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Original Research Article

FUNCTIONAL AND RADIOLOGICAL OUTCOME OF UNSTABLE DISTAL RADIUS FRACTURES TREATED WITH VOLAR PLATING-A RETROSPECTIVE STUDY

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ABSTRACT

Background: The purpose of the study was to assess the functional and radiological outcome following surgical management of unstable distal end radius fractures with volar T- plating.

Materials and Methods: In this study 25 patients with unstable fracture of the distal end of radius satisfying the inclusion criteria were treated surgically by ORIF with a volar T plate. Patient follow-up was done at 1, 4 and 8 months to assess outcome radiologically and clinically on the basis of range of movements of the wrist, grip strength, and modified Green and O'brien scores. A detailed analysis of complications was also performed.

Results: Results were graded as excellent, good, fair and poor on the basis of modified Green and O'brien score.

Out of total 25 patients, 16 patients (64%) achieved an excellent score, 6 patients (24%) had good outcome, 2patients (8%) had fair score and one (4%) had poor score. All of them attained good bony union. Two of them had screw penetration into the joint and one had infection at surgical site and resulted in fair to poor results in these patients. No wrist arthritis was reported in this study.

Conclusion: Patients with unstable and dorsally displaced fractures of the distal end of radius treated surgically with volar T plating had excellent to good functional results. But these methods can have complications like screw penetration to joint, extensor tendon irritation, infection etc.

Keywords: grip strength, T-plate, modified Green and O'brien score, unstable distal radius fractures, volar plating.

INTRODUCTION

Fractures involving the distal end of the radius have been described extensively in orthopaedic literature for over two centuries.[1] These injury patterns were recognized even before the introduction of X-ray imaging. Distal radius fractures are the most frequent fractures of the upper extremity, accounting for approximately 75% of all forearm fractures and nearly 17% of all fractures overall.[2] Traditionally, these injuries were managed by closed reduction and manipulation followed by immobilization with a plaster cast.[3,4] In 1960, Sir John Charnley remarked, "It is very fortunate that excellent functional results usually follow the common Colles' fracture, because disappointing outcomes occasionally occur even in the most skillful hands".[3] However, in complex distal radius fractures, patients may not regain complete wrist mobility and may continue to experience pain for several months. Complications such as malunion and subluxation or dislocation of the distal radioulnar joint can occur, leading to unsatisfactory functional and cosmetic outcomes.[5] Open reduction with volar plating has been shown to provide reliable reduction and maintenance of alignment in displaced distal radius fractures, resulting in improved outcomes.[6,7] Therefore, the present study aims to evaluate the functional and radiological outcomes of surgically managed

displaced distal end radius fractures treated using volar T-plate fixation. Although numerous classification systems have been proposed for distal radius fractures, none comprehensively address the wide spectrum of injury patterns and associated variables. Most systems are based on factors such as the number of intra-articular fragments, fracture location, direction of displacement, and ulnar involvement. An ideal classification should categorize fracture type and injury severity to guide appropriate treatment. In this study, the AO classification system was used, as it more accurately sub-classifies volar distal radius fractures and documents ulnar-sided involvement.[8]

MATERIALS AND METHODS

This Retrospective case series study was conducted in the Department of Orthopaedics at Government Medical College, Eluru, between November 2024 and August 2025. The study included 25 patients with unstable distal radius fractures and a follow-up period of 8 months. All patients underwent surgical management with open reduction and internal fixation using an Ellis T-plate. Fractures were classified according to the AO classification system. Among the 25 patients, 3 had C1 fractures, 9 had C2 fractures, and 13 had C3 fractures. Initially, patients presenting with this fracture underwent closed manipulative reduction and immobilization with a long arm slab, followed by check radiographs.

Inclusion criteria comprised patients with displaced distal end radius fractures who failed closed reduction and required surgical intervention. Radiological criteria for instability included >15º dorsal angulation, >2 mm articular step-off or gap, or >5 mm radial shortening. Only patients who required surgical fixation and provided informed consent were included in the study.

Exclusion criteria included patients with comorbidities contraindicating surgery, skeletally immature individuals, patients with poor skin condition, injuries older than three weeks, and those unwilling to provide consent.

All fractures were managed using Modified Henry's approach. Anatomical reduction was achieved, followed by fixation with a volarly placed T-plate.[9] Postoperative radiographs were obtained to confirm adequacy of reduction. Follow-up assessments were conducted at 1 month, 4 months, and 8 months postoperatively. Radiological evaluation included serial X-rays assessing fracture union, volar angulation (palmar tilt), radial inclination, radiocarpal alignment, ulnar variance, articular step-off, and arthritic changes.[11-14] Clinical evaluation during follow-up visits included assessment of pain, residual deformity, palmar flexion, dorsiflexion, supination, pronation, and grip strength. At the final follow-up of 8 months, functional outcome was assessed using the Modified Clinical Scoring System of Green and O'Brien.[11]

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Data Analysis: The data were collected while the patients were admitted in the ward and also at the time of post-operative follow up in OPD at 1st, 4th & 8th postoperative month. The data entered in to Microsoft excel programmer and required analysis was done using descriptive statistical analysis (SPSS version 16). Conclusions were made based on this analysis.

RESULTS

When the final functional outcome was correlated with wrist range of motion, it was observed that all movements were significantly greater in the Mayo excellent group compared to the good-to-poor outcome group. The mean dorsiflexion in the excellent group was 63.8º, whereas it was 53.3º in the good-to-poor group. Similarly, the mean palmar flexion measured 70.6º in the excellent group compared to 61.1º in the other group. The mean ulnar deviation was 34.1º among patients with excellent results, while it was 27.8º in those with poorer outcomes.

PRE OP X- RAY

Figure 1: Pre-operative radiographs

POST OP X- RAY

Figure 2: Follow up radiographs at 8 months

Figure 3: Follow up clinical images at 8 months a) dorsiflexion b) palmar flexion

Functional and radiological outcome of unstable distal radius fractures treated with volar plating

Table 1: Comparison between wrist movements and outcome

	Out come	N	Mean	SD	T	P
Dorsiflexion	Excellent	16	63.8	5	4.307	<0.001
	Poor to Good	9	53.3	7.1		
Palmarflexion	Excellent	16	70.6	7.3	3.058	0.006
	Poor to Good	9	61.1	7.8		
Ulnar deviation	Excellent	16	34.1	3.8	3.779	0.001
	Poor to Good	9	27.8	4.4		
Radial Deviation	Excellent	16	15	2.6	4.699	<0.001
	Poor to Good	9	10	2.5		
Pronation	Excellent	16	78.1	4	2.652	0.014
	Poor to Good	9	70	11.2		
Supination	Excellent	16	75	5.8	2.445	0.023
	Poor to Good	9	67.8	9.1		

Table 2: Comparison between loss of grip strength and outcome

Outcome	N	LOSS OF GRIP STRENGTH (% compared to contralateral grip)		T	P
Excellent	16	Mean	SD		
Poor to Good	9	0.6	2.5	5.686	<0.001
		16.1	10.5		

Table 3: Comparison between fracture type and outcome

Fracture classification	Outcome				Total	
	Excellent		Poor to good			
	N	%	N	%	N	%
C1/C2	11	68.8	1	11.1	12	48.00%
C3	5	31.3	8	88.9	13	52.00%
Total	16	100	9	100	25	100

Table 4: Comparison between complications and outcome

Complications	Outcome				Total	
	Excellent		Poor to good			
	N	%	N	%	N	%
Nil	15	94	4	45	19	76
Infection	0	0	2	22	2	8
Impingement on tendons	1	6	0	0	1	4
Screw penetration to wrist joint	0	0	2	11	2	8
Pain over implant	0	0	1	22	1	4
Total	16	100	9	100	25	100

Radial deviation measured 15º in the excellent outcome group, whereas it was 10º in the poor-to-good group. The mean pronation in patients with excellent results was 78.1º compared to 70º in the poor-to-good group. Similarly, the mean supination was 75º in the excellent group and 67.8º in the poor-to-good group. A p value <0.05 indicated that the differences observed in all wrist movements were statistically significant [Table 1]. Grip strength was assessed using a hand-held dynamometer. Strength measurements were taken for both hands, and the percentage loss of grip strength on the affected side was calculated relative to the normal side. Among patients with excellent outcomes, the mean loss of grip strength was 0.6% with a standard deviation (SD) of 2.5. In contrast, patients in the poor-to-good group demonstrated a mean loss of 16.1% with an SD of 0.5. This difference was statistically significant ($p<0.05$) [Table 2]. When fracture type was compared with functional outcome, it was observed that among the total 12 cases of C1 and C2 fractures, 11 patients achieved an excellent score, while only 1 patient had a good score. However, among the 13 cases of C3 fractures, 8 patients had poor-to-good outcomes and only 5 patients achieved excellent results. Chi-square test analysis revealed a statistically significant difference between fracture type and functional outcome [Table 3]. Comparison of complications with functional outcome showed that 55% of patients in the poor-to-good outcome group experienced some form of complication, whereas only 6% of patients in the excellent outcome group had associated complications [Table 4].

DISCUSSION

The objective of this Retrospective study was to evaluate the functional and radiological outcomes of unstable distal end radius fractures managed surgically with volar T-plating. Patients who met the inclusion criteria underwent detailed clinical and radiological assessment prior to surgery. Following operative management, they were periodically reviewed using a structured questionnaire, clinical examination, and radiographic evaluation over a follow-up period of up to 8 months. Functional outcome was assessed using the Modified Green and O'Brien scoring system. In the present study, 80% of patients were below 40 years of age. Unstable distal radius fractures are commonly associated with high-velocity injuries such as road traffic accidents and falls from height, typically affecting young individuals and occurring three times more frequently in males than females. Most fractures included in this study were classified as AO type C3 (52%), followed by C2 (32%). C1 fractures were relatively uncommon, possibly because many of them achieved acceptable alignment with closed reduction and were therefore treated conservatively. Functional outcomes were better in C1 and C2 fractures when compared to C3 fractures.

At the 8-month follow-up, the majority of patients had painless wrist movements. A few reported mild discomfort, and only one patient experienced moderate pain that limited daily activities. The poor outcome in that case was attributed to a postoperative surgical site infection. Restoration of normal volar tilt plays a crucial role in regaining optimal grip strength. In this study, all patients achieved acceptable volar tilt except one, who had residual dorsal angulation. Final functional outcomes were assessed during outpatient follow-up visits using the Modified Green & O'Brien scoring system. Most patients (88%) achieved excellent to good scores, while three patients (12%) had fair to poor results. Comparable findings were reported by J. Arora et al. in 2005.[15] The overall functional recovery was encouraging, with most patients achieving a satisfactory range of pain-free wrist motion. The mean palmar flexion was 67º and dorsiflexion was 60º. The average radial deviation measured 13º, while ulnar deviation was 32º. Mean supination was 72º and pronation was 75º. Approximately 64% of patients regained normal grip strength. However, two patients demonstrated a 30% reduction in grip strength, which affected their daily functional activities.

Radiologically, all patients showed satisfactory bony union and maintained normal radiocarpal alignment at the final 8-month follow-up. Volar angulation, ulnar angulation, and radioulnar variance were within acceptable limits in all cases and did not appear to influence the final functional outcome. No signs of osteoarthritis were observed at the final follow-up, likely due to the relatively short duration of the study. The majority of patients (76%) did not experience any complications. A small number developed complications such as infection and intra-articular screw penetration. These complications adversely affected wrist mobility and were associated with fair or poor functional outcomes.

Other complications reported in the literature with volar buttress plating of distal radius fractures include loss of reduction, reflex sympathetic dystrophy, extensor pollicis longus tendon rupture, and deep

vein thrombosis, as described by Mehra et al. and Jupiter et al.[16,17] However, none of these complications were observed in the present study.

CONCLUSION

In conclusion, the present study demonstrates that open reduction and internal fixation of unstable distal end radius fractures using a volar Ellis T-plate is a reliable and effective treatment modality. These fractures were most commonly observed in young, active males, predominantly involving AO type C2 and C3 patterns, with road traffic accidents and high-energy trauma being the leading causes.

The surgical approach provided stable anatomical reduction, resulting in consistent fracture union and restoration of radiocarpal alignment. A high proportion of patients (88%) achieved excellent to good functional outcomes, and the majority were able to return to their routine activities with satisfactory recovery of grip strength and wrist function. By the end of the 8-month follow-up period, most patients regained a good, painless range of motion.

Overall, volar T-plating offers predictable functional and radiological outcomes with a low complication rate. The few complications encountered, such as infection and intra-articular screw penetration, were limited and manageable. Therefore, this technique can be recommended as a dependable option for the management of complex distal radius fractures.

Ethical Statement

Institutional ethical committee clearance was taken to conduct study. Patients were informed that data from the research would be submitted for publication and gave their consent.

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