

A Prospective Study to Evaluate the Surgical Outcome of Distal End Radius Fractures Treated With Locking Compression Plate (LCP)

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Abstract

Background and Objective

Improvements in fixation of materials have provided excellent opportunities for the management of distal radius fractures. The present study was carried out to evaluate functional outcome of lower end radius fractures treated with surgical management with LCP followed by early mobilization of wrist joint.

Methods

This two year prospective study was done in the Department of Orthopaedics, Siddhartha medical college, Vijayawada from december 2017 to December 2019. A total of 20 patients who sustained fractures of lower end of radius were studied. Patients were treated with a volar locking compression plate using a volar Henry's approach.

Results

Most of the patients were males (65%) and male to female ratio was 1.85:1. The commonest age was between 18 to 30 years (35%) and mean age was 39.05 ± 12.08 years. Right sided fracture was noted in 75% of the patients and nature of trauma as fall on outstretched hand and type VIII Frykman classification was noted in 50%. Complications of arthritis were present in 20% of the patients each at second and third follow ups respectively. Maximum patients complained regarding pain and swelling during first follow up (60%). Clinical union was noted among 85% and radiological union in 65% of the patients at second follow up and in the remaining (35%), it was seen during third follow up. During third follow up, most of the patients had QUICK DASH scores of 25 or less (65%) with mean scores of 26.01 ± 12.47 . The final outcome was excellent in 65% of the patients and good outcome was noted in 25%. No statistically significant association was noted between outcome and mode of injury, side of fracture, type of fracture.

Conclusion and interpretation

Based on the findings of this study it may be concluded that, locking plate fixation for distal radius fractures provided favourable outcome in patients requiring operative intervention with early mobilization of wrist joint.

Key Words:

Distal radius fractures; QuickDASH; Volar locking plate fixation;

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I. Introduction

Fractures of the distal end radius are among the most common fractures of the upper extremity and account for approximately one-sixth (16%) of all fractures seen and treated in emergency rooms.¹

Several methods have been used historically to treat fractures of the distal radius. The first and by far the most frequently used method has been closed reduction and plaster cast immobilization.² This treatment has been applied for many years, but it has recently received a lot of criticism, especially for the more complex fractures.

The use of percutaneous pin fixation; external fixation devices that permit distraction and palmar translation; low-profile internal fixation plates and implants; arthroscopically assisted reduction; and bone-grafting techniques including bone-graft substitutes, all have contributed to improved fracture stability

and outcome.

Over the past twenty years, more sophisticated internal and external fixation techniques and devices for the treatment of displaced distal end of the radius fractures have been developed.³ Established treatment options comprise closed reduction and cast immobilisation, external fixation, and open reduction with internal plate fixation (ORIF). The first two options may be collective with percutaneous K- wire pinning.

In recent years angle stable volar locking plates have been actively used for surgical fixation of distal radial fractures, particularly in the osteoporotic bone. Though the clinical evidence in the favour of this principle is limited to case series of moderate to poor quality.⁴

The distal radius fractures especially, the high energy fractures are often associated with poor results and high complication rates. The method of immobilization that maintains the reduction with the least amount of surgical morbidity is the **ideal** treatment. Unstable distal end of the radius fractures shown an inherent tendency toward loss of reduction after non-operative treatment. External skeletal fixation has been popular for the treatment of displaced, unstable fractures of the distal part of the radius because it combines a minimally invasive procedure with reduction by ligamentotaxis.⁵

However, despite the frequency of distal radius fractures, the optimal treatment remains without consensus opinion. A doubling incidence of surgical treatment for distal radius fractures and a more than 13-fold increase in the incidence of open reduction and plate fixation were observed. Factors such as number of years in practice, practice type, and the particular type of training received contributed most heavily to whether the fracture received internal fixation.⁶

Preservation of the articular congruity is the principle and prerequisite for effective recovery. The superlative method of obtaining and maintaining precise restoration of articular anatomy ever remains a topic of considerable controversy.

Since the high frequency of distal end radius fractures and insufficiency of data about the optimal treatment, the present study was assumed to assess the functional outcome of fractures of lower end radius treated with surgical management with Locking Compression Plate followed by early mobilization of the wrist joint.

II. Methodology

The present study conducted at Government general hospital, Siddhartha medical college, Vijayawada during the period of December 2017 to November 2019.

Study design

The study design is the two-years prospective study.

Study period

The present study was conducted from December 2017 to November 2019.

Place

The present study was carried out in the Department of orthopaedics, government hospital, Siddhartha medical college, Vijayawada

Source of Data

Patients who sustained fractures of lower end radius presenting at Department of Orthopaedics

Sample Size

A total of 20 cases were enrolled in the study.

Sample size calculation

The sample size was calculated considering the average of the previous three years hospital statistics on patients presenting with the distal end radius fractures.

Selection Criteria Inclusion

- Patients with unstable, intra-articular fractures of the distal end of radius.
- Adults with more than 18 years of age
- Patients presenting with type VI, VII, VIII of Frykman's classification
- Patients medically fit for surgery.

Exclusion

- Patients present with more than three weeks duration of the injury.
- Patients with open fractures.

PROCEDURE

All cases are treated with a volar locking compression plate using a volar Henry's approach

Technique

The incision for volar fixation of the distal end radius is typically performed through the distal extent of Henry's approach. An incision is made between the flexor carpi radialis tendon and the radial artery. This interval is revealing at proximally flexor pollicis longus muscle and distally the pronator quadratus muscle. The radial artery is carefully retracted radial side, while the tendons of the flexor carpi radialis radially and flexor pollicis longus ulnar side.

The pronator quadratus is divided at its most radial aspect, leaving a small cuff of muscle for later reattachment. Any elevation of the muscle of the FPL should be performed at its most radial aspect, as it receives its innervation from the anterior interosseous nerve on its ulnar side. After the pronator quadratus has been divided and elevated, the fracture is readily visualized, and reduction technique can be done under direct vision.

After exposure and fracture site debrided, the reduction of fracture done and provisionally fixed under fluoroscopy with K-wires, reduction forceps or suture fixation. Reduction aids should be placed so as not to interfere with the plate placement.

Following fracture reduction suitable plate is selected.

In order to temporarily secure the plate to the proximal fragment, a standard cortical screw was applied to the most distal oval hole of the vertical limb of the plate. This allowed concomitant proximal and distal plate adjustment. After fixing the distal fragment with subchondral locking screws, the radial length was gained, when needed, by adjusting the plate distally.

The first screw can be either exchanged with another locking screw or left in situ.

The oval hole is a combination hole designed for placement of locking head screw at the distal end and placement of standard screw at the proximal end of the same hole. The distal screws placement is important. They must be inserted at the radial styloid, beneath the lunate facet, and near the sigmoid notch. The distal screws can be of either monocortical or bicortical engagement. During distal screw placement, more volar tilt can be achieved when the wrist is volar flexed as much as possible by an assistant. Moreover, radial length can be further improved by pushing the whole plating system distally while using the oval plate hole and screw as a glide.

The final position of the plate was confirmed using fluoroscopy.

Pronator quadratus muscle was used at the time of closure, to cover, the implants that were applied to the anterior surface of the radius.

Once stable fixation was achieved, and hemostasis secured, the wound was closed in layers and sterile compression dressing was applied. The tourniquet was removed, and capillary refilling was checked in the fingers.

The operated limb was supported with an anterior below elbow POP slab with the wrist in the neutral position.

Follow up

Follow-up of patients was done at six weeks, three months and six months.

Assessment

For all subjects, radiographs were performed at the end of six weeks, three months and six months follow-up. Patients were evaluated based on the following parameters at the time of discharge and all the three follow-ups;

- Range of motion Wrist - Flexion, extension, supination, pronation, ulnar deviation and radial deviation.
- Elbow - Flexion, extension, supination and pronation
- Complications – Arthritis, pain and swelling
 - Clinical union
 - Radiological union

Final outcome

The final outcome was evaluated by a QUICK DASH evaluation questionnaire

QUICK DASH evaluation questionnaire^{9,10}

The Quick DASH consists of 11 items to measure physical function and symptoms in people with any / multiple musculoskeletal disorders of the upper limb.

No	Items	Scoring
1	Opening of jar	1 2 3 4 5
2	Pain intensity	1 2 3 4 5
3	Tingling intensity	1 2 3 4 5
4	Sleep	1 2 3 4 5
5	Social activities	1 2 3 4 5
6	Washing ones back	1 2 3 4 5
7	Forceful recreation	1 2 3 4 5
8	Heavy chores	1 2 3 4 5
9	Carry a bag	1 2 3 4 5
10	Use knife	1 2 3 4 5
11	Limited in work	1 2 3 4 5

Table No. 1: QUICK DASH evaluation questionnaire

Each item has five response options

- 1 - no difficulty
- 2 - mild difficulty
- 3 - moderate difficulty
- 4 - severe difficulty
- 5 - unable to perform

From the item scores, a summative score is calculated. The final score ranges between 0 (no disability) and 100 (the greatest possible disability).

Only one missing item can be tolerated and if two or more items are missing, the score cannot be calculated. Based on the Quick DASH score the functional outcome among patients was graded as below.

Excellent outcome -Score between 0 to 25 Good outcome -Score between 25.1 to 50.0 Fair outcome - Score between 50.1 to 75.0 Poor outcome -Score between ≥ 75

Statistical analysis

Data obtained was coded and entered into Microsoft Excel spreadsheet (Annexure- III). The categorical data expressed as rate, ratio and percentage. The continuous data expressed as mean \pm S.D. Fisher's exact test was used to find the association between categorical data. A 'p' value of less than or equal to 0.05 was considered as statistically significant.

III. Results

Despite the high frequency of distal radius fractures, the optimal treatment remains without consensus opinion. A trend toward the increased distal end radius fracture open reduction and internal fixation has been identified, with biomechanical and clinical studies suggesting the treatment advantages of specific fixation methods over other methods.

The main objectives of distal radius fracture treatment are reestablishment of anatomic integrity and functioning. The knowledge and understanding about wrist anatomy and functioning gained through the recent studies and high expectations of patients have to lead to the expanded the borders of surgical treatment. Also, improvements in fixation of materials have provided excellent opportunities. However, to date, there is no consensus about the approach to distal radius fractures and the positioning of the plate. It prompted us to evaluate functional outcome of lower end radius fractures treated with surgical management with locking compression plate followed by early mobilisation of the wrist joint.

The present two-year prospective study was carried out in the Department of Orthopaedics, government general hospital, Siddartha medical college, Vijayawada. A total of 20 patients who sustained fractures of lower end of radius from December 2017 to November 2019 were studied.

In the present study, male preponderance noted that is, of the 20 cases studied, 65% of the patients were males and, 35% were females and, male to female ratio was found to be 1.85:1. These findings were comparable with a study by Kilic A et al⁷ who reported male preponderance with male to female ratio of 1.25:1. In contrast, Shin EK, et al.⁸ reported that, most distal radius fractures occur in females with a male-to-female ratio of 1 to 4. Another study by Lozano-Calderon SA, et al.¹¹ who retrospectively compared percutaneous fixation (10 females out of 17 patients) or a volar plate and screws (17 females out of 23 patients) reported female preponderance. Several other studies by Anakwe RE et al¹² Rohit A et al.¹³

Chung KC et al¹⁴ also reported female predominance. However, the male preponderance observed in the study was explained by the involvement in outdoor activities, riding vehicles, heavy manual labour work.

In this study 35% of the patients were aged between 18 to 30 years and The mean age was 39.05 ± 12.08 years. Shin EK. et al.⁸ found that, the age distribution for injuries to the distal end radius is typically bimodal with peaks in the 5 to 14 year age group and elderly patients older than 60 years. A study by Williksen JH, et al to determine whether volar locking plates are superior to external fixation with adjuvant pins in the treatment of unstable distal radius fractures on 111 unstable distal radius fractures reported the mean age of the patients as 54 years (range, 20-84 y). Another study by Lozano-Calderon SA, et al¹¹ which retrospectively compared percutaneous fixation or a volar plate and screws reported mean age of 55 years in percutaneous group and 51 years in ORIF volar plate group. However, the average age observed in the present study was comparable to the studies of Kilic A et al. Chung KC et al¹⁴ and Anakwe RE et al¹² who reported an average age of 45 years, 48.9 years and 48 years respectively,

In the present study majority that is, 75% of the patients had right-sided fracture and nature of trauma was fall from the outstretched hand. Nearly half of the study population that is, 50% of the patients presented with grade VIII Frykman followed by grade VII (40%) and VI (10%).

In this study majority that is, 85% of the patients had the clinical union at Second, follow up and, at the same interval 65% of the patients had radiological union. In the remaining, the clinical union noted during third, follow up that is the clinical union in 15% and radiological union in 35%.

The relatively large number of outcome measures available for evaluating wrist and hand function provides clinicians with a wide range of choice, thereby enabling them to use that outcome instrument which is the most appropriate and suitable. The choice of an outcome measure is determined by the clinical condition, one wishes to assess; the resources available and the psychometric properties are often additional determining factors. The functional outcome based on QUICK Dash score^{9,10} at the end of third follow up revealed nearly one two-third of the study population with the excellent outcome (65%) and good and fair outcomes noted among 25% and 10% respectively while none of the patients had poor outcome. No association found between mode of injury, side involved and type of fracture suggesting that the outcome was independent of aetiology, side involved, and type of fracture.

Phadnis J et al¹⁶ in 2011 to report the functional outcome of a large number of patients at a significant follow-up time after fixation of their distal radius with avolar locking plate reported 74% of the patients with Good or Excellent DASH score and MAYO score.

Statistical analysis presented that no specific variable including gender, age, fracture type, post-operative immobilisation or surgeon grade significantly affect the outcome. Complications occurred in 27 patients (15%) and in 11 patients were major (6%). This Study demonstrated good to excellent results in the majority of patients after distal radius fixation with volar locking plate, with complication rates comparable to other non-operative and surgical treatment methods and recommended this mode of fixation for distal radius fractures requiring operative intervention. Rozental et al¹¹ showed mostly excellent functional outcomes in 45 patients at 17 months mean follow up. Similar larger series^{17,18} have studied the outcome of volar plate fixation in cohorts of 150 (24 months follow up) and 114 (12 months) patients respectively, similarly our study these both presented with good to excellent functional outcome using the DASH score.

Rohit Arora et al¹⁸ used modified Green and Obrien score and reported 31 Excellent, 54 good, 23 fair and six poor results. Minegishi H et al¹⁹ in 2011 to evaluate the functional and radiological results of treating unstable distal radius fractures with the volar locking plates among 15

patients reported five patients with excellent outcome, 7 with Good outcome, and 3 with Fair outcome according to Cooney's Clinical Scoring Chart.

In this study, Complication of arthritis was present in 15% of the patients.

During the second and third follow-ups, 20% of the patients each had arthritis. Maximum (60%) patients had pain at first follow up which sub-sided during second(25%) and third follow up (10%). Similarly, swelling noted also present among maximum patients during first follow up which reduced and during the second and third follow up it was seen in only 20% and 5% of the patients, respectively.

Phadnis J et al¹⁶ in 2011 reported complications in 15% of the patients, and significant complications among 6% of the patients.

Minegishi H et al¹⁹ in 2011 reported rupture of the flexor pollicis longus tendon occurred in 1 patient.

Locked volar plates are now much used as a treatment method for unstable distal radius fractures. They present a biomechanical advantage and a lower risk of tendon complications than shown by dorsal plates. The results from using this type of plate have shown the varying incidence of complications. Grip strength and Loss of range of motion were also observed, but with few functional repercussions.

IV. Summary

Improvements in fixation of materials have provided excellent opportunities for the management of distal radius fractures. The present study was carried out to evaluate the functional outcome of lower end radius fractures treated with surgical management with LCP followed by early mobilisation of the wrist joint.

This two-year prospective study was done in the Department of Orthopaedics, government general hospital, Siddartha medical college, Vijayawada from January 2017 to December 2019. A total of 20 patients who sustained fractures of lower end of radius were studied.

Patients were treated with a volar locking compression plate using a volar Henry's approach.

Most of the patients were males (65%), and male to female ratio was 1.85:1. The frequent age was between 18 to 30 years (35%) and mean age was 39.05 ± 12.08 years. Right-sided fracture was noted in 75% of the patients and nature of trauma as fall on outstretched hand and type VIII Frykman classification was noted in 50%. Complications of arthritis were present in 15% of the patients at first follow up and 20% of the patients each at second and third follow-ups respectively.

Maximum patients complained regarding pain during first follow up (60%) while at second and third follow up, the same was noted in 25% and 10% respectively. The swelling was present in 60% of the patients at first follow up, which was present in 20% and 5% of the patients during the second and third follow up, respectively. Clinical union was noted among 85% of the patients, and radiological union was noted among 65% at second follow up and in the remaining (35%), it was seen during the third follow up. During the third follow up, most of the patients had QUICK

DASH scores of 25 or less (65%) with mean scores of 26.01 ± 12.47.

The final outcome was excellent in 65% and Good in 25% of the patients. No statistically significant association was noted between outcome and, mode of injury and side of fracture and type of the fracture.

Based on the findings of this study it may be concluded that, locking plate fixation for distal radius fractures provided the favourable outcome with early mobilization of wrist joint.

V. Conclusion

The present study demonstrates good to excellent results in the majority of patients based on QUICK Dash functional outcome evaluation after locking plate fixation of the lower end distal radius with the lower rate of complications. Hence locking plate fixation may be recommended for distal radius fractures requiring operative intervention with early mobilisation of wrist joint.

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