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ORIGINAL RESEARCH ARTICLE

FUNCTIONAL AND RADIOLOGICAL OUTCOME OF LOCKING PLATE IN DISPLACED FRACTURE OF DISTAL END RADIUS

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ABSTRACT

Background: Distal radius fracture is the most common fracture of upper extremity. There are wide variety of treatment options including plaster, ligamentotaxis, percutaneous pinning and plating for the treatment of displaced distal end radius fracture in the adult. Each option has got its own pros and cons. This study was designed with an objective of assessment of functional and radiological outcome of displaced distal end radius fracture treated with volar locking plate.

Methods: This was a retrospective study of closed displaced fracture of distal end radius managed with volar locking plate from January 2018 to September 2020. Data were collected from the case chart and included patient's demography, fracture characteristics, radiological parameters, range of motion and complications. Data analysis was done using Statistical package for social science 20.0 software. Descriptive statistics for categorical variable was used and mean of the continuous data was compared using student's t-test. P-value <0.05 was considered as statistically significant.

Results: The mean age of patient was 35.87 years after analysis of total of 30 patients with mean follow up of 12.87 months. Road traffic accident (76.7%) was the most common mode of injury. There were 36.7% Association of Osteosynthesis (AO) type B and C injuries, each. The mean Quick Disabilities of Arm, Shoulder and Hand (DASH) score was 1.13 (range 0 - 6.81) at the final follow up. The mean union time of the fracture was 6.6 weeks. One patient had stiffness and one developed reflex sympathetic dystrophy.

Conclusions: Functional and radiological outcome of the displaced distal end radius in adult treated with open reduction and internal fixation with locking plate was found good to excellent in most of the cases.

INTRODUCTION

Distal radius fracture is the most common fracture of upper extremity[1] constituting approximately one sixth of all fractures treated in the emergency department.[2] The mechanism of injury of such fracture is high energy trauma in younger individuals and low energy trauma in elderly individuals.[1] The aim of the treatment in displaced distal radius fracture is anatomic reduction of fracture with restoration of radial height, radial inclination and volar tilt within acceptable limit to achieve good functional outcome.[3]

The treatment options for distal radius fracture in practice are plaster treatment, ligamentotaxis, percutaneous pinning and plating[2]. Each option has got its own pros and cons.[4] Closed reduction and cast application is complicated by mal union, late collapse of the fracture and reflex sympathetic dystrophy.[1,5] There is increased risk of stiffness and pin tract infection with treatment by ligamentotaxis[5] and increased risk of loss of reduction and pin tract infection in percutaneous pinning.[1] Open reduction and internal fixation with plate avoids risk of stiffness and secondary loss of reduction.[5] In addition, locking plate provides angular and axial stability[3] which allows early mobilization of wrist joint.[4] This study was designed to assess the functional and radiological outcome of the displaced distal end radius fracture treated with volar locking plate as primary objective and to assess complications as secondary objective.

METHODS

This was retrospective study conducted in the tertiary care teaching hospital from January 2018 to September 2020. A total of 30 patients were included in the final analysis. Approval for the study was taken from the Institutional Review Committee of College of Medical Sciences and Teaching Hospital (Ref NO: COMSTH-IRC/2021-36).

An inclusion criterion for the study was closed displaced fracture of distal end radius treated with open reduction and internal fixation with volar locking plate of same design in adult. Exclusion criteria were pediatric distal end radius fracture, open fracture, polytrauma case, associated neurovascular injury, previously operated case, pathological fracture and ipsilateral humerus fracture. Fracture was classified according

to AO classification system.

All the demographic data including age, gender, occupation and mechanism of injury were collected from the case chart. Union time, complications and final outcome were assessed using old case records and OPD assessment at the last follow-up. Union was assessed on the basis of clinico radiological evidence. Range of motion (dorsiflexion, palmar flexion, supination and pronation) of the injured wrist was assessed on the last follow-up and was compared to the normal side. Functional evaluation was done by Quick DASH score. Quick DASH score ranges from 0 to 100; a score of 0 indicates no difficulty and 100 indicates extreme difficulty. Radiological evaluation was done by assessing fracture union and by measuring radial height, radial inclination, volar tilt and ulnar variance of the injured and normal wrist. Data was entered into Excel chart and was analyzed using statistical package for social sciences (SPSS) version 20.0 software. Categorical data was analyzed with frequency and percentage. Continuous data was calculated for its mean and standard deviation. Correlation of functional outcome was done with age, sex and fracture severity. Pearson correlation test was used and p-value <0.05 was considered statistically significant.

RESULTS

A total of 36 patients were included in the current study but 6 patients did not meet inclusion criteria and were excluded. Hence, 30 patients were available for final functional and radiological evaluation. The mean age of patient was 35.87 years (range: 18 – 73) with 86.7% (n=26) male and 13.3% (n=4) female. The distribution of age group and its frequency has been given in figure 1. The mean follow up duration was 12.87 months (range 6- 32).

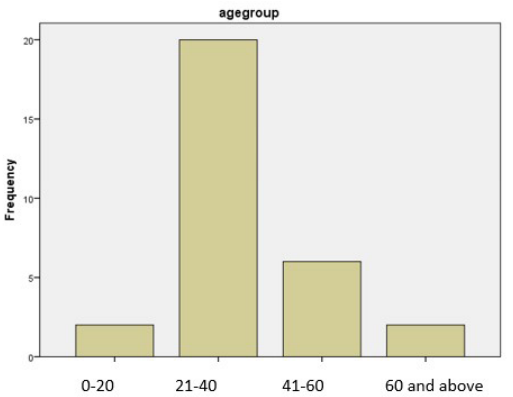

Figure 1: Bar chart showing frequency and age distribution (age in years)

Road traffic accident (RTA) was the most common (76.7%, n=23) mode of injury followed by fall from height (13.3%, n=4) and fall on outstretched hand (10.0%, n=3). The predominantly injured side was the left wrist (60%, n=18). According to AO classification, there were 36.7% (n=11) type B and C injuries each, and 26.7% (n=8) type A injuries.

The mean range of motion (ROM) of injured and normal wrist has been given in table 1 and radiological parameters of injured and normal wrist has been given in table 2 as shown below.

Table 1: Mean ROM of injured and normal wrist

Range of motion	Mean (±SD)	Range
Dorsiflexion injured wrist	73.43 (10.32)	40-90
Dorsiflexion normal wrist	79.03 (8.51)	50-90
Palmar flexion injured wrist	70.13 (11.73)	40-90
Palmar flexion normal wrist	75.97 (8.81)	60-90
Supination injured wrist	86.17 (11.28)	40-100
Supination normal wrist	89.83 (8.95)	50-105
Pronation injured wrist	73.03 (11.33)	40-90
Pronation normal wrist	76.13(10.41)	50-90

Table 2: Radiological parameters of injured and normal wrist

Radiological parameter	Mean	Range
Radial height injured wrist (mm)	9.00	7-12
Radial height normal wrist (mm)	10.57	8-14
Radial inclination injured wrist (degree)	19.37	15-28
Radial inclination normal wrist (degree)	22.70	18-28
Volar tilt injured wrist (degree)	8.73	3-14
Volar tilt normal wrist (degree)	9.93	5-14
Ulnar variance injured wrist (mm)	1.17	-1 to + 4
Ulnar variance normal wrist (mm)	1.25	0 to + 2

The range of motion and radiological picture of fracture and union has been shown in the figure 2 and 3, respectively

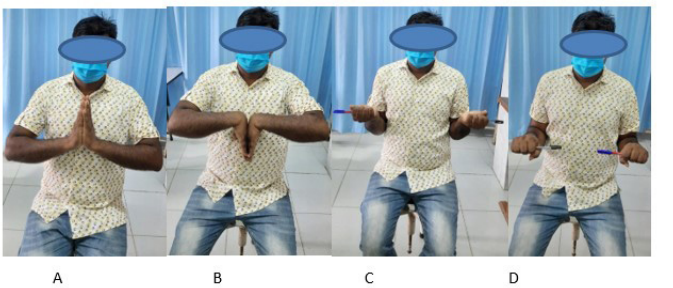

Figure 2: Clinical photographs of the patient showing range of motion (A: Dorsiflexion, B: Palmar flexion, C: Supination and D: Pronation)

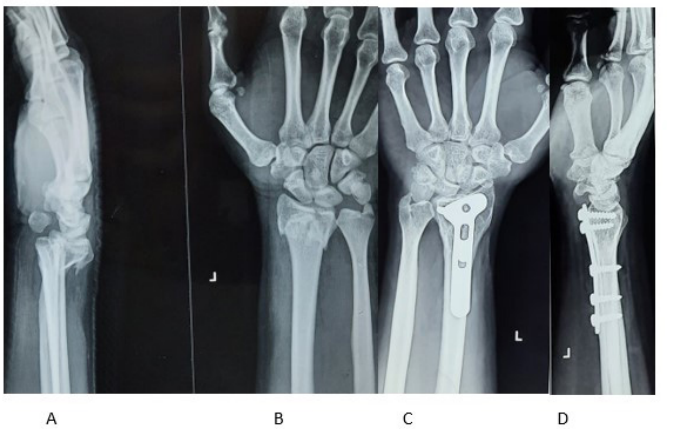

Figure 3: Preoperative x-ray of fractured wrist (A: lateral and B: AP view) and X-ray after fracture union (C: AP and D: lateral view)

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The mean Quick DASH score at the last follow up was 1.13 (range 0-6.81). There was positive correlation between younger age group (0-20 years) and final Quick DASH score (r=0.54, p=0.02). The mean union time was 6.6 weeks (range 6-10).

There was positive correlation between male sex and final functional score (r= 0.546, p= 0.002). The study showed negative correlation between fracture severity and final functional Quick DASH Score (r= -0.088, P=0.64).

Regarding complications, one patient had reflex sympathetic dystrophy at six month of follow-up and another had stiffness (dorsiflexion: 40˚, Palmar flexion: 50°, Pronation: 50˚ and supination: 70°) of wrist and fingers at nine months of follow up. There were no other complications like infection, delayed union, nonunion, neurovascular injury in the present study.

DISCUSSION

Outcome of distal radius fracture is variable depending upon the treatment modality. The current study showed good to excellent result with the treatment of volar locking plate. Distal radius fracture is common in osteoporotic bone with increasing prevalence with age. With the rise in RTA, the young adults are becoming common age group to sustain this injury.[6] The mean age of patient was 35.87 years in the current study which was comparable to the study conducted by Chavhan et al[7] and Singh et al[1] where mean age was 42.8 years and 33.03 years, respectively.

There was male predominance (86.7%) in the present study which was similar to the study conducted by Meena et al[2] where male was affected in 90% of the cases. However, in a study conducted by Phadnis et al[8], female patients (73%) were predominantly affected. The male predominance in this study could be due to more active involvement of males in outdoor activities.

The mean follow up duration was 12.87 months in this study which was in par with the study conducted by Chavhan et al[7] and Mohamed et al.[9] RTA was the most common (76.7%) mode of injury in this study which is similar to the study conducted by Singh et al[1] and Ali et al.[10]However, Chavhan et al[7] found fall injury as the most common mode followed by RTA. The predominantly injured side was the left wrist (60%) which is similar to the study conducted by Chavhan et al[7] and Singh et al.[1]

According to AO classification, type B and C fractures were the most common type of fracture (36.7%, each). Study conducted by Gracia-Cepeda et al[4] and Raudasoja et al[11] observed type C as the most common type (52.4% and 62%, respectively) whereas Chavhan et al[7] observed type B (48.6%) as the most common type. Type B and C injuries of distal radius are common probably because of high velocity injuries in young adult male. All the fractures united at mean of 6.6 weeks in the current study which is similar to the study conducted by Chavhan et al[7] and Ali et al.[10]

The mean Quick DASH score at the last follow up was 1.13 signifying good to excellent result in most of the cases. In a study conducted by Mohamed et al[9], the mean Quick DASH score was 14.4. Gogna et al[12] found mean DASH score of 16 at final follow up. Our result showed better quick DASH score indicating good functional outcome in most of the patients probably because of presence of higher number of patients (73.4%) in younger age group and good compliance to physiotherapy.

There was positive correlation between male sex and final functional Quick DASH score in this study. However, Phadnis et al[13] and Sanchez-Crespo et al[14] did not find association between gender and functional outcome. Better result in male patient in this study could be explained by their better compliance to physiotherapy.

This study showed negative correlation between fracture severity and final functional Quick DASH Score. It could be so because of higher grade of soft tissue injury and probably less accurate reduction of the fracture fragments in higher grade of injury. Phadnis et al[13] and Austine et al[15] found no correlation between fracture severity and functional outcome.

At the final follow up, mean dorsiflexion, palmar flexion, supination and pronation were 73.43˚, 70.13˚, 86.17˚ and 73.03˚, respectively and were comparable to uninjured side. In the study conducted by Gupta et al[3], mean ROM achieved at final follow up was dorsiflexion: 61.93˚, palmar flexion: 58.03˚, supination: 86.34˚ and pronation: 81.38˚. In a study by Mohamed et al[9], mean ROM at final follow up was dorsiflexion: 64.80˚, palmar flexion: 71.28˚, supination: 77.28˚ and pronation: 74.52˚. The ROM of wrist and forearm in the current study was found to be comparable to the findings in the literature.

The mean radial height, radial inclination, volar tilt and ulnar variance at final follow up were 9mm, 19.37˚, 8.73˚ and 1.17mm, respectively in the current study. In a study conducted by Sanchez- Crespo et al[14], the mean radial height, radial inclination, volar tilt and ulnar variance were 10.8mm, 21.5˚, 2˚ and – 0.8mm, respectively. Gogna et al[12], in their study, found mean radial height, radial inclination, volar tilt and ulnar variance as 12.63mm, 23.8˚, 5.54˚ and -0.55mm, respectively. Volar locking plate for displaced distal end radius fracture was found to be an effective treatment option with good to excellent result in most of our cases which is similar to the study conducted by Chavhan et al [7]and Jose et al.[5]

Total complications were present in only 2 cases (6.66%) which was nearly equal to the study conducted by Agarwala et al[16] (4%), Chavhan et al[7] (8.57%) and Gupta et al[3] (10%). One case developed stiffness of wrist and finger and another had reflex sympathetic dystrophy. In a study conducted by Gracia-cepeda et al[4] and Phadnis et al,[8] complications were present in 21.18% and 15% of cases, respectively. The variability in the complication could be due to variation in surgical technique, expertise and compliance to post-operative rehabilitation program.

The limitations of the present study are retrospective nature of the study, relatively less number of patients, and lack of comparison group.

CONCLUSION

Functional and radiological outcome of the displaced distal end radius fracture in adult treated with open reduction and internal fixation with locking plate was found to be good to excellent in most of the cases. Further study with large number of patients and comparison group is recommended to substantiate the result of this study further.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

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