Journal of Rare Cardiovascular Diseases
ISSN: 2299-3711 (Print) | e-ISSN: 2300-5505 (Online)
www.jrcd.eu
RESEARCH ARTICLE

EVALUATION OF UNSTABLE DISTAL RADIUS FRACTURES TREATED WITH DORSAL LOCKING COMPRESSION PLATES

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Article History
Received: 16.09.2025
Revised: 30.09.2025
Accepted: 07.10.2025
Published: 28.10.2025

Abstract: ***Background***: ***Introduction***:Distal radius fractures are a common orthopaedic injury with a bimodal age distribution. Fractures exhibiting dorsal instability are often unsuitable for conventional volar plating. Newer-generation thin-profile precontoured dorsal locking compression plates offer improved stability, reduced complications, and potentially faster healing. This study evaluates the effectiveness and safety of this treatment method. ***Materials and Methods***: A prospective study was conducted at Aarupadai Veedu Medical College and Hospital, Puducherry (2022–2024). Thirty patients with unstable dorsally displaced distal radius fractures were treated using newer-generation dorsal plates following preoperative assessment. Postoperative care included serial follow-up radiographs and functional evaluation using Mayo's Wrist Score. Fractures were classified using Frykman's classification. ***Results:***The study included 30 patients with a mean age of 39.87 ± 12.42 years; road traffic accidents were the most common cause of injury. Frykman Type II and Type III fractures were the most prevalent (30% each). Functional outcomes showed 53.3% "Good" and 26.7% "Excellent" results. A statistically significant correlation was observed between Frykman classification and functional outcome (p = 0.00035). ***Conclusion:***Dorsal locking compression plates provide effective mechanical stability and anatomical restoration in unstable dorsally displaced distal radius fractures. This technique facilitates early mobilization and successful return to pre-injury activity levels.

Keywords: Distal radius fracture, dorsal plating, locking compression plate, Frykman classification, unstable fractures, functional outcome, Mayo Wrist Score

INTRODUCTION

Distal radius fractures are a prevalent orthopaedic condition with bimodal peak distribution[1]. These fractures often result from blunt trauma or fall with the outstretched hand, affecting the stability and function of the wrist joint. Effective management strategies are crucial to restore function and prevent long-term complications[2]

Certain fracture characteristics like dorsal tilt >20 degree, dorsal comminution, dorsal intraarticular extension of fracture, dorsal Barton, dorsal die punch fractures, dorsal instability at the distal radioulnar joint, gross shortening of radius are specific indications for dorsal plating[3]. The conventional volar platting cannot be used for stabilizing comminuted dorsal rim and wall is these type of fractures[4]

Dorsal plate fixation enables direct visibility of the articular surface to confirm anatomical reduction, evaluation of the intercarpal ligaments, and commencement of early range of motion[5].The precontoured newer generation thin profile anatomical dorsal plates are with locking screws provides more stable and rigid fixation, minimizes complications, promotes faster fracture healing and decreases the drawbacks associated with long-term immobilization[6].

The dorsal plating is not ideally performed for unstable dorsally displaced distal radius fracture by many surgeons. This study establishes the effectiveness and safety associated with this treatment approach[7]

MATERIAL AND METHODS

This is a prospective study to analyze the functional and radiological outcome of using Dorsal Locking Compression Plates (DLCP) for dorsally displaced unstable distal radius fractures. This study was conducted in Aarupadai Veedu Medical College and Hospital, Puducherry from July 2022 to July 2024. This study includes 30 patients who sustained dorsally displaced unstable distal radius fractures.

In this study, the average age of participants is approximately 39.87±12.42 years, indicating a middle-aged cohort with moderate age variability. The gender distribution is notably skewed towards males, they constitute 73.3% (22 participants), compared to females who make up 26.7% (8 participants). In terms of injury characteristics, both the right and left sides are equally affected, with each side being reported in 50% of the cases. The most common cause of injury among the participants is road traffic accidents, accounting for 60% (18 participants), while self-falls are responsible for the remaining 40% (12 participants).

In this study, the distal radius fractures are classfied based on Frykmann's classification where Type I fractures are seen in 6 cases, representing 20% of the total, suggesting a moderate prevalence of relatively less complex fractures. Type II and III fractures, each comprising 30% of the cases with 9 instances respectively, indicating a significant occurrence of more complex fractures involving additional anatomical features which may complicate treatment and recovery. Type V fractures are less common, with 4 cases (13.3%), and Type VII, the least common, appears in only 2 cases (6.7%), potentially reflecting the most severe fracture types involving substantial anatomical disruption.

SURGICAL PROCEDURE

Following pre operative review, all procedures were performed under regional anaesthesia or general anaesthesia at anaesthetist's discretion.

SURGICAL APPROACH

Patient placed in supine position on radiolucent table with shoulder abducted to 90 degrees, elbow extended and forearm pronated. Pneumatic tourniquet in applied. Fracture reduced with AGEE's maneuver: longitudinal traction to restore length, palmar translation of carpus relative to the forearm - this restores palmar tilt and demonstrates volar instability, when present and slight pronation of the hand relative to the forearm, combined with ulnar deviation. This corrects the supination deformity of a great majority. After reduction maneuver, fluoroscopic fracture assessment (AP, Lateral and Oblique) is done. The fracture involvement of three columns of wrist is determined. (i) Medial - Ulnar head, (ii) Intermediate - Sigmoid notch, Volar and Dorsal ulnar lunate fossa, and lunate fossa die-punch, (iii) Lateral - Volar and Dorsal Scaphoid fossa and radial styloid, Metaphyseal comminution is assessed{[18]}. In severely comminuted fractures where reduction is not achieved manually, a pennnig fixator can be used to achieve ligamentotaxis. Supplemental K wires used as joysticks wherever necessary to achieve reductio

Longitudinal incision centered over the wrist, midway between the radial styloid and ulnar styloid in line with the third metacarpal (at level of lister's tubercle). Blunt dissection is made down the extensor retinaculum of extensor tendons and raise skin flaps that include all structures superficial to it. Care is taken to elevate crossing branches of superficial radial and dorsal ulnar nerves. Incise the distal forearm fascia just distal to the muscle bellies of Extensor Pollicis Brevis/Abductor Pollicis Longus and radial to Extensor carpi Radialis longus/Extensor carpi radialis Brevis tendons. The radial most structure in the depths of this wound is the muscle belly of Extensor Pollicis longus (EPL). The EPL is followed distally, and the extensor retinaculum divided over the third compartment. Mobilize the EPL and retract it radially. The EPL is left out its sheath during closure. The interval between the residual second and fourth extensor compartments is developed. The fourth compartment is retracted ulnarly and the second compartment radially. Ulnar dissection is stopped when fifth compartment is encountered. Care is taken to leave soft tissues attached to the dorsal ulnar fragment. Dorsoulnar column, intermediate and radial column are fixed in the respective manner with appropriate extraperiosteal precontoured thin profile anatomical dorsal plates and appropriate screws. Multiple column specific plates can be used at same time to fix different columns. Closure of extensor retinaculum, subcutaneous tissue and skin are done in a sequential manner. Dressing with a sterile gauze with immobilization dorsal splint done.

POST OPERATIVE PROTOCOL

Postoperatively, the affected limb of the patient in elevated in an IV stand. For the first six hours, a regular chart of the temperature, pulse rate and blood pressure is maitained. One dose of peri operative and two doses of post operative antibiotics were given. The wound was inspected regularly till suture removal. Immediate postoperatively, it was instructed to all patients for finger range of movement exercise to decrease swelling and other complications. The sutures were removed at 10-14 days.

RESULTS AND OBSERVATIONS:

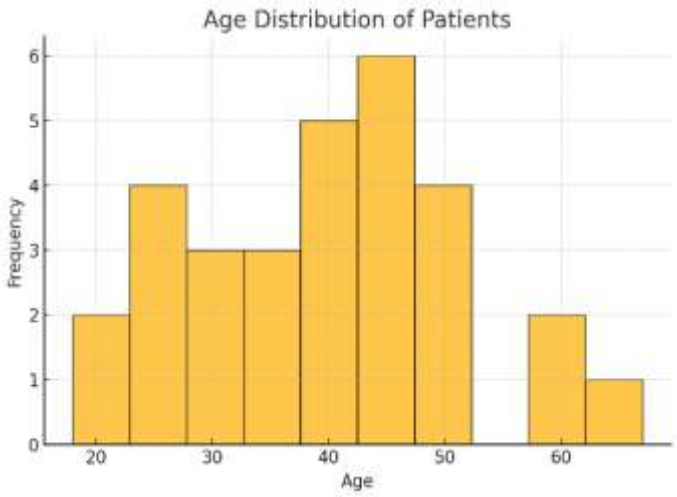
FOLLOW UP

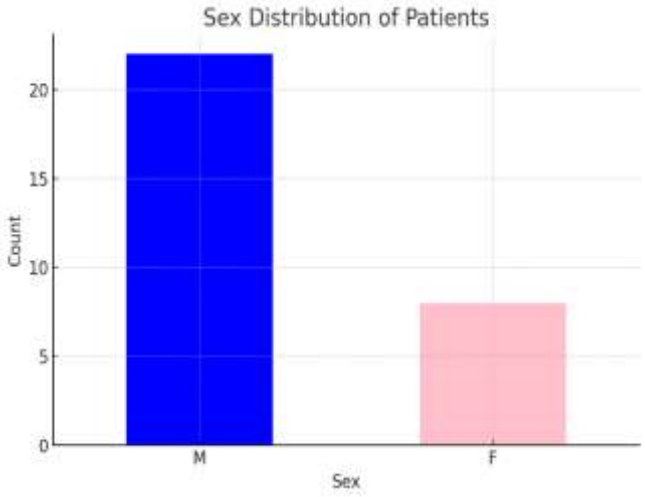
All the patients were routinely followed up at end of five days, fourth, eighth and twelfth weeks. Patients were assessed clinically and radiologically with Mayo wrist score using necessary X-rays at each follow up visit. At the 8th week follow up, after patient undergoes regular rehabilitation, patient's dorsal splint is removed. Although Mayo's wrist score is assessed at each visit, the final Mayo wrist score analyzed after 12 weeks is used in current study to assess the procedure's effectiveness.

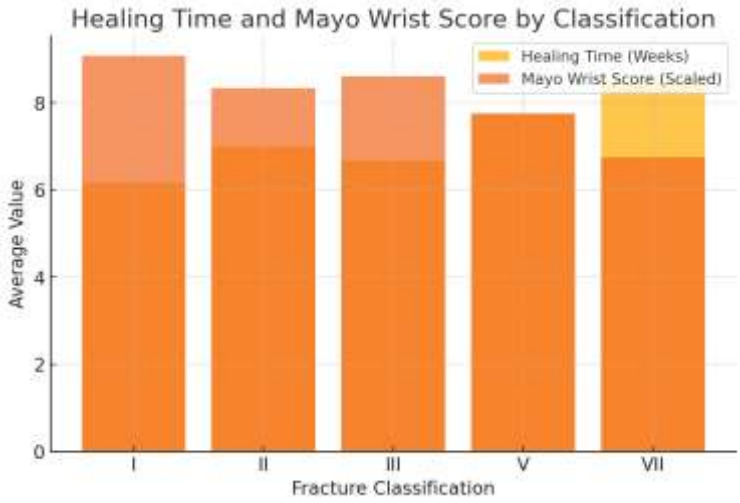
RESULTS AND OBSERVATIONS:

30 patients were treated with dorsal locking compression plates for dorsally displaced unstable distal radius fractures with patients ranging from 18 to 67 years with mean age of 39.87±12.42 years. In this study, 22 patients were male and 8 were female. We observed that Road traffic accidents were the most common cause of the injury (60%) followed by self fall(40%). Both right and left side were equally affectedwith 15 each.

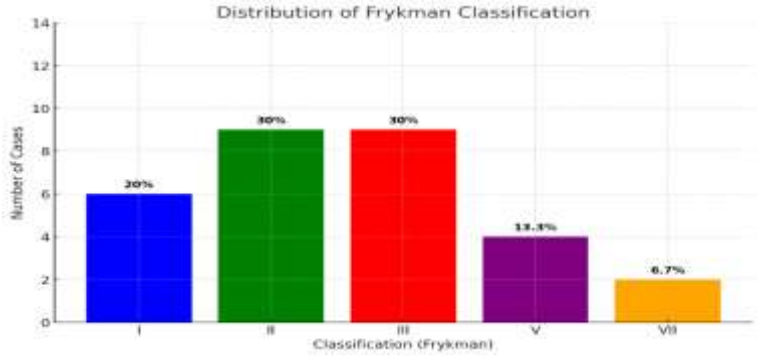
Based on Frykmann's classification, most of the patients were classified into Type II and III fractures, each comprising 30%. Type I fractures representing 20%, Type V fractures are less common, with 13.3% and Type VII, the least common, appears in only 6.7%. All the patients were followed up for a minimum of 3 months.

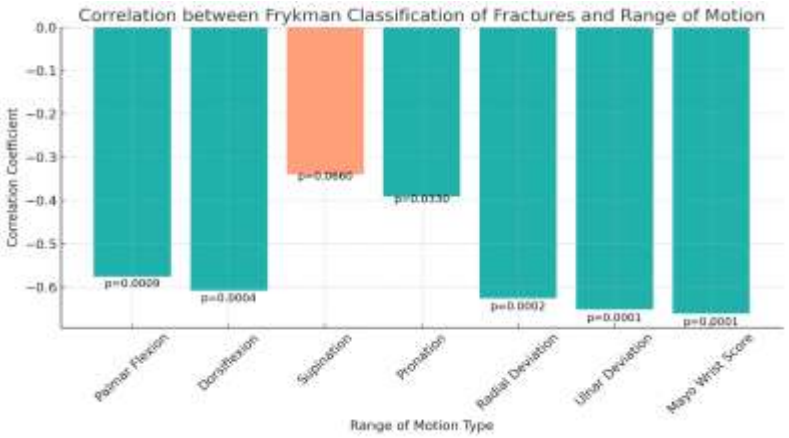






and standard deviation of Mayo Wrist Score at end of 3 months is 83.83±7.62. The objective results shows that 16 individuals (approximately 53.3%) rated as having a "Good" result. This was followed by 8 individuals (about 26.7%) achieving an "Excellent" result, indicating a highly successful treatment outcome. A smaller group of 5 participants (16.7%) had a "Fair" result, suggesting some improvement but not to the extent of those in the Good or Excellent categories. Only 1 participant (3.3%) was categorized as "Poor," indicating minimal or no improvement.





Relationship	Correlation Coefficient	P-Value	Interpretation
Age & Mayo Wrist Score	0.534	**0.0024**	Moderately strong association
Sex & Mayo Wrist Score	0.450	**0.0297**	Moderate association
Sides & Mayo Wrist Score	0.000	0.753	No association
Mode of Injury & Mayo Wrist Score	0.497	**0.0165**	Moderate association
Frykman Classification & Mayo Wrist Score	0.538	**0.0004**	Moderately strong association

DISCUSSION

Distal radius fractures have a bimodal distribution[8]. The results of this study give a better understanding of the demographic characteristics, injury patterns, and outcomes of distal radius fractures in a cohort predominantly consisting of middle-aged males[9]. The mean age 39.87±12.42 years aligns with the global epidemiological data indicating the common occurrence of these fractures in young- adults due to high-energy impacts and older adults due to falls. The gender distribution, skewed towards males (73.3%), may reflect greater exposure to high-risk activities typically associated with traumatic injuries such as road traffic accidents, which are reported as the most common cause of injury in this clinical trial (60%) [10]

The publication by Court-Brown and Caesar (2006), road traffic accidents are a significant cause of distal radius fractures, particularly in younger, more active individuals, which corroborates the 60% incidence rate in our clinical trial[11]

A study by Karl-Johan Ristiniemi (2005) found that women, especially those above fifty years old, with a higher frequency of distal radius fractures compared to men, which contrasts with our study's male-dominant cohort[12]

Research often shows a predominance of fractures on the dominant side, particularly in populations engaged in manual labor or specific sports. A contrary finding by Jupiter and Ring (1998) suggested that the dominant hand is more frequently involved in injuries due to its more active use, which contrasts with the equal distribution in our study[13] The predominance of Type II and III fractures in our study is supported by research from Jupiter et al. (1997), which emphasizes that high-energy impacts tend to cause more complex fractures, involving articular surfaces and require more intensive surgical management[14] Studies like those by Orbay and Fernandez (2002) have noted that the functional outcomes of distal radius fractures vary widely based on the severity of the fracture and the effectiveness of the treatment. They found that modern fixation techniques tend to result in better functional outcomes, aligning with our finding of a majority of participants achieving "Good" to "Excellent" recovery scores[15] MacDermid et al. (2002) reported that more severe fracture classifications correlate with poorer functional outcomes. This supports our study's findings where higher Frykman classifications were associated with worse Mayo WristScores[16]

The significant statistical correlation between the Frykman classification and functional outcomes (p-value: 0.00035) provides a clear link between the

severity of the fracture and the eventual recovery, reinforcing the importance of accurate initial assessment and tailored treatment strategies. The strong negative correlations observed between higher Frykman classifications and both range of motion measurements and Mayo Wrist Score further support this, indicating that more severe fractures lead to worse functional outcomes.

The Extraperiosteal application of the dorsal plate preserves vascularity, maintains reduction of fragments and ensures early union. When the specific dorsal fragments – dorsoulnar corner, dorsal wall, are large enough for screw fixation, then they can be stabilized by locking screws in an appropriately positioned plate. The mechanical complications earlier reported with dorsal platting such as soft tissue irritation and rupture of Extensor Pollicis Longus (EPL) tendons are avoided by using anatomic side specific pre contoured thin profile plates[17]

CONCLUSION

Dorsal locking compression plates for unstable dorsally displaced distal radius fractures yields good to excellent results as it provides mechanical stability and are effective in the correction and maintenance of the distal radial anatomy and allows free joint motion and early return to pre-fracture level of activities.

In dorsal plating for unstable distal radius fracture, the comminuted displaced fragments of the dorsal rim are held in position by buttressing the plate over the displaced fragments which provides a stable construct. The conventional volar platting cannot be used for stabilizing comminuted dorsal rim and wall.

Restoration of radial length, radial inclination and volar tilt in dorsally unstable fractures are achieved only with a dorsal stable construct.

AUTHOR CONTRIBUTIONS

The authors contributed equally for its content, writing, and reviewing and/or editing of the manuscript before submission.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENT

The authors are grateful to the authorities of Aarupadai Veedu Medical College and Hospital, Vinayaka Missions Research Foundation (Deemed to be University) and to all the patients who participated in the study.

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