

## Original Research Article

# Correlation of clinical and radiological outcome of distal radius fractures treated with volar plating

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### ABSTRACT

**Background:** Distal radius fractures are one of the most common injuries treated by an orthopaedic surgeon, accounting for approximately one sixth of all fractures. Due to increase in incidence of high velocity trauma, the injury is seen occurring in young patients more often. A displaced fracture deranges the wrist anatomy causing deformity and loss of function at the wrist joint. Open reduction and internal fixation with plate using a volar approach allows anatomical reduction of the fracture, stable fixation aiding in early mobilization.

**Methods:** Our study was a hospital-based study conducted during the period June 2016 to November 2018. A total of 30 patients with distal radius fracture were treated with ORIF with a volar plate. They were followed up for a year and clinical and radiological outcomes were evaluated.

**Results:** Among the 30 patients studied 25 were males and 5 were females with mean age of 36.23 years. According to Gartland and Werley demerit scoring system, 15 of them had excellent result at the end of one year. 13 Of them had good and 2 of them had fair results. Radiological assessment was done by Sarmiento's modification of the Lind storm criteria and 15 of them had excellent results. 15 patients had good radiological outcome.

**Conclusions:** From this study we conclude that ORIF with volar plating can provide good clinical and functional outcome in distal radius fractures. Anatomical reduction of the fracture fragments is the key in achieving good results.

**Keywords:** Distal radius fracture, ORIF, Volar plating

### INTRODUCTION

There is an increase in the incidence of fracture of distal radius with the increase in life expectancy and also in young due to increased incidence of road traffic accidents and sports related trauma.<sup>1</sup> They account for approximately one sixth of all fractures seen and treated.<sup>2</sup> The ultimate goal of outcome in these fractures has frequently been revisited as newer methods of treatment have been developed.<sup>3</sup> The preservation of integrity of the three columns of distal radius, each with distinct function, restores radial length, radial tilt angle and congruity of articular surfaces for good functional results in the form of normal anatomy with early functional recovery, full and painless motion of the wrist and prevention of late osteoarthritis.<sup>4-6</sup> With ongoing controversies and differences regarding the optimal surgical treatment for

unstable distal radius intra and extra articular fractures, methods like percutaneous direct pinning, external fixator and internal fixation with plates and screws do not have standard protocols or definitive indications.<sup>7</sup>

Moreover, they have their own complications ranging from infection to superficial nerve neuropraxias, a cumbersome external frame, pin track infection, pin loosening and loss of fracture reduction, neuropathies involving the radial and median nerves, tendon rupture, metacarpal fractures, reflex sympathetic dystrophy and non-union.<sup>8,9</sup>

ORIF with plate osteosynthesis promises to be a good option allowing accurate fracture reduction and early mobilization. The aim of the study was to analyse the clinical outcome of open reduction and internal fixation of fractures using volar plate and screws.

**METHODS**

Our study was a hospital based prospective study conducted in a tertiary care teaching hospital during the period from June 2016 to November 2018. Patients who are diagnosed with distal radius fracture, aged 18 and above diagnosed with intra and extraarticular distal radius fractures willing for the surgery and study, were included in the study. Open fractures, associated Carpal fractures and neurovascular injury were excluded. A total of 30 patients were included in the study. All patients were clinically examined and plain radiographs of wrist were done and categorised based on Frykman’s classification. Initial management was done with above elbow splinting and limb elevation.

Post-operatively all the cases were followed for a period of 12 months, and evaluated at 6 weeks, 6 months and 12 months. Post-operative evaluation of clinical and functional outcome was done using the demerit system of Gartland and Werley with Sarmiento et al modification and radiological outcome using Sarmiento’s modification of Lindstorm criteria.<sup>10-12</sup> Results are analysed using appropriate statistical methods.

**Technique**

Under anaesthesia patient was positioned supine on operating table with the limb placed on the arm board. Parts were painted and draped. A pneumatic mid-arm tourniquet was used in 15 cases, remaining were operated without tourniquet, which was according to the surgeon’s preference.

Using Henrys volar approach to the wrist, incision taken over the FCR tendon or just lateral to it. Plane created between the brachioradialis and the FCR. The FCR and the median nerve were retracted medially. The radial artery along with the brachioradialis was retracted laterally, exposing the pronator quadratus muscle. The pronator quadratus muscle was elevated from its radial origin and reflected ulnarly to expose the volar aspect of the distal radius and the fracture subperiosteally.<sup>13</sup> The plate was placed directly on the radius following fracture reduction, and plate placement was confirmed with intra-operative fluoroscopy. After fixation, the pronator quadratus was reattached to its radial insertion. The operating surgeon determined the choice of implant. Antibiotic prophylaxis was given for 48 hours. Sutures were removed at 12<sup>th</sup> post-operative day. Post-operatively, the wrist was immobilized in a volar splint for 4 weeks. Patients were instructed active and passive finger movements.

**RESULTS**

A total of 30 patients were included in the study. Patients were evaluated in terms of clinical outcome and by radiological parameters. Gartland and Werley scoring has been used to assess the functional scoring of patients. Radiological outcome was measured according to

Sarmiento’s modification of Lindstorm criteria. The data obtained was analyzed to study the final clinical and radiological outcome, correlation between clinical and radiological outcome, incidence of complications.

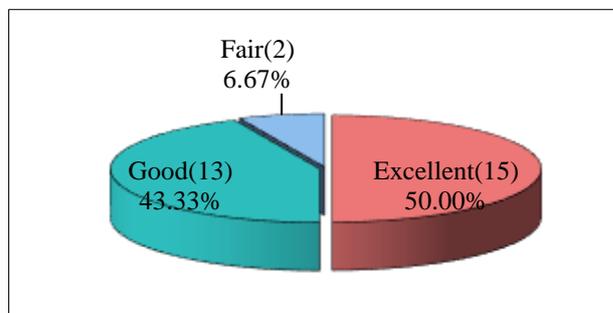
Out of 30 patients 83.33 % (25) of them were males and 16.67% were females.

Age wise distribution showed that 33.33% of the patients were among the age group between 18 and 30.40% of them were between the age of 31 and 40. 26.67% of them were over the age of 40 years. 83.33% of the injuries occurred due to road traffic accidents. 13.33% of them slipped and fell injuring the wrist and one patient fell from a height (3.33%).

Among the total 30 patients 2 patients had a type II Frykman’s fracture, 6 had type III, 9 had type IV, 3 had type V, 3 had type VII and 7 patients had type VII fractures. A fixed angle locking plate was used in 27 (90%) patients and a non-locking buttress plate was used in the remaining 3 (10%) of them.

Incidence of complications were among the 30 patients studied one of them had arthritic changes (3.33%) and one of them had an implant failure (3.33%).

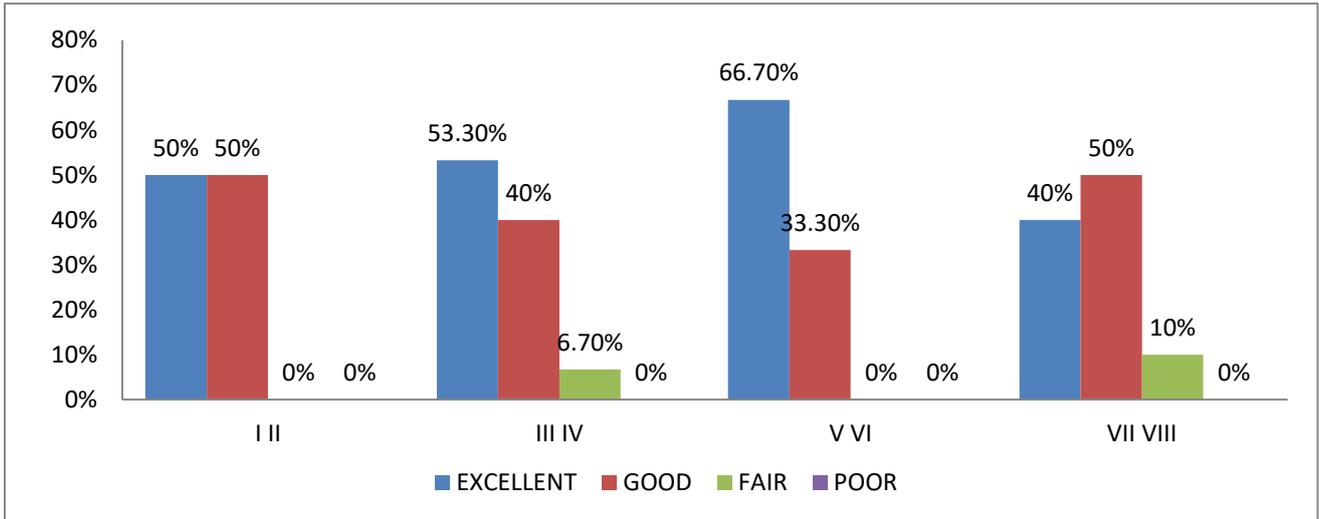
The correlation between the radiological and the clinical outcome was made using kappa statistics, which showed a 93.33% agreement between the two and with a p value of 0.0001.



**Figure 1: Clinical results- distribution of patients.**

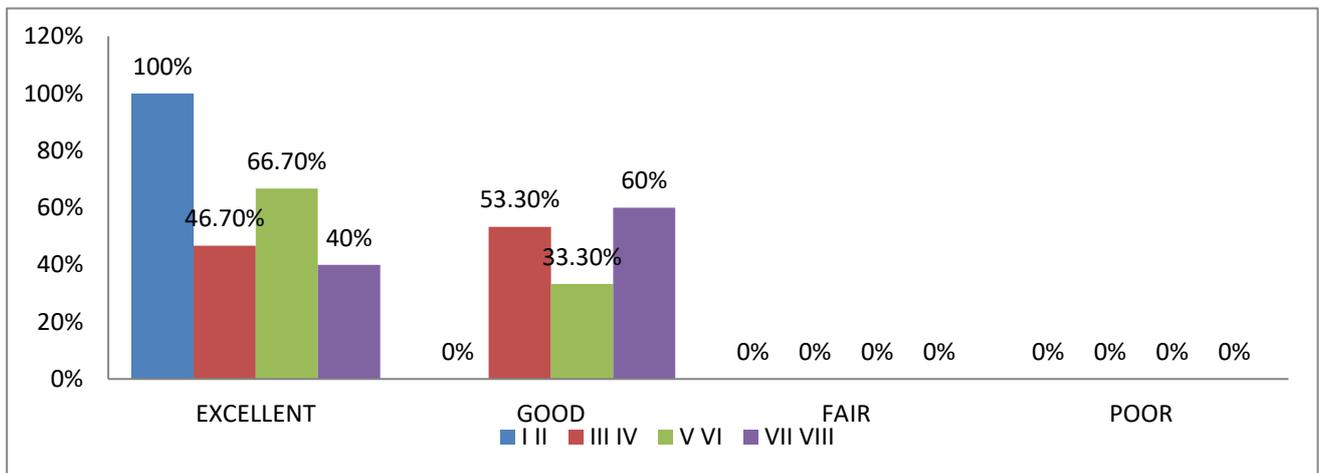


**Figure 2: Lindstorm criteria-radiological results- distribution of patients.**



**Figure 3: Association between type of fracture and clinical outcome.**

Note: Chi square value=1.131, p value=0.980.



**Figure 4: Association between type of fracture and radiological outcome.**

Note: Chi square value=2.8, p value=0.423.



**Figure 5: Pre-operative.**



**Figure 6: Post-operative.**



Figure 7: Clinical photos.

Table 1: Agreement between clinical and radiological results.

Result-clinical	Result-radiological			Total	Percentage (%)
	Excellent	Good	Fair		
Excellent	14	1	0	15	50.00
Good	1	12	0	13	43.33
Fair	0	2	0	2	6.67
Grand total	15	15	0	30	100.00
Percentage (%)	50.00	50.00	0.00	100.00	333.33

Table 2: Weight agreement between clinical and radiological results by kappa statistic.

Agreement	Expected agreement	Kappa	Standard error	Z value	P value
93.33%	71.67%	0.7647	0.1611	4.7500	0.0001*

\*p<0.05

## DISCUSSION

Distal radial fractures are one of the most common injuries encountered in orthopaedic practice. Up until a few decades ago, distal radius fractures were usually regarded as 'Colles' fracture. The treatment was mainly manipulation and casting, proposed by Abraham Colles in 1814, however they would heal with a deformity but with acceptable functional deficits.<sup>14</sup>

Fracture union is no longer the only goal, as the restoration of normal anatomy with early functional recovery, and restoration of full range of motion of wrist and forearm are the ultimate goals of treatment.

With better understanding of the various fracture types, classification such as Frykman et al, Melone et al, and Muller et al were developed. There was a need for better modality of treatment according to individual fracture pattern to obtain better functional results.<sup>15-17</sup>

Our study was a prospective study into determining the clinical outcome of distal radius fractures fixed with volar plating. The objective was to determine the clinical, functional and radiological outcome of distal radius fractures fixed with volar plating and to analyse the possible correlation between them. All fractures in our study were approached using the Henry's volar approach to the distal radius and fixed with either a fixed angle locking plate or a non-locking buttress plate.

Clinical-functional outcome in our study was assessed by Gartland and Werley demerit scoring system. The scoring system consists of subscales that evaluate objective findings, subjective assessment in addition to complications and residual deformity.<sup>13,18</sup> The radiological outcome was assessed based on Sarmiento et al modification of the Lindstorm criteria. It takes into account the radial inclination, radial length, residual dorsal (radial tilt) and residual deformity.<sup>12</sup>

83.33% of the patients in our study were males and 16.67% were females. The western studies show females being more commonly affected and Indian studies show that males are more commonly being affected. This might be correlated to the mode of injury, RTA being the most common mode of injury at 83.33%, most of them were due to motorcycle accidents. This may be correlated with young adults being most commonly injured. 16.66% of them were due to other mechanisms which include slip and fall and fall from a height. This goes to show that the injury occurs most commonly in the working age group, thus causing significant financial implications on the patient and the family in our set up. Only two among the 30 patients studied had an extra-articular fracture (both type II Frykman's) and 28 of them were intra articular fractures. Locking plates were used in 27 patients and non-locking plates were used in 3 patients.

As per Gartland and Werley score, excellent results were achieved in 15 patients (50%), good results were achieved in 13 patients (43.33%) and fair result was achieved in 2 patients. Excellent and good results may be considered as favourable outcomes. As per Lindstorm criteria, excellent radiological results were achieved in 15 patients (50%) and good results were achieved in other 15 of them. There was no statistically significant correlation between type of fracture and either clinical outcome or radiological outcome.

Only two patients developed complications in our study, i.e.; wrist arthritis and another incidence of screw placement in the joint, considered as implant failure. Both patients attained only a fair result clinically, despite good radiological result. We did not encounter any tendon related or neurological complications.

Restoration of the anatomy, represented by radiological parameters should achieve better functional results in distal radius fractures. The main radiological factors influencing the functional outcome of fractures of the distal radius are radial shortening and a step-off in the articular surface.<sup>20,21</sup> ORIF with volar plating had better results in restoration of radiological parameters and functional results.<sup>22</sup> The association between the clinical and radiological outcome was done using kappa statistics, which revealed an agreement of 93.33% between them, with a significant p value of 0.0001. This is hence a positive correlation showing that a better radiological result ensures a better functional outcome.

## CONCLUSION

There had been a change in demographics of distal radius fractures, with high velocity trauma i.e.; RTA being the most common mechanism and younger patients being affected more commonly.

There was a strong correlation between the radiological results and the clinical-functional outcome in our study group, who have undergone open reduction and plate osteosynthesis. Thus, anatomical fracture reduction, reconstruction of the anatomy and stabilisation with volar plating is the key for good clinical and functional outcomes, also stressing on the placement of screws in relation to the articular surface.

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