



International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2018; 4(1): 732-736
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www.orthopaper.com
Received: 26-11-2017
Accepted: 27-12-2017

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Volar locking plate fixation (Ellis plate) of intra-articular distal radius fractures: Prospective randomized study

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DOI: <https://doi.org/10.22271/ortho.2018.v4.i1k.106>

Abstract

Background: Intra-articular fractures of the distal radius represent a therapeutic challenge as compared with the unstable extra-articular fractures. With the recent development of specifically designed volar plate for the distal radius, treatment of these fractures by fragment-specific implants using two or more incisions has been advocated.

Purpose: The purpose of this study was to investigate the efficacy of a fixed-angle locking plate applied through a single volar approach in maintaining the radiographic alignment of unstable intra-articular fractures as well as to report the clinical outcomes. We only excluded those with compound fracture of distal radius grade III and above.

Patients and Methods: This prospective randomized study comprised 60 patients with displaced intra-articular (Frykman type IV-VIII) distal end radius fractures treated with volar locking plates. The patients were followed up at 2nd week, 6th week, 12 week, 6 months and 1 year after surgery. The assessment of pain, range of motion, grip strength and activity were assessed at each follow-up visit and scored according to the Green and O'Brien scoring system.

Results: At the end of 1 years, In volar plate group out of 60 patients, excellent result was achieved in 08 patients (13%), good in 48 patients (80%), fair in 04 patients (7%). No poor outcome seen.

Conclusions: Irrespective of the direction and amount of initial displacement, a great majority of intra articular fractures of the distal radius can be managed with a fixed angle volar plate through a single volar approach.

Keywords: Distal radius fracture, volar plate, internal fixation, intra-articular fractures

Introduction

The fracture of distal radius is common injury in old patients with osteoporosis bone ^[1], but in present scenario the incidence of these injuries are also increasing in working adult ^[2]. The variety of treatment methods are available like cast, external fixator and ORIF with plating ^[3]. Many complication are seen in these fracture like Malunion and deformity of wrist even after best fixation option ^[4] therefore, out of all available treatment methods, these remains debate as to the find out optimal treatment for a given patient and fracture.

However, with the recent development of specifically designed locking implants for the distal radius, fragment-specific fixation has emerged as an option. Open reduction and internal fixation (ORIF) using volar fixed – angle plates has also shown to be a valid treatment option for unstable, dorsally displaced distal radial fractures ^[5].

The purpose of our study was to investigate the efficacy of a volar locking plate applied through a volar approach in maintaining the radiographic alignment of intra-articular fractures as well as to report the clinical outcomes.

Material and Methods

This study was done prospectively in the Department of Orthopaedics and Trauma Centre in J. A. Group of Hospitals, Gwalior (M. P.) from Aug 2015 to Aug 2017 for the period of 2 years. Total of 60 intra articular distal radius fractures, treated with volar plating.

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Fractures were classified using Frykman classification and Randomization was done to allocate the patient to one of the two treatment groups [6].

Functional outcome was assessed according to the Green and O'Brien scoring system. Pain, grip strength, wrist range of motion (ROM) and activity were noted at each visit. All the patients were followed up till the radiological union achieved [7].

The fractures were classified according to the Frankman Classification. Fracture displacement was volar in 35 fractures and dorsal in 25 fractures for radiographic evaluation, standard anteroposterior (AP) and lateral X-ray images were taken of both wrists.

The preoperative radiographic evaluation showed an average dorsal tilt of 24° (range, 35° volar tilt to 60° dorsal tilt), an average radial inclination of 9.5° (range, -10° to 35°), and an average radial shortening of 4.0 mm (range, 0 to 12 mm).

Follow-Up: Patients were regularly followed after 2, 6 and 12 weeks, and every 4 weeks thereafter until radiographic healing and function are established.

Results

This study was conducted in the Department of Orthopedics, Jaya Aarogya Hospital, Gwalior over a period of 24 months to assess functional outcome of volar locking plate intraarticular fractures of distal radius & is being presented here.

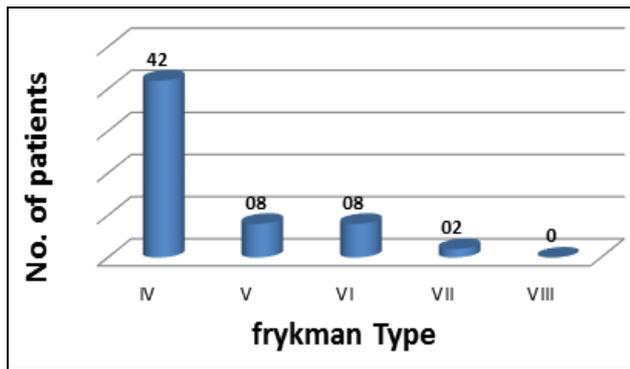


Fig 1: Frykman Type (Volar Plate Group)

In our study of 60 patients of distal radius fractures frykman type (IV-VIII), In volar plate group we had type IV-42(70%),type V-08(13.33%), type VI-08(13.33%), type-VII-02(3.33%). Frykman type IV most common fracture pattern in volar group 21(70%) involved.

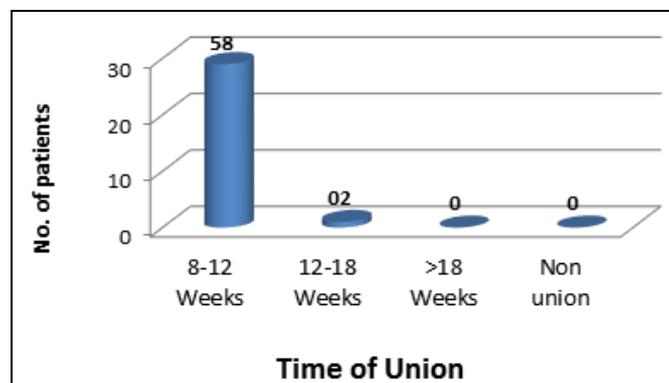


Fig 2: Duration of Union

In volar locking plate group 58(96.66%) had average union time is (8.2weeks) 8-12 weeks and only 2(3.33%) had union time 12-18 weeks.

Table 1: comparison of green and o'brien score by volar techniques at 6 months and 1 year follow-up

	Volar plate(n=60)		
	6 month	1 years	P value
Pain	18.91 ± 4.6	22.36 ± 2.86	0.000
ROM	18.36 ± 6.2	22.67 ± 5.4	0.000
Grip strength	17.91 ± 5.3	18.78 ± 4.31	0.326
Activity	22.36 ± 4.4	23.67 ± 3.2	0.065
Final score	77.54 ± 20.5	87.48 ± 15.77	0.004

Mean value obtained by Green and o'Brien score all measure viz. Pain, ROM, Grip strength, Activity, Final score of all 60 patients had shown gradual improvement from 6 month to final follow up at 1 years postoperatively.

Table 2: Clinical Outcome

	Volar plate(n=60)		
	6 month	1 year	P value
Flexion (°)	50°	56°	0.047
Extension(°)	55°	58°	0.071
Pronation (°)	85°	89°	0.229
Supination (°)	86°	89°	0.026
Radial deviation (°)	22°	24°	0.004
Ulnar deviation (°)	38°	38°	0.373

Clinical Outcome-The means and ranges show that p value(<0.05) more Significant in flexion and radial deviation of volar locking plate group.

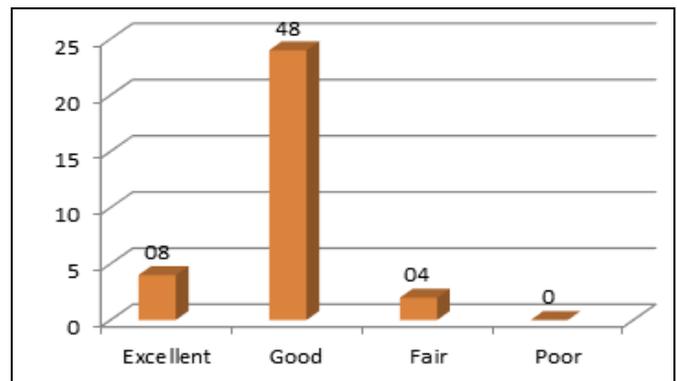


Fig 3: Result

We observed out of 60 patients of excellent result was achieved in 08 patients (13%), good in 48 patients (80%), fair in 04 patients (7%). No poor outcome seen.

Discussion

The advent of distal radius locking plates has provided several solutions to these problems. Direct visualization and manipulation of the fracture fragments appears to be the greatest advantage of ORIF [8].

The emerging trend is towards volar locked plates but there is little evidence in the form of trials and studies to support their purported advantages.

Our study shows that fixation with a locked volar plate is a viable option that produces good subjective and objective outcomes even in unstable DRF. Due to its excellent stability, the wrist need not be immobilized for prolonged periods (immobilization cause stiffness related morbidity and suggested as one of the etiological factors for reflex sympathetic dystrophy).

The perfect anatomical reduction that is possible with these plates prevents malunion and potential deformities. The plates available today have a very low profile with no disturbance to the surrounding anatomical structures even if they are indefinitely left in situ [8].

1. Age/Sex: Pattanashetty OB *et al.* [8] This clinical study done on 32 patients with displaced, comminuted, intra-articular fractures of distal end of radius of whom 15(46.9%) were female and 17(53.1%) were males. In our study of 60 patients with comminuted intra articular distal end radius fractures frykman type (iv-viii). There were 46 males (81%) and 14 females (19%) in volar locking plate

2. Age wise distribution: In a study in the Czech Republic, In fractures of the distal radius the average age is 59. By the 5th decade the representation of male is higher in all groups of fractures. In our study age of the patients ranged from 18-60 years with the fracture being most common in 4TH decade and mean age 31 years in volar locking plate group.

3. Side affected: Thomas W. Wright *et al.* [9] Right side (71.8%) was more than the left (28.1%). The right side was dominant for all the patients with right sided involvement. In our study, were 36 (60%) patients with right sided fractures and 24 (40%) patients with left sided fractures in volar plate group.

4. Mode of Injury: Pattanashetty OB *et al.* [8], In this study the most common mode of injury causing distal end radius fractures was road traffic accident (RTA) 40.6%, followed by fall on outstretched hand 25%. In our study most of the injuries were caused by road traffic accidents affecting mostly males. We had 40(67%) RTA injuries, 12 (20%) Falls from height, 06(10%) Fall on outstretched hand and assault 02(03%).

5. Fracture Pattern: Tamara D. Rozental [10], The study group consisted of 15 men and 26 women with a mean age of 53 years (17–80years). According to the AO classification scheme, there were 18 type A fractures (3A2, 15 A3), 4 type B fractures (all B2), and 19 type C fractures (14 C2, 5 C3). In our study of 60 patients of distal radius fractures frykman type(IV-VIII),we had type IV- 42(70%), type V-08(13%), type VI-08(14%), type-VII-02(3%). Out of all Frykmsn type IV most common fracture pattern involved.

6. Time of Union: Joideep Phadnis *et al.* [11] 133 patients (74%) had post-operative radiographs available for analysis. Overall mean time to fracture union was 8.4 weeks (6- 28 weeks) shows time to union by fracture type. Tamara D. Rozental *et al.* [10], In the ORIF group average time to union was 7 weeks (range, 6–10 wk). In our study, average time to union was 8.2 weeks (Avg 8-14weeks). Radiological union of the fracture i.e. characterized by cortex to cortex healing and bridging callus of the fracture in both AP and lateral views of follow up x-rays, was considered as satisfactory union.

7. Trauma surgery interval: Tamara D. Rozental [10], In this study, 49 consecutive patients treated with volar fixed-angle plating. All but 1 patient had definitive fixation within a week after the initial injury. In our study all patients operated with in 7 days.

8. Intra op time: Rajeev Shukla *et al.* [12] Mean surgery time was 56.5 ± 2.7 min in the volar plate fixation group. In our study Mean operative time for volar locking plate is with in 60 minutes.

9. Complications

CRPS (Complex regional pain syndrome): Tamara D. Rozental *et al.* [10] In volar locking group, 3 complications of CRPS in 21 patients. All 3 cases of CRPS improved with physiotherapy all of them resolved with physiotherapy. In our study 5(8.33%) developed CRPS, which is resolved with physiotherapy.

Extensor tendon & Flexor tendon injury: Luigi Tarallo *et al.* [13]. 303 patients were evaluated. We observed 5 cases of extensor tenosynovitis and 3 cases of EPL rupture, due to excessive screw length with dorsal cortical penetration. In our study, 2(3.33%) case of EPL rupture due to excessive screw length with dorsal cortical penetration.

Loss of reduction: Luigi Tarallo *et al.* [13], loss of reduction after plate fixation was observed in 3 cases, 2 cases of loss of screw purchase, occurring in older adults and probably due to the reduced bone mineral density and the use of conventional, instead of locking screws and 1 case of loss of the lunate facet reduction. In our study loss of reduction after plate fixation was observed in 2 cases (3.33%) however, patients were satisfied with their outcome, requiring no further surgery.

Outcome and Result

Rajeev Shukla *et al.* [12], 110 patients (61 females and 49 males) with Cooney's type IV distal radius fractures were recruited into the study. In the volar locking plate group, they found there was no change in pain, ROM and grip strength; however, there was a significant change in activity and final score at 1 year compared to 6 month follow-up.

Although there was no significant difference in pain, ROM, grip strength, activity and final outcome in patients at 6 months after surgery using this techniques, they observed low pain and high ROM in patients treated with volar locking plates.

In our study, total 60 patients volar locking plate groups with frykman type IV-VIII distal radius fractures were recruited into the study. Follow-up data after 6 months and after 1 year. After one year of surgery, we observed, excellent result was achieved in 08 patients (13%), good in 48 patients (80%), fair in 04 patients (7%). No poor outcome seen according to the Green and O'Brien score.

Final outcome in patients at 6 months after surgery and 1 yr after surgery, we observed low pain and high ROM high grip strength and final outcome in patients treated with volar locking plate.

Clinical picture volar plate
Case 1



Pre Op Xray

Intra Op

Post Op Xray

AT: 24 week



Dorsiflexion

Palmar Flexion

Supination

Pronation



Radial Deviation

Ulnar Deviation

Grip Strength

Conclusion

It is prospective study. There was no control group; hence, no conclusions can be made as to comparison with other types of treatment methods. The series included different cohorts ranging from simple articular to complex intra-articular fracture patterns, which were not analyzed separately. Nevertheless, this study demonstrates that with the execution of good surgical techniques, including proper plate position, proper insertion of screw and proper patient selection, a satisfactory functional and radiological outcome can be obtained for a great majority of patients with intra-articular distal radius fractures by using a volar approach and a single locking plate.

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