

Original Research Article

Evaluation of volar locking plate fixation for management of intra-articular fractures of distal end of radius

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ABSTRACT

Background: With the increase in high velocity trauma, the incidence of intra-articular fractures of distal end of radius, particularly in adults- the working class of society is increasing. Normal functioning of wrist is of paramount importance for all activities of daily living and working. The present study was undertaken to evaluate the results of using volar locking plate for fixation of intra-articular fractures of distal end radius, with emphasis on return to pre-injury employment assessment.

Methods: It is a combined prospective and retrospective study from January 2013 to June 2016. Twenty patients of intra-articular fractures of distal end of radius (AO type B2 and B3) were treated with volar locking plate through volar approach. The patients were regularly followed up for one year. The assessment of pain, range of motion, activity and grip strength were scored by Green and O'Brien's system.

Results: According to scoring system of Green and O'Brien the patients were assessed at 1 year follow up. 17 patients (85%) showed excellent results (scores 90-100). 2 patients (10%) showed good result (scores 80-89) while 1 patient (5%) had fair outcome (score 65-79). No patient had poor result (score less than 65). 19 patients (95%) returned to their pre-injury employment at 1 year.

Conclusions: Open reduction and internal fixation with volar locking plate is reliable and excellent methods of management of intra-articular fracture of distal end of radius especially shear type of injury (AO type B2 and B3) in adults.

Keywords: Volar locking plate, Distal end radius fracture, Green and O'Brien scoring

INTRODUCTION

Classically described fracture Colles' i.e. fracture at the cortico-cancellous junction of lower end of radius, usually occurs in elderly people with osteoporotic bones.¹⁻³ Although it was described almost 180 years ago, the best modality of its treatment still remains controversial. With increase in incidence of high velocity accidents, the number of Colles' fracture geriatric patients is gradually shifting to adults with intra-articular lower end radius fractures.

The rapid expansion of knowledge about functional anatomy of hand and wrist, increasing functional demands of patients, need for early resumption of work to avoid loss of wages and improved perioperative technology has ignited renewed interest in this common injury. With the evolution of Orthopedics, the treatment of distal end radius fracture has evolved from cast immobilization to external fixator to locking plates to fragment specific fixation.⁴⁻⁷ Despite of this, the results of treatment of intra-articular and unstable fracture are still unsatisfactory. The therapeutic dilemma is further

compounded by the fact that, in intra-articular fractures, the reduction is easy to bring but difficult to maintain by closed methods. Hence, over a period of time, open reduction and internal fixation is increasingly becoming popular method for this demanding fracture. Now, the aim of the management is to obtain perfect anatomical reduction and to start early mobilization.

For open reduction and internal fixation, two approaches are described- volar and dorsal. The volar approach is frequently preferred as it is associated with less chances of extensor tendon rupture. By contrast, dorsal approach provides good exposure of articular surface, easier reduction and fixation of dorsal comminution. The purpose of this study was to analyze the efficacy of volar locked plating method in intra-articular fractures in adults.

METHODS

This study was performed between January 2013 and June 2016 at Department of Orthopedics of IIMSR Medical College, Badnapur, Jalna, Maharashtra, India. The inclusion criterion for patients were age more than 18 years, no other skeletal injury and patients with AO type B2 and B3 fractures who presented within 72 hours of injury. Patients with any other associated fracture, open radius fracture, bilateral distal radius fractures, delayed presentation (>72 hours) and associated head/chest/abdomen injuries were excluded from study.

All surgical procedures were performed by a single author (RSP) using standard protocol under suitable anesthesia. The volar approach was used to expose the fracture site. The skin incision was taken along the course of flexor carpi radialis (FCR) tendon. The FCR sheath was opened. Below the FCR, the flexor pollicis longus (FPL) was retracted ulnarly to expose the pronator quadrates (PQ) muscle (Figure 1). The PQ muscle is elevated from its radial attachment and reflected medially to expose the fracture site and distal part of radius. Fracture configuration studied carefully. All the fragments identified and reduced with great care taken to maintain articular congruity as well as radial inclination, length and tilt, using C-arm guidance. A volar distal locking plate was fixed in buttress mode. Incision closed in layers. No slab or cast was applied so as to allow free mobilization.

The patients were discharged on 3rd day after surgery. All patients were given proper antibiotic coverage for 3 days. Active finger and wrist movements were started immediately or as tolerated but not later than 2nd postop day. Radiographs of wrist joint were taken before discharge. The patients were called for suture removal on 14th postop day.

Acceptable criterion for fracture reduction were:

1) Radial inclination of >15⁰

- 2) Radial shortening of <5 mm
- 3) Sagittal tilt between 15⁰ dorsal and 20⁰ volar
- 4) Intra-articular step <2 mm

All the patients were followed up every month for initial 3 months and later every 3 months till 1 year. Patients were assessed by a single author (AA) at each visit for pain, grip strength, wrist ROM and activity and scored by Green and O'Brien scoring system (1978).

Data was entered in Microsoft Excel 2013 and analyzed using OpenEpi version 3.01. Percentages and proportions were used whenever appropriate.

RESULTS

Twenty patients with AO type B2 and B3 intra-articular fracture distal end radius were involved in this study. There were 15 males and 5 females and age of the patients ranged from 20 to 53 years (as mentioned in Table 1).

Table 1: Age and Gender wise distribution of cases.

Particulars	No. of Cases
Gender	
Male	15
Female	05
Age (in yrs)	
18 to 30	04
31 to 40	07
41 to 50	07
51 to 60	02

The injury occurred due to low energy trauma like domestic fall on out stretched hand in 6 patients while high velocity trauma like road traffic accident (12 patients) and fall from height (2 patients) was the cause in remaining 14 patients (as shown in Table 2).

Table 2: Distribution of patients as per mode of injury.

Mode of injury	No. of cases
Domestic fall	06
Fall from height	02
Road traffic accident	12

Preoperative assessment of enrolled patients was done by clinical and radiological examination. X-ray of wrist in both AP and lateral views were analyzed. The fracture fragments were carefully studied and classified by AO classification of fractures distal end radius. There were 2 cases of type B2.2, 2 cases of type B3.1, 12 cases of type B3.2 and 4 cases of type B3.3 (as seen in Table 3).

One year after the surgery 17 patients (85%) had excellent result (score 90-100), 2 patients showed good result (score 80-89) while 1 patient had fair result (score

65-79). No patient had poor result at one year as per Green and O'Brien scoring system. 19 patients out of 20 (95%) returned to their pre-injury employment/profession at one year (as seen in Table 4).

Table 3: Distribution of cases according to AO classification.

AO type	No. of cases	Percentage
B2.2	2	10
B3.1	2	10
B3.2	12	60
B3.3	4	20

Table 4: Results at one year according to Green and O'Brien scoring system.

Result (Green & O'Brien)	No. of cases	Percentage
Excellent	17	85
Good	02	10
Fair	01	05
Poor	00	00

Table 5: Complications.

Complications	No. of cases	Percentage
Scar Hypertrophy and scar pain	01	05
Median Neuropathy and carpal tunnel syndrome	00	00
Reflex sympathetic Dystrophy	00	00
Intra-articular screw	00	00
Tendon (EPL/FPL) rupture	00	00
Rotational stiffness	00	00
Early infection	00	00
Late infection	00	00

In our series we came across only one complication i.e. scar hypertrophy and scar pain in one patient. We encountered no other complication (as shown in Table 5).

DISCUSSION

Fractures at distal end of radius have varied configuration and pattern due to peculiar anatomy and effects of forces dissipated in different directions with age of the patient playing an important role in determination of pattern as well as functional outcome. To have a successful

outcome, same therapeutic approach and methods, implants cannot be used to treat the differing types of fractures of distal end radius. Most complications of distal radius fracture treatment are the consequences of required immobilization of wrist for 4 to 6 weeks with either plaster cast or external fixator.^{8,9} Volar plating with locking screw plate system, has the advantage of an easy surgical approach, no or relatively less period of immobilization of wrist and removal of plate is not mandatory.¹⁰ Dorsal plating is associated with a high complication rate mostly due to tendon-related delayed problems and almost always plate removal is required.



Figure 1: Exposure of pronator quadratus muscle.



Figure 2: Different plates used in the study.



Figure 3: Plate fixed in buttress mode.

In order to achieve reproducibly good results, some aspects of the surgical technique are very important. The

distal locking screws have to be placed as close to the articular surface as possible.¹¹



Figure 4: Preop radiograph showing unstable intra articular fracture.

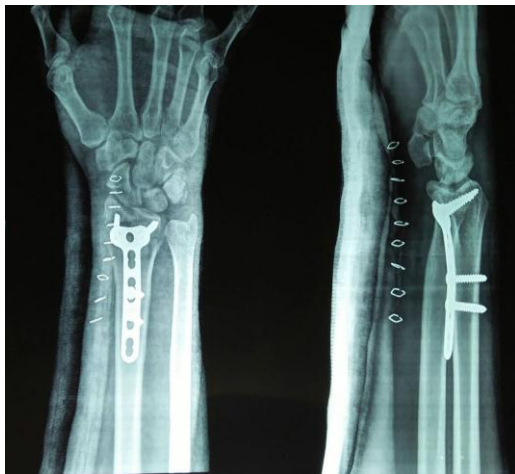


Figure 5: Immediate postop radiograph showing anatomical reduction of fracture.



Figure 6: Radiograph at 3 months follow up showing union.



Figure 7 (a – e): Clinical results showing full range of motion.

In the series of Drobetz and Kutscha- Lissberg the outcome was excellent in 33%, good in 15%, Fair in 17% and poor in 5% of their cases.¹¹ Their series reported a high complication rate related to tendon ruptures (FPL, EPL) which was not encountered in our series probably due to advancement in plate designs.

In the series of Wong and Chan results were excellent in 80% patients, good in 20% with no fair or poor results.¹² This was equivalent to our series.

The series of Vargaonkar evaluated the results of various treatment modalities of distal end radius fracture.¹³ In this series, in the subgroup of patients treated with ORIF and plating, 67% had excellent results, 33% with good results and no fair or poor outcome.

The series of Ho et al showed the incidence of median neuropathy after volar plating at 5.3% and that of carpal tunnel syndrome at 3.2%.¹⁴ In our study we did not encounter any case of postoperative median neuropathy. Median nerve neuropathy has been postulated to be the result of scarring in the forearm surgical wound or retractor injury during surgery. Different causes of carpal tunnel syndrome have been postulated such as local edema, fracture hematoma, closed reduction, and manipulation.

CONCLUSION

We conclude that intra-articular fracture of distal end radius can be effectively stabilized by a volar locking plate and screw system. The construct maintains the reduction till union and prevents collapse or re-displacement of fracture fragments. It allows early functional mobilization, thus overcoming the problems of long term immobilization with concurrent stiffness of wrist and hand. The clinical and radiographic results are easily reproducible. The advantage of our series is that

we have included very specific types of fracture of distal end radius but limitation is small number.

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