Case Series

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The functional outcome of dorsally displaced distal end radius fractures treated with dorsal plating: A series of 7 cases

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Abstract

Introduction: Distal-end radius fractures are one of the most common fractures encountered by an Orthopaedic surgeon. It accounts for 17.5% of the fractures in adult age group, of which 57 to 66% are extra-articular, 9 to 16% are partial articular and 25 to 35% are complete articular fractures. Commonest mode of injury is fall on an outstretched hand with the wrist in dorsiflexion. Closed reduction and cast, with or without K wiring, closed reduction with External fixator or Open reduction (volar or dorsal) with internal fixation with either volar or dorsal plates are the various treatment modalities undertaken.

Till recently volar approach for plate fixation had been a preferred choice for even dorsally displaced distal end radius fracture due to high risk of complications like tendon irritation and rupture in dorsal approach and skin dehiscence. In recent years, due to availability of fragment-specific low profile dorsal plates there has been a renewed interest in dorsal approach for plate fixation in these fractures.

Material and methods: In the present observational study, 7 patients were evaluated who had dorsally displaced distal end radius fractures and underwent dorsal plate fixation by a dorsal approach. The outcomes were measured by Modified Mayo wrist score and VAS score. Patients were evaluated clinically and radiologically at 6 weeks intervals with follow-up after 1 year.

Results: At the end of 1-year, excellent results were observed in 6 of the 7 patients. Significant improvement was noted at 6 months and 1 year follow-up in Modified Mayo wrist score and VAS score. No complications were reported in any of the patients.

Conclusion: We conclude that dorsal plate fixation using a dorsal approach for dorsally displaced fractures of lower end radius with newer generation, low profile fragment-specific plates is a good treatment modality for dorsally displaced distal-end radius fractures.

Keywords: dorsally displaced distal end radius fracture, dorsal plate fixation, dorsal surgical approach, Modified Mayo Wrist Score (MMWS), VAS Score.

Introduction

Distal-end red radius fractures are one of the most common fractures encountered by an orthopedic surgeon, accounting for 17.5% of the fractures in adult age group, of which 57 to 66% are extra-articular, 9 to 16% are partly articular and 25 to 35% are complete articular fractures. [1] Commonest mode of injury is due to fall on an outstretched hand with the wrist in dorsiflexion. Concomitant injury to inter-carpal ligamentary structures of the wrist depends on the position of the wrist when it hits the ground which also defines the form of distal radius fracture as well as its severity. The different appearances of ligamentary injuries, the compression of carpus along with direction of the force are determined by the position of the wrist and the forearm at the time of fall. [2]

Many treatment options to treat these fractures have been described. For dorsally displaced distal-end radius fractures, closed reduction and cast immobilization with or without K-wiring has been the gold standard for treating them, which has stood the test of time. Other methods of treatment being used commonly are wrist spanning and non-spanning external fixator application, open reduction and internal fixation using peri-articular locking compression plates and fixed angle/variable angle locking plates and arthroscopic assisted reduction techniques. However, open reduction and internal fixation with a buttress plate is preferred choice for volar displaced distal-end radius fractures. [3] Distal radius fractures with dorsal displacement are common and tend to suffer secondary displacement after conservative treatment due to communition and the cancellous nature of the bone. [3] The goal of distal radius fracture treatment is to restore anatomy of the wrist and restore function to pre fall status. [4]

Till recently volar approach with volar plating has been the preferred choice even in dorsally displaced fractures due to high rate of complications like skin breakdown, prominent implant and tendon irritation and rupture in dorsal approach. [5] With the availability of newer generation low profile fragment specific dorsal plates leading to reduced incidence of skin and tendon related complications has renewed interest in the dorsal approach and fixation of dorsally displaced fractures. Recent literature also confirms that the results of dorsal plating are comparable to those of volar plating. [5, 6] The aim of the present study was to evaluate the functional outcomes of dorsal plating for the management of dorsally

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Figure 1: a & b: pre-operative X-rays suggestive of intra-articular fracture of distal end of radius with dorsal displacement of the distal fragment; c & d: post-operative X-rays of wrist showing surgical plate in-situ with satisfactory alignment

Figure 2: a & b: pre-operative X-rays suggestive of intra-articular fracture of distal end of radius with dorsal displacement of the distal fragment; c & d: post-operative X-rays of wrist showing surgical plate in-situ and satisfactory alignment

displaced distal end radius fractures.

Material and Methods

For present study patients with dorsally displaced distal end of radius fractures of either gender visiting to Department of Orthopaedics, at a tertiary care hospital were evaluated in the study. The 7 cases that underwent internal fixation with a plate using dorsal approach for treatment of distal-end radius fractures between June 2018 and April 2020 were included in the present study. Patients sustaining Volar Barton's fracture, Smith's fracture or compound fractures of the distal end radius were excluded from the study. Preoperative radiological assessment was done for all patients. Distal end radius plating using dorsal approach was carried out under regional/general anaesthesia. The dorsal plate was applied in Buttress Mode.

Surgical technique

Provisional reduction was achieved using longitudinal traction and counter traction. Dorsal skin incision between the radial and intermediate columns centring over the fracture site was made. Extensor retinaculum and the 3rd dorsal compartment opened in the line of Extensor pollicis longus tendon (EPL). EPL tendon was protected and retracted laterally using a vessel loop being careful not to cut the tendon and 4th dorsal compartment was elevated sub-periosteally keeping the compartment intact to expose the intermediate column. To expose radial column, the 2nd dorsal compartment was elevated sub-periosteally in medial direction. The limited dorsal arthrotomy was done for monitoring of the articular surface and assessment of scapho-lunate interosseous ligament in patients with intra-articular fracture extension. Periosteal elevator used to elevate the dorsal fragment and fixed temporarily using Kirschner wire after confirming reduction with help of imaging techniques. To fix the fracture, 3.5 mm low profile fragment specific locking dorsal T-plate or L-plate was used; the extensor retinaculum was repaired followed by closure in layers. A plaster slab was applied for a period of 3 weeks. On day 1 active finger movement, elbow & shoulder range of motion started, and at 3 weeks wrist range of motion initiated.

Figure 3: post-operative range of motion among one of the patient

Outcome Assessments

The outcome assessment was done at 6 weeks, 3months, 6 months and 1 year clinically as well as radiologically. The primary clinical outcome was wrist range of motion (ROM) and secondary outcomes were pain, deformity, grip strength and functional status as assessed by MMWS (Modified Mayo Wrist Score) and VAS (Visual Analogue Scale). The MMWS has two subjective parameters, pain and functional status, each of which is awarded 25 points. Each objective parameter, range of motion, and grip strength is awarded 25 points. An excellent score is 90 to 100 and a poor score is less than 65. [7] Wrist pain was rated with VAS by the patients. The scale ranges from 0 to 10, where 0 represents no pain and 10 represents the worst imaginable pain. Fracture healing was assessed using sequential post-operative radiographs at 6 weeks, 3 and 6 months.

Results

Out of the 7 cases, 4 were females and 3 were males. 3 of the patients had extra-articular distal radius fracture, 2 of them with right side and 1 had left side involvement. 4 patients had intra-articular distal radius fracture, with involvement of left side in 3 patients and right side in 1 patient. The mean age of all patients was 56.57 ± 9.24 (ranging from 47 to 74) years. No loss to follow-up was noted at 1 year assessment for all patients.

The mean ± SD values of MMWS were 63.57 ± 5.56 and 96.43

Table 1: Demographic and clinical parameters of the patients with distal end radius fractures at the time of admission and at 6 months & 1 year after surgery

Sr. No	Age (years)	Gender	Diagnosis	Mayo wrist score at 6 months	Mayo wrist score at 1 year	VAS score at 6 months	VAS score at 1 year
1	59	Female	Right dorsally displaced Colle's fracture	65	100	2	0
2	74	Female	Left dorsally displaced Colle's fracture	NA	90	NA	1
3	47	Male	Left Dorsal Barton's fracture	70	100	2	0
4	61	Female	Right dorsally displaced Colle's fracture	NA	95	NA	0
5	55	Male	Left Dorsal Barton's fracture	70	95	3	1
6	49	Female	Left Dorsal Barton's fracture	65	95	2	0
7	51	Male	Right Dorsal Barton's fracture	NA	100	NA	0
Mean ± SD (standard deviation)				63.57 ± 5.56	96.43 ± 3.78	2.29 ± 0.49	0.29 ± 0.49
P value				<0.0001*		<0.0001*	

± 3.78 at 6 months and 1-year post-surgery respectively. When the difference in the means of MMWS was compared, we found statistically significant (<0.0001) increase in the score. The mean ± SD values of VAS score were 2.29 ± 0.49 and 0.29 ± 0.49 at 6 months and 1-year post-surgery respectively. The VAS score was found to be reduced significantly (<0.0001) at 6 months and 1-year. No complications were reported among the 7 patients. The results are depicted in table no. 1, the representative images of pre- and post-operative x rays are shown in figure 1 and 2.

Discussion

Intra-articular distal radius fractures if not treated properly heal with articular incongruity and may result in the development of post-traumatic arthrosis and painful and restricted movements. Loss of height of radius can cause deformation of the wrist with malalignment of DRUJ leading to painful restriction of prono supination. The goal of surgical fixation is to restore anatomical and articular alignment to minimize these risks. [5]

Once the fracture is healed, in contrast to volar implants which are usually left in situ, the dorsal implants are preferably removed due to their superficial disposition and chances of complications. [8]

Wichlas F et al [9] suggested use of variable angle palmar locking plate for the vast majority of fractures.

Arora R et al [10] stated fixation of unstable dorsally displaced distal radius fractures with a fixed angle plate provide sufficient stability with minimal loss of reduction, but on the other hand very distal palmar plate position can interfere with the flexor tendon functioning, too long screws can penetrate the extensor compartments, and in comminuted fracture patterns, distal screws can cut through the subchondral bone and penetrate into the radio-carpal joint.

Also, volar plating is associated with a higher rate of neuropathic complications. [11]

The potential for direct reduction and assessment of articular alignment and evaluation and management of concomitant intrinsic inter-carpal ligament injury are among benefits of dorsal surgical approach. [6]

In cases of complex multi-fragmentary articular fractures where no compromise in intra-articular reduction is acceptable, dorsal plating is a good option for fixation. [9]

The dorsal approach for plating has some benefits over the volar approach like, the potential for direct anatomical reduction and assessment of articular alignment. It also allows direct visualization of the articular surface, evaluation and subsequent management of concomitant intrinsic inter-carpal ligament injuries. [5] Also, newer generation low-profile fragment specific dorsal plates have polished surfaces with tapered edges and low-profile locking screw heads and hence have fewer incidences of extensor tendon related complications. [11] When compared with previous reports on dorsal plating, volar plates appear to have a higher incidence of fracture collapse but a lower rate of hardware-related complications. [12]

In the study titled "Treatment of Distal Radius Fractures With a Low-Profile Dorsal Plating System: An Outcomes Assessment" published in The Journal of Hand Surgery / Vol. 31A No. 3, March 2006 concluded that the treatment of distal radius fractures with a low-profile stainless steel dorsal plating system is a safe and effective method that provides stable internal fixation and allows for full extensor tendon glide and full metacarpophalangeal joint motion. Objective outcome testing showed uniformly good to excellent recovery of wrist and hand function in all patients. [13]

Similarly in our small series of 7 patients we did find excellent results in 6 patients and good result in 1 patient with no complications related to skin or extensor tendons.

In the article titled "Dorsal Approach For Impacted Comminuted Distal Radius Fracture By Open Reduction And Internal Fixation By Plate And Screws With Bone Grafting" published in AIMJ March 2021 issue concluded that, dorsal plating with bone grafting for impacted distal radius with dorsal comminution allows accurate reduction and maintenance with early mobilization, good function and an early return to work. [14]

In our series of 7 patients too we got similar excellent results in 6 patients and good result in 1 patient with early mobilization.

When compared to volar approach, a lower risk of neuropathy and carpal tunnel syndrome is offered by dorsal fixation. Evident from the cases discussed in the current case series, comparable outcomes can be achieved in patients with distal radius fracture after dorsal plate fixation. [15]

The present study encountered the advantages of dorsal plate

fixation of distal end radius fractures by means of improvement in MMWS and VAS score. We also did not report any complications among these patients. Anatomical reduction was achieved in 85% of the patients. Excellent functional recovery was noted in 85% of the patients with 100% functional recovery in 42% of the patients.

Conclusion

Plate fixation using a dorsal approach with newer generation, low profile fragment-specific plates is a good modality for the treatment of dorsally displaced distal-end radius fractures with possibility of early mobilization and return to work. The incidence of complications like tendon irritation and skin break down are far less due to low profile fragment specific plates. Dorsal approach also eliminates shortcomings and complications of volar plating such as carpal tunnel syndrome, fracture collapse and inability to assess the intra-articular reduction.

Declaration of patient consent : The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest : Nil **Source of support :** None

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