

A Prospective Study to Evaluate the Clinical and Radiological Outcomes of Plating in Patients with Intra-Articular Distal end Radius Fracture

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Abstract:

Background: Fractures of the distal radial end are one of the most common fractures of upper extremity. There is considerable debate regarding the best treatment approach for these fractures. Hence, this study was conducted to evaluate the functional and anatomical outcomes of volar plating for the treatment of distal radial fractures.

Methods: This was a prospective study conducted at the department of orthopaedic at a tertiary care hospital in Western India for a duration of two years. All the patients with distal radial fracture belonging to age group of 50 to 70 years were included in the study after obtaining informed consent. Detailed history of trauma and demographic details were recorded. X-rays were taken to confirm the diagnosis and classify the type of fracture and degree of displacement or comminution was checked. A thorough pre-operative evaluation was conducted and open reduction with internal fixation using volar plate was performed. Physiotherapy exercises were prescribed. The outcomes were assessed at 6 weeks, three-, six- and 12-months post operation using DASH questionnaire and Sarmiento criteria for functional and anatomical outcomes, respectively. Descriptive statistics was used to describe the results.

Results: A total of 50 patients were included in the study out of which 64% were male. The fracture was on right side in 70% patients. The main cause of fracture was fall on outstretched hand in 76% patients followed by road traffic accidents (RTA) in 24% patients. RTA was more common in males (91.6%) as compared to females. The most common type according to AO classification was C2 fracture (36%) followed by B3 (30%). In 86% of cases, fractures were healed within 3 months post surgery. 6 months follow up revealed that 72% patients had excellent results according to DASH score and 86% patients had excellent results based on sarmiento score. Poor result was not reported in any of the study participant.

Conclusion: Volar locking plate is an effective method of fixation in individuals aged 50-70 years with distal radial end fracture, along with adequate immobilisation and routine physiotherapy exercises.

Keywords: DASH, RTA

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Introduction

Radius bone is one of the two bones which forms the basis of the forearm support. It is vital for the structural stability, integrity and movement of the forearm and wrist joint. It facilitates forearm rotation, provides attachment site for muscles, protects neurovascular structures and transmits weight.^[1] This makes it an essential bone for proper hand and arm function.

Fracture is defined as a break or breach in the structural continuity of a bone which is accompanied by varying degrees of damage to the surrounding soft tissues.^[2] The fracture of the distal end of radius bone are very common type of fractures encountered in orthopaedic settings. There are different types of fractures of distal radius. The most common is Colles' fracture which occurs an inch proximal to the wrist joint with distal fragment tilting upwards causing 'dinner fork' deformity.^[3] The opposite is Smith's fracture in which the distal end tilts downwards after fracture.^[3] The other common type is Barton's fracture in which wrist joint surface either radiocarpal or radioulnar joint is also involved in addition to distal radius.^[3] The fracture is confirmed and assessed using X-rays, lateral and PA views. Usually, immobilization or closed reduction can suffice in limited displacement. But, in fractures with significant displacement or open fractures, open reduction and internal fixation is required.^[3]

The fractures of distal end of radius incapacitates the functions of wrist joint. Any malunion of this fracture can lead to residual deformity which can adversely affect the range of motion of wrist joint and lead to pain and decreased grip strength.^[4] Even though this is the most common type of fracture in upper extremity, there is still ambiguity regarding the treatment of choice for this fracture.^[5] As they are usually a result of high energy trauma, they usually result in intra-articular and comminuted

fractures. Hence, it is important to reach a consensus regarding the best treatment practice, immobilization and rehabilitation practices for fracture of distal radius. In the elderly individuals of 50 to 70 years age group, the bones progressively become weaker due to weakened bones, osteoporosis, repetitive stress or pathological conditions.^[6] Hence, this study was planned to evaluate the clinical and radiological outcomes of plating in patients with distal radial fracture using Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire and sarmiento criteria to respectively assess the functional and anatomical outcomes of this technique in individuals aged 50 to 70 years.

Materials and Methods

This was a prospective study carried out for a duration of two years at a tertiary care hospital in Bhuj, Gujarat. The study was commenced after obtaining permission from institutional ethics committee. To recruit the study participants, following inclusion and exclusion criteria were defined –

Inclusion criteria:

- Patients of age group 50 to 70 years of either gender having intra-articular distal end radius fracture.
- Patients willing to give written informed consent for the plating procedure.
- Patients medically fit for the procedure.
- Patients willing to attend regular follow-ups and aggressive supervised physiotherapy.

Exclusion criteria:

- Patients with bilateral distal end radial fractures.
- Patients with compound fractures.
- Patients outside of the inclusion age group or unwilling to give informed consent for the procedure.

Pre-operative evaluation: Following their admission to hospital, the patients were carefully examined and a detailed history was taken to reveal the mechanism of injury and severity of trauma. A careful inspection of deformity, swelling and ecchymoses was done. Clinically, any bony irregularity, tenderness, crepitus and the relative positions of radial and ulnar styloid processes were determined. Distal vascularity was assessed by radial artery, pulsations, capillary, filling pallor and paraesthesia over fingertips.

All the details were recorded in a preformed and pre-validated patient data sheet. The general condition of the patient and associated injuries was also noted. To confirm the diagnosis, standard radiographs in PA and lateral views were taken. The type of fracture was also confirmed. Oblique views were taken when the patient had complex comminuted fractures. Analysis of fracture fragments was done. Assessment of distal radioulnar and radiocarpal was done and classified based on the Müller AO classification.^[7] CT scan of the rest was also done for better understanding of comminuted fracture pattern.

The patient was prescribed analgesics and anti-inflammatory drugs for pain and inflammation. The involved form was immobilised in a POP slab and was kept elevated.

The routine pre-operative evaluation of blood and urine samples was conducted for all patients. BP and ECG were recorded. On the day of operation, tetanus toxoid and intravenous antibiotics were administered to all patients. After a pre-anaesthetic check-up, surgical consent was taken and operation was performed.

Surgical Procedure: All the operations were performed either under general anaesthesia or brachial block.

For the surgical procedure of volar radial plating, two approaches can be used. One is through flexor carpi radialis/radial artery

interval, and the other is through a midline flexor tendon/ulnar neurovascular bundle interval. The first approach is preferred for fixation of dorsally displaced fractures with dorsal comminution as well as fixation of partial articular fractures. The second approach is preferred when majority of comminution is at palmar lunate facet.

The fracture is fixed to the palmar plate once the columns are aligned. The plate is initially temporarily fixed to the shaft using either a unicortical screw or a screw in a sliding hole in the plate. After reducing the metaphyseal fragment to the plate, using a combination of traction and palmar flexion, remaining screws are placed.

The decision of approach and fixation depended upon the degree of comminution as well as the location and the degree of displacement of the intra articular component. Residual displacements of the palmar lunate cortex were addressed with palmar plate, and the residual displacement of the radial styloid was addressed using percutaneous wires.

Post-operative management and rehabilitation: PA and lateral view check X-rays were taken immediately post operation to confirm fracture reduction and evaluate displacements, if any.

To manage the post-operative pain and inflammation, analgesics and anti-inflammatory drugs were prescribed. Initially for 1-3 days, cefotaxime 1gm 12 hourly was given intravenously to all patients. This was followed by oral antibiotics like amoxicillin + clavulanic acid 625mg or cefixime 200mg 12 hourly for 10 postoperative days.

The operated limb was kept raised and supported with a below elbow splint. Inspection of wound was carried out on post-operative day 2 and dressings were changed on day 3. Suture removal was done on day 15. Also, at the same time, splints were discarded and replaced by an elastocrepe bandage for partially intraarticular fractures. For complete

intraarticular fractures, splints were replaced by elastocrepe bandage in 3rd post-operative week. Patients were advised to carry out routine activities within the elastocrepe bandage. Active movements of shoulder and elbow joints as well as supination and pronation of forearm were recommended throughout the healing duration along with physiotherapy exercises.

Follow-up: Post discharge, first follow-up was on on 15th postoperative day and second at 1 month. Pain and tenderness at the fracture site and signs of infection were assessed at both visits. The range of wrist movements was recorded, and any deformity was assessed. Collapse or consolidation and displacement at the fracture site was assessed at 6 weeks using X-rays. A united fracture was the one where there was no tenderness clinically and the fracture line was not visible, radiologically. Delayed union refers to the fractures which healed by 4-6 months, with no additional operative procedures. On the other hand, non-union refers to the fractures that did not unite even after 6 months or required an additional surgical procedure to promote healing. Malunion refers to the fractures that heal in a distorted or misaligned manner such as > 10° of dorsal tilt or > 15° volar tilt, > 5mm radial shortening and > 4mm of radial shift. Knirk and Jupiter system was used to evaluate the arthritic

changes.^[8] The patients were regularly followed up at 6 weeks, 3 months, 6 months and 12 month post suture removal. Disabilities of the Arm, Shoulder and Hand (DASH) score^[9] was used to assess the functional treatment outcome and Sarmiento score^[10] was used for anatomical treatment outcome at follow-ups.

Statistical analysis: The data was entered and analysed using Microsoft excel 2016. Descriptive statistics using mean, standard deviation and percentages was used to express results with tables and graphs.

Results

A total of 50 patients aged between 50-60 years were recruited for the study. The mean age of the patients was 58.5 ± 5.62 years. 68% of patients were aged between 51 to 60 years and 32% were between 61 to 70 years. Out of 50 patients, 64% were male and 36% female. The fracture was on right side in 70% (n = 35) patients, which was the dominant side. The main cause of fracture was fall on outstretched hand in 76% patients followed by road traffic accidents (RTA) in 24% patients. RTA was more common in males (91.6%) as compared to females.

Table 1 classifies the type of fracture according to Müller AO classification. The most common type was C2 fracture followed by B3 and C1.

AO TYPE	No. of Cases (%)
B1	0
B2	5 (10%)
B3	15 (30%)
C1	12 (24%)
C2	18 (36%)
C3	0

Among the participants, 58% had associated ulnar styloid injury. 76 % of the patients were treated with volar plating only for distal radial fracture. Only 24% required augmentation with radial styloid k-wire. Figure 1 illustrates the duration of fracture union post surgery. In 86% of cases, clinical and radiological signs of union were present at 3 months post surgery.

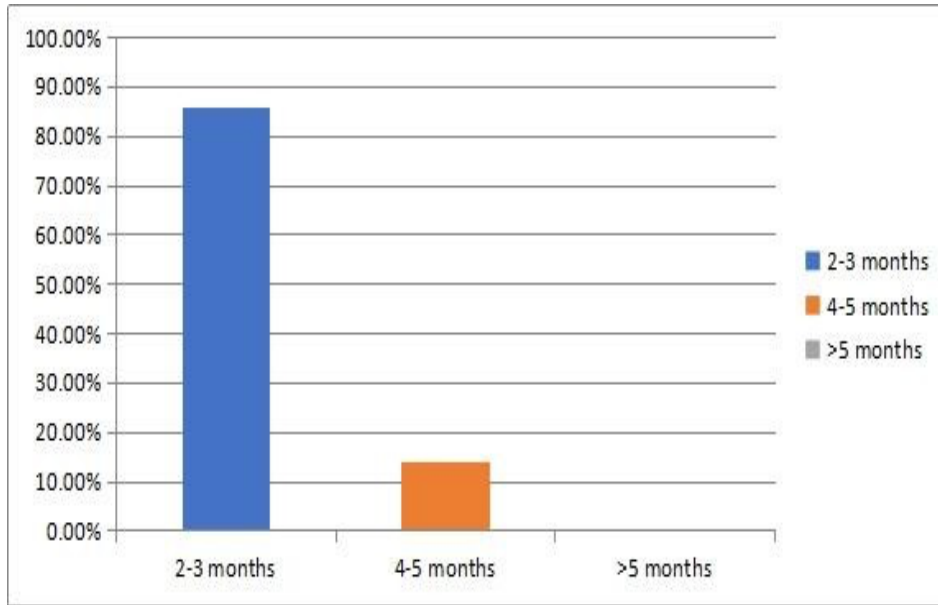


Figure 1: Duration of Fracture healing

Table 2 demonstrates the range of motion achieved with the volar locking plate post operation. Only 12% patients achieved submaximal movements, 88% patients achieved movements within normal functional range.

Movement (within normal functional range)	No. of Cases (%)
Dorsiflexion loss (<45 degrees)	0
Palmar Flexion loss (<30 degrees)	2 (4%)
Supination loss (< 50 degrees)	0
Pronation loss (< 50 degrees)	0
Ulnar Deviation loss (< 15 degrees)	0
Radial Deviation loss (< 15 degrees)	0
Distal radioulnar joint pain	2 (4%)
Grip Strength \leq 60% of opposite side	2 (4%)

Regarding the post operative complications, 8% of patients had joint stiffness, 4% patients had superficial infection and 4% had arthritis as shown in table 3.

Complications	No. of Cases (%)
Joint stiffness	4 (8%)
Arthritis	2 (4%)
Infection	2 (4%)

Evaluation of results 6 months post operation revealed that 72% of patients had excellent results according to DASH score and 86% of patients had excellent results based on sarmiento score. Poor result was not reported in any of the study participant. It has been illustrated in figure 2.

Discussion

The fractures of distal end of radius are quite common. As the life expectancy increases, there has been an increase in the prevalence of these fractures as they are predominant in children and elderly. Due to senile fragility of bones, or pathological diseases, the bones weaken which can lead to this fracture, the most common cause of which is falling on the outstretched hand.^[3] These are quite complex fractures in nature where treatment must be individualised based on the type of fracture and degree of comminution and displacement. Even though this fracture was first described 200 years ago by Colles, there is no general consensus regarding the best mode of treatment and immobilization with rehabilitation for this fracture, especially in elderly individuals belonging to 50-70 years of age group. Hence, this study was carried out to evaluate the functional and anatomical outcomes of volar plating in distal end radius fracture in patients aged 50-70 years.

There was male preponderance among the study participants which is similar to the findings observed in a few previous studies.^[11, 12] Right side was more commonly involved in the fracture which could be because it is the dominant side in majority of people and is subjected to trauma while falling. This was similar to the findings in other studies which also reported predominant involvement of right side in the fracture.^[13, 14] The ulnar styloid process was also injured in 58% participants in this study which could be due to the ligamentous attachment of distal radius and ulna leading to a simultaneous fracture of both bones. This was also described in other studies.^[12, 14]

The most common cause of distal radial fracture was identified to be fall on outstretched hand in this study followed by RTA. Fractures due to RTA were more common in males which could be possibly due to the fact that they are commonly

involved in rash driving as compared to females. These findings were similar to the study published by Pattanashetty et al. which reported 59.4% cases were due to fall on outstretched hands. As the study group is from 50-70 years of age, it is common for osteoporosis to start during this age, especially in females post menopause.

The post-operative complication rate following open reduction and internal fixation was low in the present study, with 8 patients suffering from any complication. This was similar to the findings reported by other studies which report a complication rate in the range of 6% to 19%.^[13, 15]

The fracture was united within 3 months of operation in majority of study participants. It can be inferred that volar plate fixation results in a rigid and stable fixation in this age group of patients even though their bone quality is poor due to various reasons. The range of movements within normal limits was achieved in 88% of patients. This suggests that even though the bones in this age group can be weakened due to arthritis or osteoporosis, volar fixation plate can achieve good results with early union and follow-up physiotherapy. DASH score was high for majority of the patients in the study. Similar results were obtained in a study by Fok et al. which reported DASH score of 8 and improvement in grip strength by 81% following volar fixation of distal radial fractures indicating good functional outcomes.^[15]

The main limitation of this study was that the sample size was small hence the results may not be generalizable to wider population group.

Conclusion

In conclusion, volar locking plate can be considered as an effective method of fixation in individuals aged 50-70 years with fracture of distal radial end, along with adequate immobilisation and routine physiotherapy exercises. It results in a timely union of the fracture and helps in regaining the normal range of movement of

wrist joint in the individuals. Further studies comparing the different types of plating approaches can be done to further evaluate the better treatment outcomes.

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