end radius fracture volar locking plate system has shown to be a reliable plating system. Volar plating technique has the added advantage that is the comfort that it provides to patient in initiating early finger & wrist motion. Despite, our use of an early motion rehabilitation protocol, the distal end radius fracture reduction was maintained at the follow-up periods. Early rehabilitation had the advantage of enabling the patient to regain self-dependency in daily activities rather quickly. At about the end of one year after fixation with the volar locking plating system, patients can have grip strengths and most wrist motions approximately 80 % to 90% of those on the contra-lateral, uninjured side.

With the locking design, the distal screws are locked with the plate, which stabilize the screws against lateral movements (toggle) and resist loosening. This provides additional strength to the fixation by constructing a scaffold under the distal articular surface. The proximal diaphyseal screws fix the plate quiet strongly to thick cortical bone, completing this stable form of fixation. Some short-term complications associated volar locking plating system arises. Non-operative care for infections was given for the cure of superficial skin. Plate related complication did not occur in this series. Muscular coverage of the plate was provided by the pronator quadratus and shield the flexor

tendons from the plating system. The distal screws can be of either monocortical or bicortical engagement. Dorsal comminution may not afford stable purchase dorsally; however, it is not crucial to the stability of the whole mechanism with LCP. Howard PW and co-workers (1989)⁵ in a comparative study found that functional results were related more to the quality of anatomic reduction than to the method of immobilization.⁶ These findings were supported by Van der Linden and Ericson (1981), Porter and Stockley (1984). The present series also supports above findings.

In the present series there were no patients with nerve injuries, tendon injuries and Volkmann's ischaemic contracture. The cases of delayed compression neuropathy and delayed rupture of long tendons were not observed in the present study. Cooney W.P⁵ reported incidence of nerve injuries of 8% whereas Pool C. (1973) reported 7% incidence. Cooney (1983, 1990)^{7,8} also reported Volkmann's ischaemic contracture in about 1% patients following a tight short or long arm cast. In the present series, not a single patient developed finger stiffness and early dystrophy, The incidences of this ranges from 3% (Cooney 1980) to 2% (Frykman) to 10% Lidstrom (1959).⁹

CONCLUSION

Due to high velocity trauma, distal end radius fractures are occurring in young adults, which are common in males and usually they are intra-articular and could be bilateral. Surgical intervention is required for these patients for a perfect functional result in these patients.

Fractures of the distal radius continue to be one of the most common skeletal injuries treated by Orthopedic surgeons. Several issues still remain regarding treatment considerations for patients with this injury. In conclusion, extra-articular fractures give better results than intra-articular fractures.

The treatment goal for fractures of the distal end of the radius is fully functional recovery of the wrist and prerequisites are restoration of the anatomy and early mobilization. Functional outcome depends upon patient's age, fracture anatomy, displacement, reducibility, stability and articular incongruity of fractures. It has also been shown that functional results are related more to the quality of anatomical reduction than to the method of immobilization.

Distal radius volar locking compression plating is a safe and effective treatment for unstable fractures Specially locking implants provide advantages in the treatment of distal radius fractures with metaphyseal comminuted zones (A3 and C2 fractures).

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