



DISTAL RADIUS FRACTURE - OUTCOME WITH VOLAR LOCKING COMPRESSION PLATE

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ABSTRACT

**Objective:** To evaluate the result of operative fixation of distal radius fracture using volar locked compression plate.

**Introduction:** Distal radius fracture are one of the most common and are one of the most disabling fracture when untreated & when mal-united, as wrist joint contributes a large share in the dexterity and optimum upper limb function. While treating these fracture (operatively/ non-operatively) achieving articular congruity, restoration of adequate range of motion & prevention of wrist arthritis is the prime thing. We studied the results of operative management in distal radius fractures.

**Patients and Method:** Our study consisted of 50 patients with distal radius fractures, between 20-50 years. Medically unfit patients, open fractures, pathological fractures were excluded from our study. Fractures were classified using AO/OTA classification system. After primary splinting, fractures were fixed using volar locking compression plate, at mean 4 days of trauma. Serial follow up were made after discharge to evaluate the patient clinically and the fracture radiologically. We used Gartland & Werley Scoring system for final evaluation of the patients.

**Results:** Our study had 84% of excellent, 14% good and 2% fair results. We had no cases with nonunion or malunion. We had no case with infection. All cases returned to their preoperative occupation except one which had to change his job; included in fair outcome.

**Conclusion:** From our study we conclude that, volar locking compression plate is a valid treatment option for the management of distal radius fracture.

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INTRODUCTION

Being one of the most common skeletal injuries treated by Orthopaedic surgeons, Fractures of the distal radius constitute 17% of all the fractures evaluated in emergency room (Hagino *et al.*, 1999; Solgaard, 1985; Court-Brown and Caesar, 2006). An insufficiency fracture in elderly patients associated with all of the risk factors for osteoporosis and has been linked to estrogen withdrawal and reduced bone mineral density in elderly females (Mensforth and Latimer, 1989 O'Neill *et al.*, 2001). A traumatic injury in younger males, where the injury is not as strongly related to gender, but related to high energy injuries (21% of all fractures) rather than to simple fall. As the consensus prevails, the vast majority of the distal radius fractures are intra-articular injuries resulting in disruption of both radio-carpal and radio-ulnar joints (Lindau *et al.*, 1997; Lindau *et al.*, 2000). The management of distal radius fractures has undergone an extraordinary evolution over the preceding two decades (Percutaneous, 2011; Saffar, 1995). Open Reduction and Internal Fixation is an alternative but definitively valid treatment option for displaced intra-articular

and extra-articular distal radius fractures, that cannot be taken care of with close manipulation, ligamentotaxis & casting or external fixation (Jupiter *et al.*, 1996; Fitoussi and Chow, 1997; Adani *et al.*, 2008; Arora *et al.*, 2007). One constant in the recent literature is that, the specific technique is not as important as attaining anatomical reduction. Both clinical outcome and biomechanical studies demonstrated that maintenance of radiographic parameters are of paramount importance in obtaining good results.(Table-1) (Robert *et al.*, 2012). The closed treatment options are associated with high incidence of prolonged immobilization, Joint stiffness & Deformity, Decreased Grip strength & Endurance, Malunions & Cosmetic problems (young patient particularly), Articular incongruity & Arthritis, Limited motion & Radio-carpal instability, Sudeck's osteodystrophy.

Reestablishment of intra-articular congruity & maintaining radial length is often not possible with closed methods of treatment (Cooney *et al.*, 1980; Jupiter *et al.*, 2002; Ark and Jupiter, 1993). The use of strong implant in the form of Volar Locking Compression Plate (LCP) theoretically achieves and maintains the reduction & stability in displaced intra-articular & extra-articular distal radius fractures in both the economically productive young age group as well as in the

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osteoporotic elderly population with less bone stock. Hence, we studied the results of management of distal radius fractures with the open reduction and internal fixation with volar locking compression plates, both clinically & radiologically.

### Aims and Objectives

To study the results of operative management of distal radius fractures in terms of functional and radiological outcome, with open reduction and internal fixation with volar locking compression plate

### MATERIALS AND METHODS

This prospective study consisted of 50 patients with complex, displaced and unstable distal radius fractures treated between July 2013 and August 2014 at the Department of Orthopaedics, and approved by Institutional Ethics committee for Human Research (IECHR) SSG Hospital, Vadodara, Gujarat, India. Patients < 18 years, medically unfit for surgery, with open fractures, with pathological fractures were excluded from our study. All fractures were classified using AO/OTA classification system (Table-2, Fig. 1). The study included patient between (20-50) years age group, mean age was 42.2years with 40(80%) male & 10(20%) female. Majority 37(74%) were due to RTA & 13(26%) were due to fall. Wrist involvement was 35(70%) dominant & 15(30%) non dominant. Associated injuries were in 13(26%) wrists. Age, occupation, functional demands & concomitant comorbid conditions were taken into consideration while selecting the patients. All fractures were reduced & splinted provisionally in emergency room to avoid pain, edema, further displacement & complications. Neurovascular status checked periodically.

The mean surgical lag time was 4 days (range 1-6 days). All fractures accessed with Volar Henry approach, under tourniquet, reduced and fixed with 3.5mm volar locked compression plate. Locked plates were preferred because of their biomechanical strength. Intra-operative fracture reduction, fixation, & stability confirmed using image intensifier by moving wrist joint through complete range of motion. Postoperatively a volar slab with elevation was given to give rest to the operated wrist. Active finger movements were encouraged postoperatively. Physiotherapy started at 2 weeks after suture removal to increase the wrist ROM, GRIP & PINCH. None of our patient required bone grafting or bone substitute. Six patients were having DRUJ instability, with two having ulnar styloid fracture. The DRUJ instability appreciated intraoperatively with surgeons clinical judgment. These were dealt with trans-radioulnar k-wire fixation where immobilization continued for 3 weeks to avoid forearm rotation.

Serial follow ups were made at 6 weeks, 3 months, 6 months, 9 months & 1 year. At each follow up patient were evaluated both clinically and radiologically, compared with contralateral unaffected wrist. Radiographic evaluation was done with true AP & true Lateral wrist views. The parameters compared were volar tilt, palmar angulation, radial length, ulnar variance & joint congruency. Goniometer was used to measure the wrist range of motion. Gripometer (Dynamometer) used to assess the grip strength. Fracture healing assessed clinically by degree

of tenderness at fracture site and radiologically by comparing postoperative images with that of at final follow up. Fracture healing is assessed by the extent of bony trabeculae across the fracture site (Figure 3, 4). The final evaluation of outcome was done at one year postoperatively using Gartland and Werlely scoring system (Garland and Werely 1951).

### RESULTS

The mean follow up period was 9 months (range 6-12 months). 40(80%) cases had union within 12 weeks; 10(20%) required 16 weeks for union; no non-union were reported. We had no case with deformity and no one had any infection.

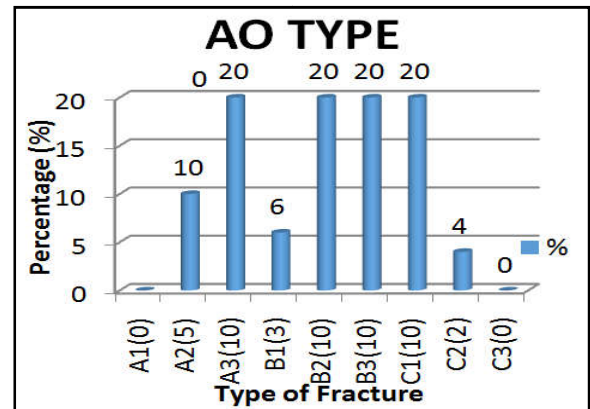


Figure 1. Fractures according to AO classification

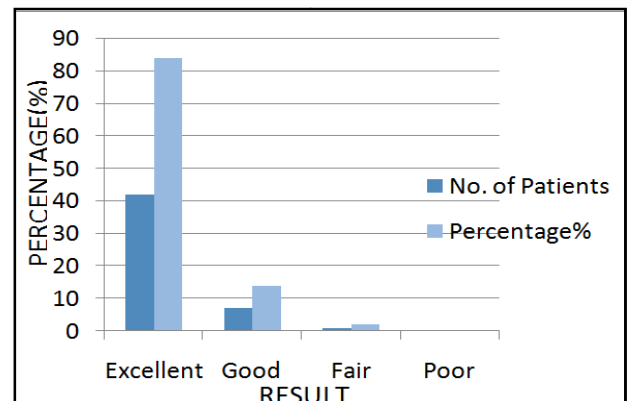


Figure 2. Results of our study



Preoperative



At 4 Week follow-up



At 7 Month follow-up

Figure 3. X-Ray(case-1)



Pre-Operative



At 6 Week Postoperative



(Screw from intermediate column was removed due to percutaneous impingement)

At 6 Month Postoperative

Figure 4. X-ray (Case-2)

Majority of the cases were having full range of wrist motion at the end of 4 weeks & good range of forearm rotation at 8 week postoperatively. The average wrist motion was; 57.2° of flexion (range,0-80°), 59.5° of extension (range 0-70°), 14.7° of radial deviation (range 0-20°), 23.2° of ulnar deviation (range 0-30°), 78° of supination (range 0-80°), 79.3° of pronation (range 0-90°) (Figure-5, 6). The mean grip strength was 85% at final follow up when compared with contra-lateral wrist (range 0-100%).



Dorsiflexion



Palmar Flexion



Supination



Pronation



Ulnar deviation



Radial deviation

Figure 5. Clinical photographs at final follow up (Case -1)



Figure 6. Clinical photographs at final follow-up (Case-2)

Clinically, 42 patients (84%) experienced no pain; 7(14%) had mild pain & 1(2%) had moderate degree pain at final follow up on a (0-10) pain scale according to Visual Analogue Pain Score (Visual Analog Scale and Verbal Pain Intensity Scale, 1996). All patients were able to go back to their pre-injury occupation except the one who had to change the occupation to a clerical job. Most of them were farmer who had no disability and had no difficulty in performing their daily work. Radiographically, at last follow up the mean values were as follows: volar tilt of 12.4(range 0-15), radial inclination of 20.4 (range 15-25), radial height of 10.4mm (range 9-15). Two cases were having radial shortening of +3mm.

Table 1. Radiological parameter

| Radiological parameter | Normal range     |
|------------------------|------------------|
| Palmar Tilt            | 11 to 14 degrees |
| Radius Height          | 10 to 13 mm      |
| Radius Inclination     | 20 to 25 degrees |
| Ulnar Variance         | +/-2mm           |

Table 2. Fractures according to AO classification

| Type of Fracture | No. of Cases | Percentage (%) |
|------------------|--------------|----------------|
| A1               | 0            | 0              |
| A2               | 5            | 10             |
| A3               | 10           | 20             |
| B1               | 3            | 6              |
| B2               | 10           | 20             |
| B3               | 10           | 20             |
| C1               | 10           | 20             |
| C2               | 2            | 4              |
| C3               | 0            | 0              |
| TOTAL            | 50           | 100            |

Table 3. Results of our study

| TYPE      | No. of Patients | Percentage% |
|-----------|-----------------|-------------|
| Excellent | 42              | 84          |
| Good      | 7               | 14          |
| Fair      | 1               | 2           |
| Poor      | 0               | 0           |
| TOTAL     | 50              | 100         |

This was related to the failure to place the plate at more distal location. In all the cases articular congruity was kept to < 2 mm. we had no cases of infection or implant failure. The ulnar styloid fracture in two cases had bony union at final follow up. The six cases with DRUJ instability disclosed no residual laxity or instability at eventual follow up. The final evaluation of outcome was done at one year postoperatively using Gartland and Werlely scoring system (Table 3, Fig. 2).

## DISCUSSION

Anatomic reduction, meticulous soft tissue handling, proper plate positioning, accurate screw trajectory and supervised post-operative rehabilitation in our study enabled mean recovery of ~ 82% in wrist range of motion & ~85% in grip strength; with no functional impairment at the final follow up when compared to the contra-lateral side. With the use of Gartland and Werlely evaluation scale (Gartland and Werlely, 1951), we had 84% excellent, 14% good and 2% fair results. Failure to achieve intra-articular congruency is an important cause of post traumatic arthritis, which may not always correlate with the outcome scoring systems. Volar locked compression plate are very useful in achieving anatomical reduction, particularly in displaced unstable intra-articular distal radius fractures. (Fitoussi and Chow, 1997; Adani *et al.*, 2008; Arora *et al.*, 2007) Use of this plate enables early joint mobilization with stable fixation construct owing to its close plat-forming near articular margin and availability of different screw directions; proving its biomechanical superiorities. As well, the use of volar approach poses minimal soft tissue trauma and good space for implant placement, avoiding the pitfalls of the dorsal approach like irritation of extensor tendon rupture and possibly late tendon ruptures (Schnur and Change, 2000). With volar approach the large volar fragment, small fragment near the lunate fossa, the radial styloid and the ulnar fragment of the distal radius should be fixed with buttressing of the plate itself and with the use of spatially oriented small threaded screws as and when necessary. Separate screws, k-wires or tension band should be utilized to fix the radial or ulnar styloid fractures and unstable DRUJ. The very absence of settling, secondary fracture fragment displacement and shortening in our case is related to the proper plate placement within 2mm of the articular margin and securing each fragment with accurate placement of fixation screws.

Though instability of the DRUJ is recognized as a poor prognostic factor in distal radius fracture, no significant difference noted in the eventual outcome between patients with or without ulnar styloid fracture, provided the distal radius fractures are anatomically reduced and fixed rigidly. TFCC injuries (Ruch, 2003) are also taken care of and kept well-vascularized to heal early when fractures are fixed accurately and rigidly with locked compression plate. The pitfall in our study include that it's a study with no comparison group and also the short duration of follow up and smaller study group can produce biases.

## Conclusion

The study shows that with proper patients selection, good surgical technique, proper plate positioning and accurate placement of screws; satisfactory clinical as well as



radiological outcome can be obtained in majority of the patients with the use of volar locking compression plate.

### Clinical massage

Though conservative (non-operative) method of treatment are available, operative fixation with volar locking compression plate is valid option for treating complex distal radius fracture.

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