

Functional Outcome and Radiological Outcome of Comminuted Distal Radius Fractures Treated Surgically with Column Specific Fixation in a Tertiary Care Hospital

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Conflict of interest: Nil

Abstract:

Introduction: In clinical practice, a fracture of the distal radius is one of the most common types of fractures observed. Accidents involving motor vehicles or falls from great heights are the most common causes of comminuted intra-articular fractures in young patients. It is connected with severe osteoporosis in older age groups since even a minor fall might cause it. To study the functional outcome and radiological outcome of Comminuted Distal Radius fractures treated surgically with column specific fixation in a Tertiary care hospital

Material and methods: A prospective observational study was conducted to show the effectiveness of column specific fixation on the functional/radiological outcomes while managing comminuted intra-articular distal end radius fractures. This study was conducted in the Department of Orthopaedics, SV Medical College, and Tirupati between April 2021 to October 2022. 35 patients with comminuted intra-articular fractures of distal radius were analysed. Measurements recorded pre-operatively based on PA radiograph and lateral radiograph are Radial height, Radial length, ulnar variance and sagittal inclination. Patients included in the study underwent surgical procedures as per the standard guidelines. Pre and postoperative assessments were performed to evaluate their functional outcome. Finally, statistical analysis was performed to evaluate effectiveness of column specific fixation with LCP before and after surgery

Results: The study included 26 male and 09 female patients aged 18 to 75 years. Patients were followed up at three, six, twelve, and twenty-four weeks and evaluated based on the assessment scores. The mean Mayo wrist score at six months post-op was considerably greater than at six weeks. Mean early post-operative radial height, inclination, and volar tilt were considerably higher than six months post-op. Mean early post-operative ulnar variance was much smaller than six months post-op. Mean flexion, extension, supination, pronation, radial deviation, and ulnar deviation were considerably higher six months after surgery than six weeks after surgery. Mean grip strength was significantly higher six months after surgery than six weeks after surgery.

Conclusion: When one or both columns are involved, column-specific fixation is useful. Hardware impingement is limited due to low profile and anatomical design. Dorsal plating has fewer tendon irritation and attritional rupture issues with this approach. Making fragment-specific implants like buttress pin plates and hook plates available on the table when designing complicated fractures improves satisfactory radiological and functional outcomes.

Keywords: Distal Radial Fractures, Functional outcome, Radiological outcome, column specific fixation.

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Introduction

Emergency room distal radius fractures are common upper extremity fractures. These account for 3% of upper limb fractures. Intraarticular involvement is a complex pattern that accounts for 25% of injuries. [1]. Distal radius fractures usually occur after an impact on an outstretched hand, depending on speed, force, and direction. About 90% of wrist fractures are caused by dorsiflexion stress. The bimodal distribution shows higher

occurrence in old age due to osteoporosis and in young people due to high-velocity injuries and sports. Non-operative therapy works for undisplaced fractures. Surgical repair of misplaced or unstable fractures restores alignment, function, and prevents subsequent osteoarthritis. Fractures in younger people are difficult to treat due to bone loss, comminution, and soft tissue involvement. [2] In a study of articular fractures of distal radius,

severe forms (Frykman VII and VIII) of intraarticular fractures were more frequent (up to >52%). [3]

Open reduction and internal fixation is the most common unstable fracture treatment. Volar, dorsal, radial, and fragment-specific fixation is included. Our study is based on Daniel Rikli and Pietro Regazzoni's (1996) 4column in distal radius concept. Three columns were found.

The radius's styloid process and scaphoid facet form the radial column or lateral column. Lunate facet forms intermediate column, the radius's main load-bearing column. The medial column is the distal ulna, triangular fibrocartilage, and radio-ulnar ligaments. This column must be intact for appropriate forearm rotation. Rikli and Regazzoni showed that orthogonally arranged microplates were better for column-specific radius fixing biomechanically and clinically.

Aim: To study the functional outcome and radiological outcome of Comminuted Distal Radius fractures treated surgically with column specific fixation in a Tertiary care hospital.

Objectives:

1. To identify and approach to a radiological diagnosis
2. To classify the type of fracture of Distal Radius

3. To identify the fracture suitable for surgical management by column specific fixation and operating it accordingly.
4. To determine the functional outcome of Comminuted Distal Radius fractures surgically managed by Column specific fixation using Modified Mayo score. [5,6,7].

To determine the radiological outcome of Comminuted Distal Radius fractures surgically managed by Column specific fixation using Sarmiento et al's (1980) 7modification of Lidstrom's (1959). [8]

Material and Methods:

A prospective observational study was conducted to show the effectiveness of column specific fixation on the functional/radiological outcomes while managing comminuted intra-articular distal end radius fractures. This study was conducted in the Department of Orthopaedics between April 2021 to October 2022. 35 patients with comminuted intra-articular fractures of distal radius were analysed. Ethical clearance was obtained from institutional Scientific and Ethical committee (IESC/PGS/2019/95). Informed consent was obtained from all participants before surgical procedures. Measurements recorded pre-operatively based on PA radiograph and lateral radiograph are Radial height, Radial length, Ulnar variance and Sagittal inclination.

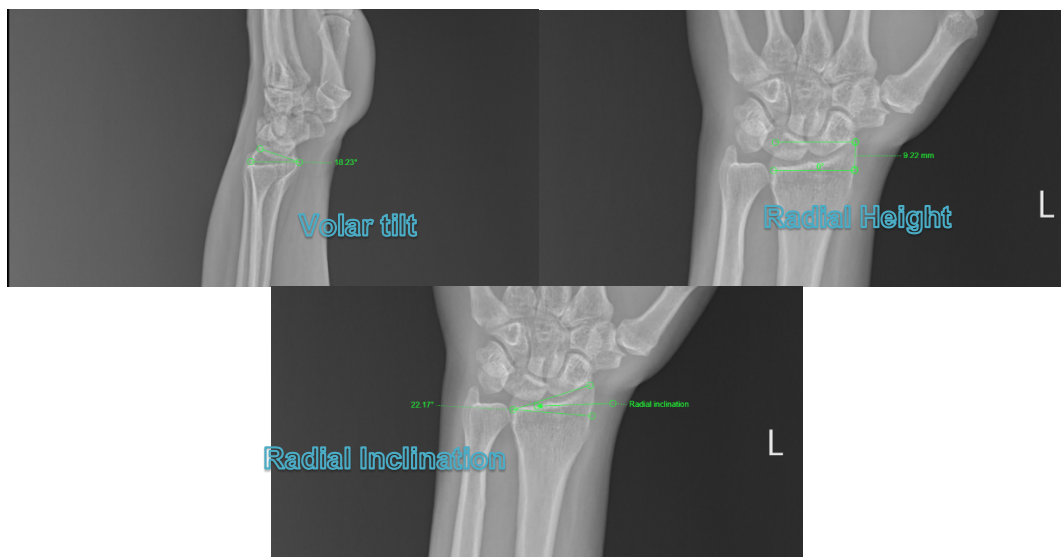


Figure 1:

Patients included in the study underwent surgical procedures as per the standard guidelines. Pre and postoperative assessments were performed to evaluate their functional outcome.

Finally, statistical analysis was performed to evaluate effectiveness of column specific fixation with LCP before and after surgery. Patient with comminuted distal radius fracture who underwent

fragment specific fixation with volar and dorsal approach between April 2021 to October 2022 were included in this prospective study.

In the end, 30 of 35 patients returned for follow-up at 1 year were finally included in the study. There were 26 men and 09 women with an average age of 43.6 years (range 21 to 70 years). Among these 18 (51%) dominant hands and 17 (49%) non-dominant

hands. 14 fractures are attributed to simple fall at home or workplace and 21 fractures are due to road traffic accidents.

Inclusion and exclusion criteria

Patients were included in the study if they were over 20 years of age; presented within two weeks of fracture, namely, displaced, comminuted, or closed fractures; and had intra-articular fractures (fracture with intraarticular step-off of 2 mm) decided by X-ray. Patients were excluded from the study if they were less than 20 years of age; had pathological, open, or undisplaced fractures; had pre-existing functional impairment of the ipsilateral upper limb; had neurological and psychiatric disorders that would preclude assessment; were considered unfit for surgery; and were unwilling to participate.

Fracture classification:

Fractures were classified according to AO classification. All are of C3 category. AO classification

Surgical procedure

All surgical procedures were carried out by a three experienced (minimum of five years of experience) faculty of the Department under a general or local anesthetic. As standard practice, we used IV cefoperazone and sulbactam as preoperative antibiotic. Pneumatic tourniquet was used for all patients and bipolar diathermy for haemostasis. An appropriate surgical approach was utilized based on the fracture configuration. Standard FCR approach for volar plating and Dorsal approach through 3rd extensor compartment for dorsal plating. Intraoperative fluoroscopy was used to assess adequacy of fracture reduction and hardware position. Five types of LCPs and straight recon plates were used in the study, including the Small T locking plate along with the right and left side variants of distal radius volar locking plate, oblique locking plate, extra-articular LCP (Head 5H), Distal radius styloid LCP. All implants are made of SS 316L by ORTHOFIX

Evaluation of surgical outcome

The surgery was performed within 05 days of admission. The average time interval between injury and surgery was 07 days. We used volar approach (33 cases) or dorsal approach (02 cases). We have used modified wrist score for functional assessment and Sarmiento et al's modification of Lidstrom's for radiological assessment. Standard preoperative and postoperative posteroanterior and lateral wrist radiographs were obtained for each patient. We recorded radiological parameters from electronic images with web PACS software (cyanomed IT solutions) like degree of volar angulation, radial inclination and radial length. Follow up radiographs were taken in the outpatient clinic at 6 weeks, 3 months, and 6 months.

Statistical Analysis:

Radiological and functional outcomes of column specific fixation of comminuted intraarticular distal radius fracture were derived from statistical analysis. Microsoft excel used for data entry and analysis was performed using EPI-Info 7. Appropriate parametric/non-parametric tests were performed to know statistical differences in functional outcome by comparing results in immediate post-operative period and at 3 weeks, 6 weeks, 12 weeks and 24 weeks post-operatively.

Results

This one and half year of Prospective Functional and Radiological Outcome of surgical study was conducted in the Department of Orthopaedics, at S.V. Medical College, Tirupatiduring the period of April 2021 to October 2022. 35 patients with comminuted intra-articular fractures of distal radius were analysed.

Open reduction and internal fixation procedures was performed on 35 patients with type C3(AO) distal radius fracture. The study included 26 male and 09 female patients aged 18 to 75 years.(Fig.1) Mean surgery time was 71.4min.

Patients were followed up at three, six, twelve, and twenty-four weeks and evaluated based on the assessment scores.

Gender Distribution of Comminuted Intra-articular distal radius fractures

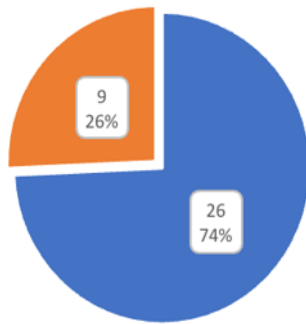


Figure 2:

Radiological outcomes:

The radiological outcome was assessed based on volar tilt and radial inclination (Figure 2). The volar tilt and radial inclination following postoperative assessment were 9.3 ± 2.6 degrees (minimum: 2 degrees, maximum: 12 degrees) and 20.7 ± 2.1 degrees (minimum: 18 degrees, maximum: 26 degrees), respectively. Moreover, no change was observed in volar tilt (8.4 ± 2.4 degrees) and radial inclination (19.9 ± 2.4 degrees) between assessments after three weeks and three months following surgery. The change in volar tilt and radial inclination postoperatively and after three months. The average shift in volar tilt was $2-3^0$ degrees. No change in volar tilt was larger than 3 degrees in any patient. Similar to volar tilt, the average shift in radial inclination was 0.5-1.0 degrees. Moreover, even after three months, all

Radiological Outcome assessment using the parameters

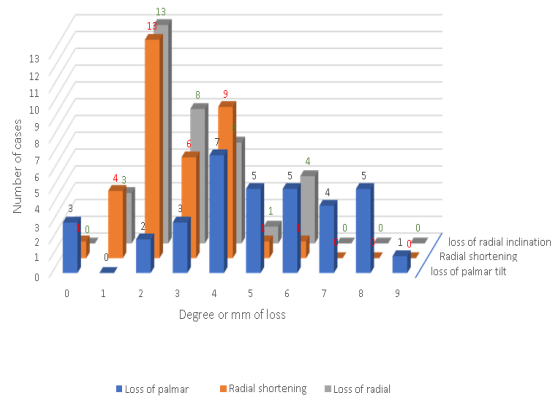


Figure 3:

patients had no change in tilt/inclination of greater than 3 degrees. This was observed to be a satisfactory result. Moreover, on immediate postoperative radiological assessment (X-rays), there was no indication of articular steps (intra-articular step-off). This was the same during follow-up at three weeks and three months, and no significant change in radio-ulnar variance was observed.

Functional outcomes:

Pain, ROM, and functional status at various time intervals were obtained to quantify the modified Mayo score. Assessments at six, twelve, and twenty-four weeks are shown in Figure 3.

Assessments of grip strength and final Mayo score at six, twelve, and twenty-four weeks were documented.

Mayo Wrist Score

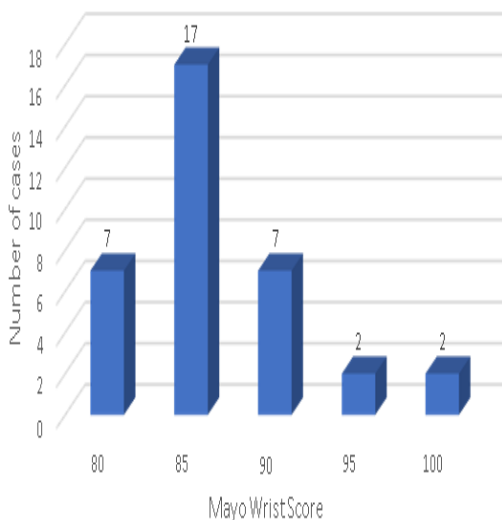


Figure 4:

Complications

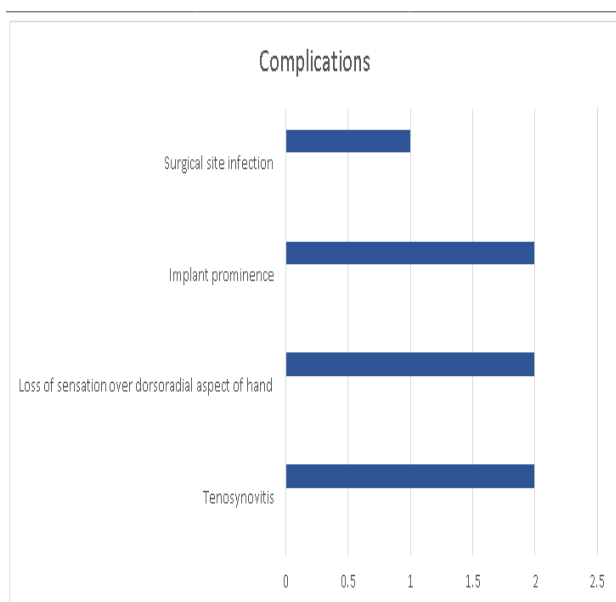


Figure 5:

Case of comminuted intra articular distal radius fracture



Figure 6:

Case of comminuted intra articular distal radius fracture

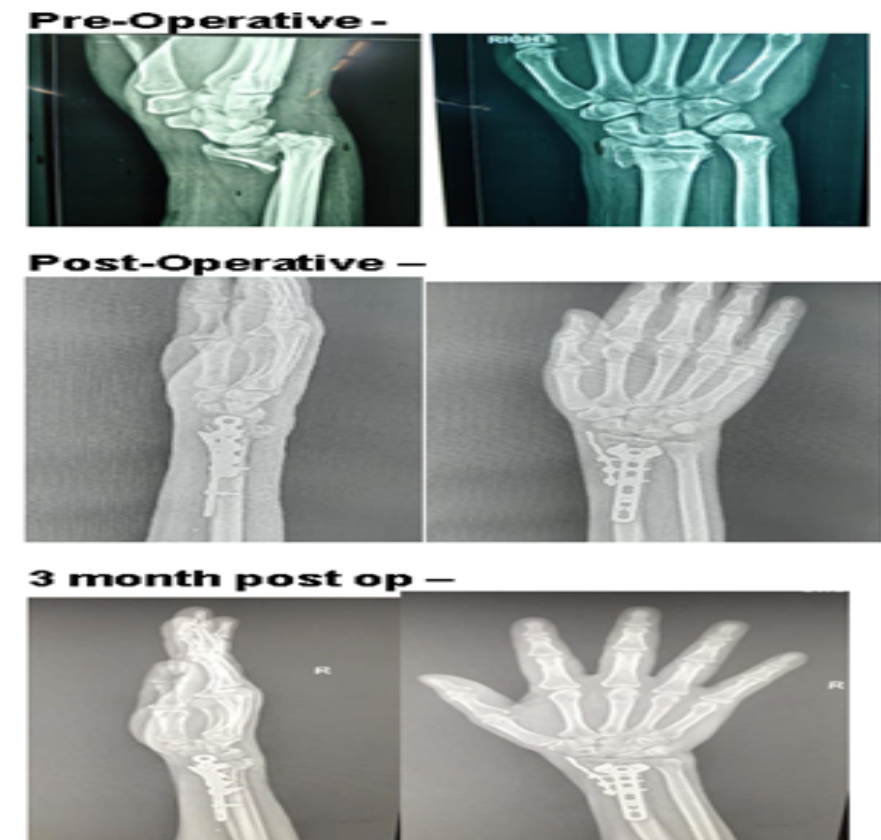


Figure 7:

After 3 months, the average modified Mayo score was 26.5. With 10 patients having no pain, 20 patients had occasional pain at the end of 6 weeks. 20 patients had wrist and forearm movement similar to their opposite side, with an average ROM of 22.5. Moreover, 19 patients returned to their pre-injury employment status with little discomfort. The group average for employment status was 23.1. Ten patients had grip strength greater than 90% when compared to the opposite side with an average modified Mayo score of 23.2% for grip strength. The score improved after 12 weeks, with 23 patients experiencing no pain; the average Mayo score of the group was 86.4%. The average Mayo score for ROM was 23.4 in 24 patients who exhibited wrist and forearm movement similar to the opposite side. seven patients had difficulty returning to their pre-injury work status, with an average Mayo score of 19.4.

Discussion:

Column specific fixation of distal radius fracture is a novel concept which offers several advantages over conventional dorsal or volar plating system. Major advantages are low profile nature of plates, column specific exposure and improved fixation and less hardware impingement problems (Rozenal and Blazar, 2006). Dodds et al. (2002) have proved the biomechanical advantage of column-specific systems. [9]

Since introduction of column concept of distal radius by Rikli and Regazzoni and low-profile plate for fixation by Medoff and Koplov [10] has revolutionized the management of comminuted intraarticular distal radius fracture. The same concept and implant profile was applied to achieve best possible outcomes. We have used column specific plates dorsally and volarly and lateral column specific plated for styloid predominant fractures through two different approaches. CT scan was done preoperatively to delineate the fracture configuration more accurately and to know the presence of displaced volar lunate fragment and fracture impaction.

Many intraarticular fractures can be treated with volar plating. Indications for dorsal or combined approach would be displaced intermediate column, dorsal comminution, and presence of impacted articular fragments. Bone grafting is required to fill the void after elevation of impacted fragments and reduction of the comminuted fragments in osteoporotic fractures to prevent collapse. We had two cases of tendinitis due to longer screw from volar plate and asymptomatic hardware prominence dorsally in another patient. The distal screws should be unicortical and proximal row screws to be perfectly gauged to avoid dorsal irritation. [11] Flexor tendinitis does occur with volar plating if plate is applied improperly or due to dorsal settling

of fracture in osteoporotic fractures. Plate contouring may be required to prevent such complications. Jupiter et al (2009) [12] reported similar results with minimal tendon-related complications using similar type of plate.

Our study showed that fracture configuration has a significant impact on the quality of articular reduction obtained. Restoration of the anatomical parameters of the distal radius and DRUJ congruity to be obtained within normal range the incidence of secondary degenerative changes also higher in patients with improper reduction of joint surface. The patient reported functional scores failed to show any statistical difference with respect to articular mal-reduction or presence of arthritic changes. Longer follow-up is necessary for more data on the functional alterations due to mal-reduction and arthritic changes.

Limitations of our study are small sample size, short follow-up and lack of controls. The benefits of good articular reduction and long-term effects of malreduction on wrist function can be better studied only in long-term randomized control trials. The strengths of our study include homogenous fracture subtypes, recruiting consecutive patients and good follow-up rates.

Conclusion

The concept of column specific fixation is very useful when one or both columns are involved. Because of low profile and anatomical design, complications from hardware impingement are minimal. With this system dorsal plating also has fewer complications like tendon irritation or attritional rupture. Fragment specific implants like buttress pin plates and hook plates if made available on the table when planning for more complex fractures improves the outcome.

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