



E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2022; 8(3): 162-165
© 2022 IJOS
www.orthopaper.com
Received: 10-05-2022
Accepted: 15-06-2022

Dr. Viplav V Shetty
DNB Post Graduate,
Department of Orthopaedics,
Kerala Institute of Medical
Sciences, Trivandrum, Kerala,
India

Dr. Praveen Dileep
DNB Post Graduate,
Department of Orthopaedics,
Kerala Institute of Medical
Sciences, Trivandrum, Kerala,
India

Dr. Mohammad Nazeer
HOD, Department of
Orthopaedics, Kerala Institute of
Medical Sciences, Trivandrum,
Kerala, India

Corresponding Author:
Dr. Viplav V Shetty
DNB, Post Graduate,
Department of Orthopaedics,
Kerala Institute of Medical
Sciences, Trivandrum, Kerala,
India

Correlation of radiological parameters with functional outcomes in distal radius fractures treated surgically

Dr. Viplav V Shetty, Dr. Praveen Dileep and Dr. Mohammad Nazeer

DOI: <https://doi.org/10.22271/ortho.2022.v8.i3c.3194>

Abstract

Twenty nine patients with distal radius fractures treated with various modalities including LCP and K-wire fixation with below elbow cast from September 2018 to May 2019 prospectively, with follow up period of 6 months. Functional outcome of each patient was assessed based on DASH score and Radiological score was assessed using Radiological score at 6 weeks, 3 months and 6 months. The outcome of this study states that there is positive correlation exists between radiological and functional outcomes. Positive correlation exists with individual radiological parameters and functional outcomes, although the strength of correlation was poor. Among the radiological parameters, Ulnar Variance showed the greatest correlation while the Radial Inclination was the least correlated.

Keywords: Radiological outcome, functional outcome, distal radius fractures, dash score - disability of arm, shoulder and hand score

Introduction

Distal radius fractures are the most common fractures encountered in Orthopaedic trauma. The distal radius articulates with scaphoid and lunate as well as with distal ulna. About 80% of axial load transmitted from the hand through the wrist is borne by distal radius. Fractures of distal radius are treated conservatively if the fragments are displaced or the fragments are held in anatomical alignment by plaster cast. Long-term results following conservative treatment may not be as acceptable as is generally assumed ^[1].

Treatment modalities like percutaneous pinning, external fixator and plating has produced better functional outcomes. Each surgical fixation has its own advantages and disadvantages. K-wire fixation is relatively simple, quick and minimally invasive technique, which is cheap and requires limited operative hardware. However, since the fixation is not 'rigid', the wrist has to be immobilized in plaster cast; normally upto 6 weeks or until the wires are removed. There is a risk of infection where the wires enter the skin. There is a risk that fracture will collapse when the wires are removed, leading to deformity and loss of function. If bone is found to be fragile preoperatively or in patients greater than 70 years old, locked palmar plate fixation seem to be the logical choice ^[2]. The potential for restoration of normal alignment and the stability of the fixation are the main advantages of internal fixation with plates ^[3].

Assessment of superiority of one procedure over the other is mainly done with radiological parameters. Functional outcomes have been studied to assess its correlation with radiological parameters. Still, the correlation between the degree of radiological deformities and functional outcome is controversial.

Materials and Methods

A prospective study was conducted from September 2018 to May 2019 in the Department of Orthopaedics, KIMS Hospital (Kerala Institute of Medical Sciences), Trivandrum, Kerala. We studied a total of 29 patients with distal radius fractures including both extra and intra articular fractures treated with both K wire fixation / LCP.

Patients with age more than 18 years and with history of trauma < 2 weeks were included in the study.

Fractures associated with vascular injury and compartment syndrome, prior history of distal radius fracture in the same wrist, fractures with history of trauma >2 weeks were excluded from the study.

K wire fixation, was done after adequate reduction of distal radius fractures, reduction was then stabilized with K wires across the fracture. Sterile dressing applied. Below elbow cast applied. LCP Fixation was done using Modified Henry approach – skin incision made over along the radial border of the flexor carpi radialis tendon. The sheath is opened and tendon retracted towards the ulna. Deepen the incision between the flexor pollicis longus and the radial artery. Flexor pollicis longus muscle belly is brought towards ulna. Pronator quadratus muscle is incised on its radial border, exposing the radius. Fracture reduced and LCP is fixed. Position confirmed on C arm. Thorough wash given. Wound closed in layers.

Patient treated with LCP – all patients were started on active wrist mobilization from the first day itself. Sutures were removed after 12 to 14 days. Patient treated with K wire- were immobilized with below elbow cast for 6 weeks. Check X-rays was taken at 1st and 2nd week to look for loss of reduction. K wires were removed after 6 weeks. Range of motion was started at 6 weeks.

All the patients were followed up at 6 weeks, 3 months and 6 months. Check x-rays were taken to assess fracture union and status of reduction and fixation. Functional outcome of each patient was assessed based on DASH score and Radiological score was assessed using Radiological score (Table 1) at 6 weeks, 3 months and 6 months. All patients were followed up immediately postoperatively, 6 weeks, 3 months and 6 months.

The Performa (DASH) and questionnaire for assessment of functional outcome was given to the patients at the end of 6 weeks, 3 months and 6 months for assessing of functional outcomes which included 30 different activities and the total score was calculated for 150. X-ray Wrist AP and Lateral view taken at 6 weeks, 3 months and 6 months and Radiological outcomes (Table 1) were assessed in terms of Radial Inclination, Radial Length, Ulnar Variance and Volar Tilt at 6 months. (Figure 1) of 29 patients under the study, 16 patients (55.2%) were males and 13 patients (44.8%) were females. 17 patients (58.6%) had an history of RTA as a Mechanism of Injury while 12 patients (41.4%) had history of fall on an outstretched hand. 25 patients (86.2%) had Closed Injury while 4 patients(13.8%) had type 1 open injury. 18 patients (62.1%) had left sided injury while 11 patients (37.9%) had right sided injury. 25 patients (86.2%) underwent ORIF while 4 patients (13.8%) underwent K wire fixation and cast application.

Statistical analysis: All data were entered into MS Excel and analysed using SPSS, version 20.0. Categorical and continuous variables were expressed as frequency (Percentage) and mean ± SD. Karl Pearson correlation was used to find out the relationship of radiological parameters and functional outcome. A $P < 0.05$ were considered the

threshold for statistical significance.

Ethics: The Study was constructed after the Clearance of Institution of Human Ethics Committee Kerala Institute of Medical Sciences. Written informed consent was obtained from all patients.

Results

We found that the patient treated with Locking Compression Plate showed better range of motion and functional ability at 6 weeks follow up. Functional scores at 6 weeks with patients treated with LCP were higher when compared to patients treated with K wire as patient treated with LCP were started with Active Range of motion immediately postoperatively. Patient treated with K wire fixation complained of stiffness in wrist and reduced functional ability at 6 weeks. None of our patients suffered any extensor tendon or flexor pollicis longus rupture and no wound complications.

In our study, we obtained weak positive correlation between functional outcomes and radiological outcomes, which was statistically significant (Figure 2). All radiological parameters (Radial Inclination, Radial Length, Ulnar Variance and Volar Tilt) showed weak positive correlation at 6 months. (Table 2). Among which Ulnar Variance showed greatest correlation ('r' value 0.553 and 'p' value 0.002) compared to other variables, even though the strength of correlation was weak. Ulnar Variance was the most important factor affecting final function; Positive Ulnar Variance was associated with poor function. Restoration of Radial Length, Radial Inclination and Volar tilt had a positive influence on the functional outcome but to a lesser extent. Radial Inclination was least correlated among the variables. Table 2 shows the correlation between various radiological variables and the functional results.

The outcome of this study states that there is positive correlation exists between radiological and functional outcomes. Positive correlation exists with individual radiological parameters and functional outcomes, although the strength of correlation was poor. Among the radiological parameters, Ulnar variance showed the greatest correlation while the radial inclination was the least correlated.

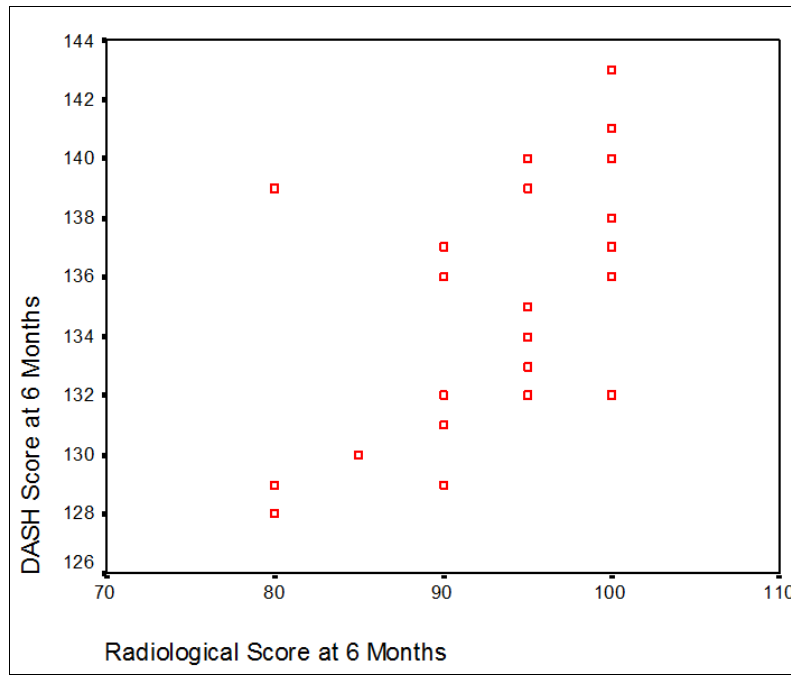
Table 1: Scoring system for Radiological Outcomes

Radial Inclination (22 degree) :	Ulnar variance (neutral) :
Grade 1 : loss upto 2 degree	Grade 1 - neutral
Grade 2 : loss upto 2-4 degree	Grade 2 : loss upto 0-2 mm
Grade 3 : Loss upto 4-6 degree	Grade 3 : 2-4 mm
Grade 4 : loss upto >6 degree	Grade 4 : >6 mm
Radial length (12mm) :	Volar Tilt :
Grade 1 : +/- 2 mm ;	Grade 1 : neutral
Grade 2 : +/- 2-4 degree	Grade 2 : 5 degree of dorsal tilt
Grade 3 : +/- 4-6 degree	Grade 3 : 5-10 degree of dorsal tilt
Grade 4 : +/- >6 degree	Grade 4 : 10-15 degree of dorsal tilt

Scores per each grade:- Grade 1: 25; Grade 2: 20; Grade 3: 15; Grade 4 : 10;



Fig 1: Ulnar Variance and Volar Tilt at 6 months



$r = 0.623^{**}, p < 0.01$

Fig 2: Scatter diagram for radiological parameters with functional outcomes at 6 month

Table 2: Correlation of components of radiological parameters and functional outcome at 6 months

	r	p
Radial Inclination	0.37*	0.048
Radial Length	0.501**	0.006
Ulnar Variances	0.553**	0.002
Volar Tilt	0.431*	0.020

** : - Significant at 0.01 level, * : - Significant at 0.05 level

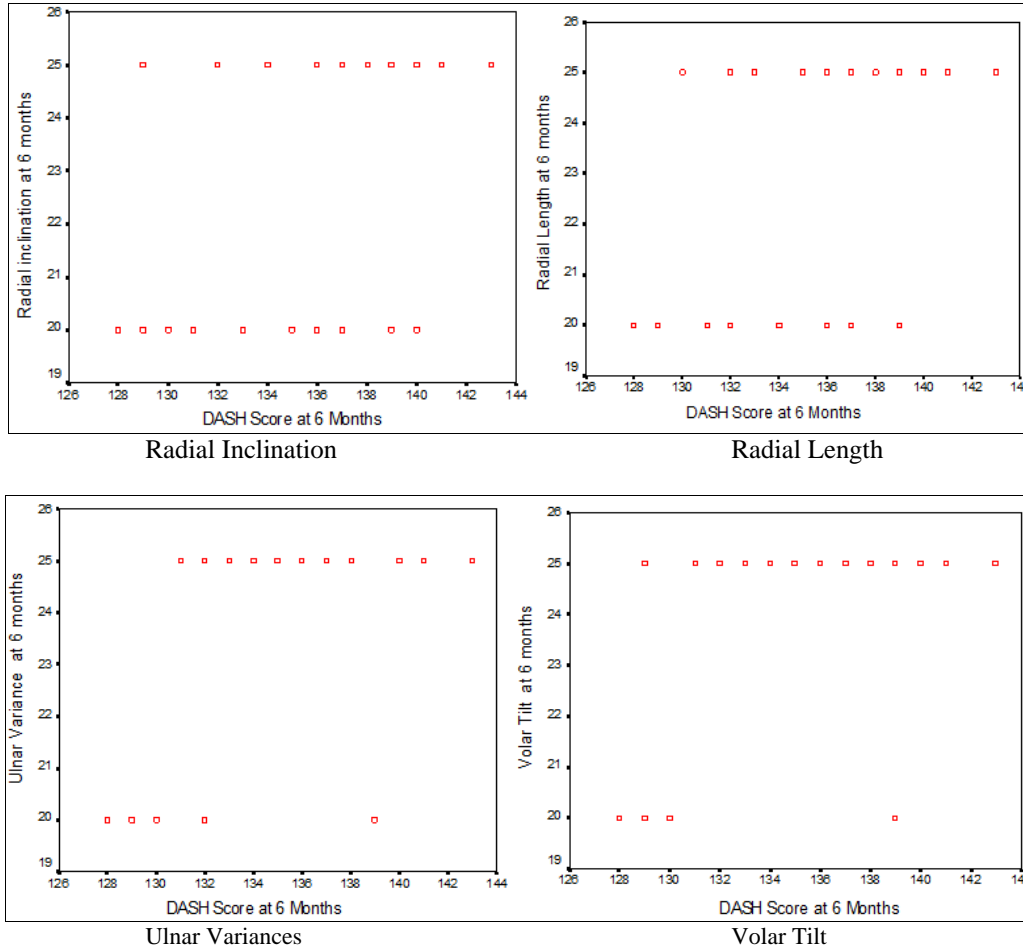


Fig 3: Scatter diagram for components of radiological parameters and functional outcome at 6 months

Discussion

In our study we found that the patient treated with Locking Compression Plate showed better range of motion and functional ability at 6 weeks follow up. Functional scores at 6 weeks with patients treated with LCP were higher when compared to patients treated with K wire as patient treated with LCP were started with Active Range of Motion immediate postoperatively. Patient treated with K wire fixation complained of stiffness in wrist and reduced functional ability at 6 weeks.

It is widely believed that accurate reduction and superior radiological results produce good functional outcome. Assessment of functional outcomes on radiological parameters has shown varied results. Some authors have shown that there is no correlation between functional outcomes and satisfactory radiological results. Altissimi *et al.* [1] who report, 'although a good functional result can be obtained despite a poor anatomical result, excellent function is more likely when anatomy has been properly restored'. Tsukazaki *et al.* [4] showed that only final dorsal angulation was correlated to loss of flexion. There was no relationship between radial shortening and loss of grip strength or loss of range of motion. Plant *et al.* [5] in their a study on 50 patients with dorsally displaced distal radius fractures treated with locking plate fixation concluded that correlation between the radiographic parameters and the functional outcomes was poor, with minimal significant correlations detected. The palmar tilt correlated to the greatest extent with the functional outcomes, with weak correlations demonstrated between the palmar tilt at 6 weeks and 12 months, and the final pinch strength and wrist flexion at 12 months. The palmar tilt at 6 weeks also weakly correlated with the early PRWE score at three months and the wrist flexion for patients under 50 years old at 6 months. Even Howard *et al.* [6] also reported that functional results correlate with anatomical results. In our study, we obtained weak positive correlation between functional outcomes and radiological outcomes.

Various radiological parameters influence on functional outcomes. Most commonly used radiological parameters are Radial length, Radial Tilt, Volar tilt, Ulnar variance and Radioulnar joint subluxation. However, there has been a controversy concerning the relative importance of each factor in influencing functional outcome. Warwick *et al.* [7] followed patients with Colles' fractures for 10 years and found that initial and 10 year radial shortening significantly affected the final outcome; dorsal angulation influenced early but not 10 year function. Villar *et al.* [8] found that the most significant radiographic feature to influence the outcome was the presence of shortening of the radius 1 week after reduction of the fracture; persistent dorsal tilt, radio-carpal involvement and ulnar styloid fractures were each associated with reduced range of motion, but had no effect on grip strength; radial tilt of the distal fragment did not correlate with any aspect of the result.

Kumar *et al.* [9] in their study on 102 distal radius extraarticular fractures treated with manipulation and cast application found that the patients had better functional results, despite of unsatisfactory radiological results. They found that satisfactory radial tilt was associated with superior functional outcome in the younger age group of patients. Cai *et al.* [10] in their study found that Radial height and Volar Tilt were significantly correlated with the clinical outcomes of conservative treatment of distal radius fractures. They also found that Radial Height should be given foremost consideration in elderly patients with distal radius fractures. Batra *et al.* [11] in their study showed that radial length was the most important factor affecting functional outcome; a loss of radial length was associated with poor function. Loss of normal volar tilt also affected the functional outcome but to a

lesser extent.

In our study all radiological parameters – Radial length, Radial Tilt, Volar tilt and Ulnar variance showed weak positive correlation at 6 months. Among the radiological parameters, Ulnar variance showed the greatest correlation while the radial inclination had the lowest correlation with functional outcomes.

Conclusion

Radiological Parameters in distal radius fractures are the main source for the assessment of functional outcomes in distal radius fractures. Correlation of radiological parameters with functional outcomes in distal radius fractures is still controversial.

The outcome of this study states that there is positive correlation exists between radiological and functional outcomes. Positive correlation exists with individual radiological parameters and functional outcomes, although the strength of correlation was poor. Among the radiological parameters, Ulnar variance showed the greatest correlation while the radial inclination was the least correlated.

References

1. Altissimi M, Antenucci R, Fiacca C, Mancini GB. Long-term results of conservative treatment of fractures of the distal radius. *Clinical orthopaedics and related research.* 1986 May;206:202-10.
2. Obert L, Rey PB, Uhring J, Gasse N, Rochet S, Lepage D. Fixation of distal radius fractures in adults: a review. *Orthopaedics & Traumatology: Surgery & Research.* 2013 Apr 1;99(2):216-34.
3. Fitoussi F, IP WY, Chow SP. Treatment of displaced intra-articular fractures of the distal end of the radius with plates. *JBJS.* 1997 Sep 1;79(9):1303-2.
4. Tsukazaki T, Takagi K, Iwasaki K. Poor correlation between functional results and radiographic findings in Colles' fracture. *The Journal of Hand Surgery: British & European.* 1993 Oct 1;18(5):588-91.
5. Plant CE, Parsons NR, Costa ML. Do radiological and functional outcomes correlate for fractures of the distal radius?. *The bone & joint journal.* 2017 Mar;99(3):376-82.
6. Howard PW, Stewart HD, Hind RE, Burke FD. External fixation or plaster for severely displaced comminuted Colles' fractures? A prospective study of anatomical results. *J Bone Joint Surg B* 1989;71:68-73.
7. Warwick D, Field J, Prothero D, Gibson A, Bannister GC. Function 10 years after Colles' fractures. *Clin Orthop* 1993;295:270-4.
8. Villar RN, Marsh D, Rushton N, Greatorex RA. Three years after Colles' fracture. A prospective review. *The Journal of bone and joint surgery. British volume.* 1987 Aug;69(4):635-8.
9. Kumar S, Penematsa S, Sadri M, Deshmukh SC. Can radiological results be surrogate markers of functional outcome in distal radial extra-articular fractures?. *International orthopaedics.* 2008 Aug;32(4):505-9.
10. Cai L, Zhu S, Du S, Lin W, Wang T, Lu D, Chen H. The relationship between radiographic parameters and clinical outcome of distal radius fractures in elderly patients. *Orthopaedics & Traumatology: Surgery & Research.* 2015 Nov 1;101(7):827-31.
11. Batra S, Gupta A. The effect of fracture-related factors on the functional outcome at 1 year in distal radius fractures. *Injury.* 2002 Jul 1;33(6):499-502.