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ORIGINAL ARTICLE

Using Fragment Specific Plate 2.5 Millimeter in Cases of Distal Radius Fracture

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Abstract

Background: **Fractures of the distal radius inside the joint are a common injury. Whether caused by high-energy trauma or, more commonly among the elderly and those with osteoporosis, low-energy trauma, these fractures tend to be unstable and require immediate medical attention. The use of external fixators for intra-articular distal radius fractures has been supplanted by the use of internal fixators.**

Aim and objectives: **To examine the radiological and clinical results of treating distal radius fractures that occurred on the dorsum of the individual's right and left arms (dorsal or dorso-radial) using a fragment-specific plate (2.5 mm).**

Patients and methods: **Hospitals associated with Al-Azhar University cared for 20 patients with Association of Osteosynthesis (AO) type B, C dorsal comminution intra-articular distal radius fractures between May 2022 and January 2023.**

Result: **Disability of arm, shoulder and hand (DASH) score and the Mayo score revealed statistically substantial variations among the groups. There was no statistically significant disparity among pre and postoperative radiological measures.**

Conclusion: **Dorsal plating is a successful therapy for intra-articular distal radius fracture resulting in restored wrist anatomy, regained clinical function, and high case satisfaction in most cases.**

Keywords: Distal radius fracture, Fragment specific plate, Intra-articular fractures

1. Introduction

Distal radius fractures are the most prevalent type of upper-extremity fracture, accounting for 1 in 6 of all such injuries seen in emergency rooms. Pain and swelling typically manifest near the distal radius after a break. The most common cause of hand injuries is falling on an outstretched hand. Displaced fractures frequently cause deformity and swelling of the wrist.[1]

Patients who experience pain when moving or palpating the distal radius may delay surgery or end up with a malunited fracture. This usually occurs because it is believed that the fracture is stable after a good reduction and will not shift back to its original place. Age and severity of trauma both contribute to an increase in fracture comminution. These are the most significant markers of relapse throughout therapy, hence it is crucial to keep a watch on them. Stability at the time of injury can be inferred using anatomical parameters such as changes in radial tilt, inclination, and/or shortening.[2]

Internal fixation has been used successfully in many cases of surgical stabilization. However, there is currently no agreed-upon standard method for dealing with distal radius fractures. Surgical treatment minimizes stiffness by reducing the risk of further displacement and allowing for early mobilization by stabilizing the fracture and articular surfaces during surgery.[3]

Although dorsal comminutions can be difficult to stabilize, they are often treated using a volar approach and internal fixation with a volar plate. A volar approach also obscures the surgeon's view of the radiocarpal joint. The joint must be visually inspected for congruence and extra issues to be avoided. Instead of using intraoperative fluoroscopy, which has lower resolution, arthroscopy or arthrotomy can be performed. The displaced

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fracture and comminuted area are easier to reach from the dorsal position. Arthrotomy allows for direct visualization of the radiocarpal articular surfaces.[4]

Dorsal plate fixation is required to provide an anatomic reduction and assess the intercarpal ligaments.[5]

The dorsal plates provide additional support by functioning as buttresses. In this non-comparative retrospective study, we looked at the results of treating comminuted intra-articular impacted fractures with open reduction and internal fixation (ORIF) via a dorsal approach.[6]

The purpose of this study was to radiographically and clinically evaluate the efficacy of a fragment-specific plate (2.5 mm) in the treatment of dorsal and dorsoradial distal radius fractures.

2. Patients and methods

Hospitals associated with Al-Azhar University cared for 20 patients with Association of Osteosynthesis (AO) type B, C dorsal comminutions intra-articular distal radius fractures between May 2022 and January 2023.

2.1. Inclusion criteria

Young adult, age greater than 16, intra articular fractures type B1, B2, C1, C2, C3 with dorsal comminutions and fragmentations greater than 50%, dorsal Barton and die-punch fractures, chauffeur fracture and closed fractures or gustilo1 (G1) open fractures.

2.2. Exclusion criteria

Fractures that excluded from our study since neither of these fracture patterns indicated fragment specific plating fixation are: intra-articular fractures type C1,C2, C3 with volar comminutions, type A extra articular fractures, patients with low functional demands or elderly patients with multiple medical comorbidities, presence of active infection or soft tissue contamination, presence of severe open wounds (G3)and soft tissue loss, dorsal plate fixation is not appropriate for volar shear (volar Barton) fractures, fractures of the volar lunate facet and smith fractures.

2.3. Management

2.3.1. History

Age of patient, sex and mechanism of injury, dominant side or not at the time of trauma. Clinical examination: inspection: edema, deformity Palpation: tenderness on distal radius and wrist joint, investigations: radiography: (AP, Lateral, and Oblique), computed tomography: obligatory for all patients and MRI: if doubt of soft tissue injury. Preoperative preparation: full labs routine preoperative Investigation, k-wires, dorsal miniplates 2.5 mm.

2.4. Surgical technique

2.4.1. Preparation

Under complete aseptic conditions, adequate toweling sterilization.

2.4.2. Anesthesia

Regional block or general anesthesia.

Position: place the individual on supine position and pronate forearm and place on arm board, or place the individuals on prone position.

2.4.3. Approach

Dorsal universal approach.[7]

2.4.4. Skin incision

The third extensor compartment is reached via a dorsal longitudinal skin incision.

A bone graft may be required when an osteoporotic bone has a significant deficiency. A 2.5 mm dorsal microplate was used to repair this fracture. The plate is meticulously placed on the bone so that it conforms to the bone's unique shape.

Fixation and reduction of fractures on a temporary basis: the fracture is revealed, reduced, and K-wires are used to fix it temporarily while fluoroscopy is used.

2.4.5. Plate positioning

Plate position and the order of screw insertion will be determined by fracture pattern and/or patient anatomy.

Screws insertion: Set the plate to bone and insert a 2.5 m Cortical Screw into the oblong hole in the shaft following the technique described below.

2.4.6. Tips

When using nonlocking screws to compress a plate, it is best to do it before any locking screws are installed.

A short 2 mm drill bit inserted into a 2 mm drill guide with a handle is all that's needed to install a 2.5 mm cortical screw. The correct screw length can be determined using either the 2.5 mm depth gauge or the Drill Bit's in-built calibrations.

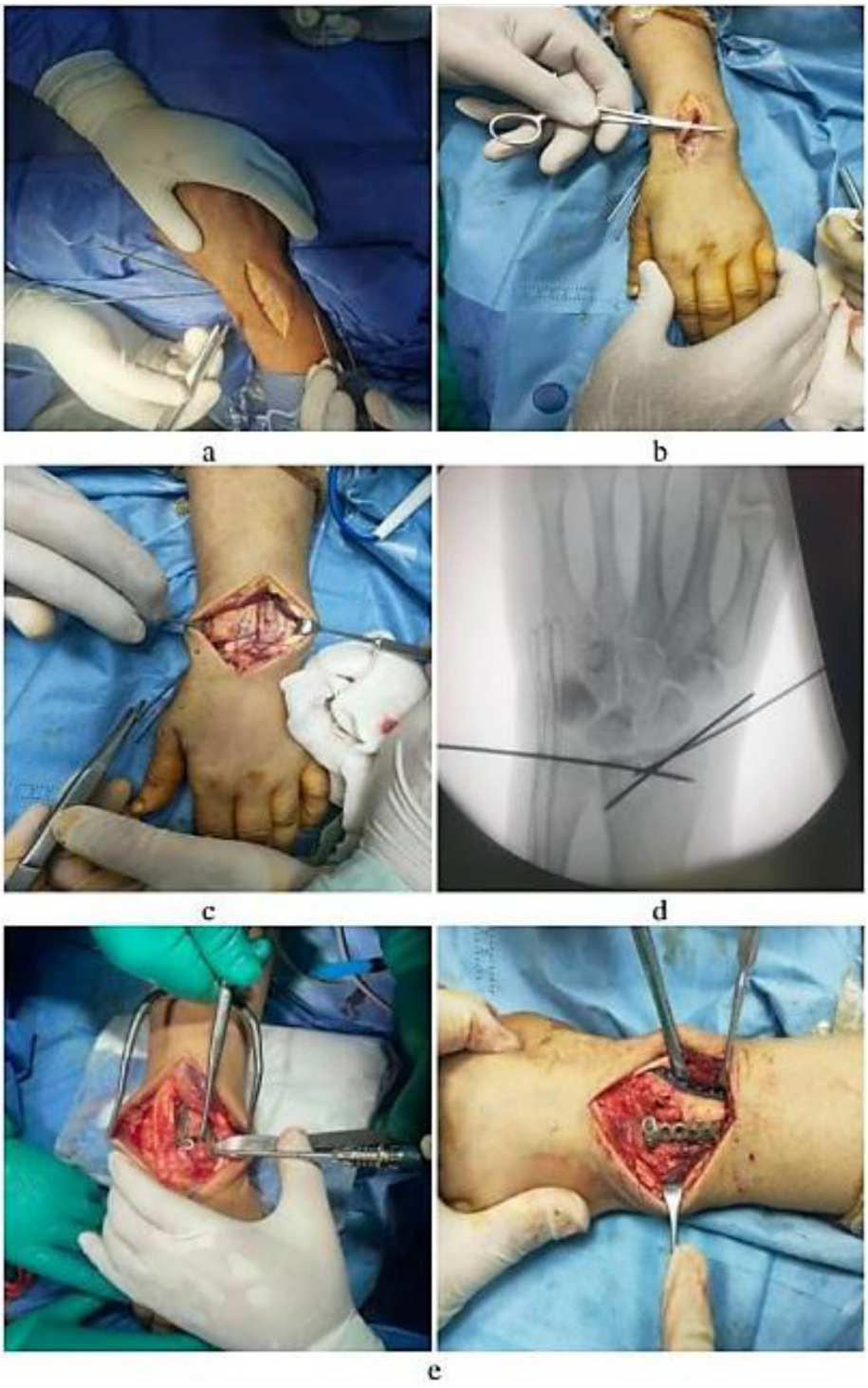

Fig. 1. (a): Longitudinal dorsal incision just ulnar to Lister tubercle between third and fourth compartments. (b): Release of EPL tendon at third compartment and retracted radially and incision of extensor retinaculum. (c): Elevation of the periosteum where the first, second compartments were elevated radially and fourth, fifth compartments elevated to the ulnar side with preliminary fixation of the fracture by K-wires. (d): Preliminary reduction of the fracture by K-wires under C-ARM. (e): Intraoperative reduction of the fracture and the articular surface and fixation of the fracture by double plates. EPL, extensor pollicis longus.

Inserting a Locking Screw of 2.5 mm: in the screw hole, insert the 2 mm Locking Drill Guide. You can either read the calibrations on the 2 mm drill bit or use the 2.5 mm depth gauge to figure out how long your screws need to be.

Closure of the wounds and follow up: recovery from an injury the second and fourth compartments are restored under the extensor pollicis longus (EPL) tendon without tension or a periosteal sleeve.

Results at 6 months follow-up, assessed using the disability of arm, shoulder and hand (DASH) and Mayo scoring systems, radiological and clinical evaluation.

3. Results

Results: The union was achieved in all the patients. The functional results at 6 months follow up, assessed using the DASH and Mayo scoring systems, were excellent in 10 patients, good in eight patients, and fair in two patients. The average correction of deformity was 5.4° mm for radial

Table 1. Age, sex and dominant hand distribution of the studied cases (n = 20).

Age (y)	**No. (%)**
<40	13 (65.0)
≥40	7 (35.0)
Minimum–maximum	18.0–57.0
Mean ± SD.	37.0 ± 11.06
Median (IQR)	36.50 (31.0–43.0)
Sex	**No.** (%)
Male	12 (60.0)
Female	8 (40.0)
Dominant hand	No. (%)
Nondominant	8 (40.0)
Dominant	12 (60.0)

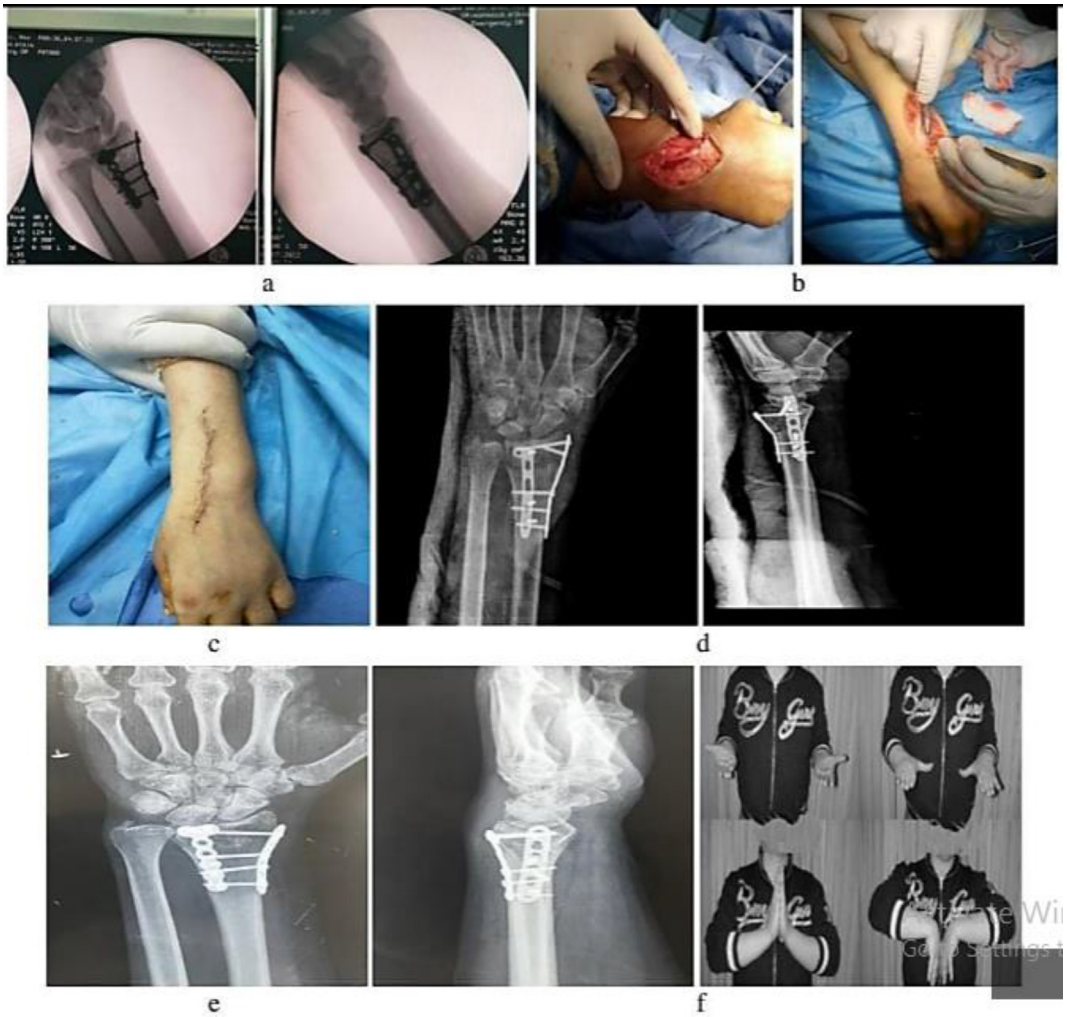

Fig. 2. (a): Intraoperative double plates fixation. (b): Showing third compartment closure and positioning of EPL. (c): Subcuticular skin closure. (d): Postoperative radiography 2 weeks after operation. (e): Postoperative radiography after 6 months follow-up. (f): Showing postoperative clinical follow-up after 6 months. EPL, extensor pollicis longus.

Table 2. Distribution of the studied cases according to number of plates and classification (n = 20).

		No. (%)
Side of plate	Number of plates	
Dorsal	**1**	5 (25.0)
Dorsal, radial	**2**	13 (65.0)
Dorsal, radial, volar	**3**	2 (10.0)
	Minimum–maximum	1.0–3.0
	Mean ± SD	1.85 ± 0.59
	Median (IQR)	2.0 (1.50–2.0)
	AO classification	
	B	9 (45.0)
	B2	8 (40.0)
	B3	1 (5.0)
	C	11 (55.0)
	C2	8 (40.0)
	C3	3 (15.0)

AO, Association of Osteosynthesis.

Table 3. Distribution of the studied cases according to DASH score (n = 20).

DASH score	No. (%)	*P* value
Moderate disability	2 (10.0)	
Mild disability	8 (40.0)	
No disability	10 (50.0)	
Minimum–maximum	6.0–28.0	
Mean ± SD	11.50 ± 5.81	
Median (IQR)	10.0 (7.0–13.0)	0.03

DASH, disability of arm, shoulder and hand.

Table 4. Distribution of the studied cases according to Mayo score (n = 20).

Mayo score	No. (%)	*P* value
Fair	2 (10.0)	
Good	8 (40.0)	
Excellent	10 (50.0)	
Minimum–maximum	73.0–95.0	
Mean ± SD	87.55 ± 6.46	
Median (IQR)	89.0 (84.0–93.0)	0.04

ROM, range of motion.

Table 5. Distribution of the studied cases according to postoperative pain (n = 20).

Postoperative pain	No. (%)
No painful ROM	10 (50.0)
Mild painful ROM	8 (40.0)
Moderate painful ROM at activities	2 (10.0)

height, 7.2° for radial inclination, and 8.3° for volar tilt none of our patients showed evidence of loss of fracture reduction on their serial follow-up till union.

Clinical evaluation: at final follow-up, the mean range of wrist motion consisted of flexion/extension ranged from 65 to 80° (mean 73.1), RD ranged from 10 to 15° (mean 13.6), UD range from 26 to 40 (mean 34.2), pronation range from 75 to 85 (mean 80.5), supination range from 80 to 90 (mean 85).

At final follow-up 10 patients have no pain, 8 mild and 2 complaining of moderate painful wrist movement. Normal functions and wrist motion were assumed in 18 (90%) patients without affection their daily activities, while little restricted functions and daily activities were observed in 2 (10%) patients one patient was developed indicis tendon rupture which treated by plate removal and tendon transfer and the second one developed tenosynovitis treated with plate removal and physiotherapy.

Age of cases ranged from (20–55 years) with a mean (36.15 years), 12 (60%) males, and 8 (40%) females. The dominant hand was involved in 12 (60%) cases.

Dorsal, radial was the most common side of the plate as regard number of plates and classification.

This table displays the range of DASH scores, indicating the range of disability among the instances analyzed where there was an statistically significant disparity among them.

In this table, we see the range of mayo score improvements among the studied groups where the differences were statistically noteworthy.

No painful range of motion (ROM) was the highest percent as regard postoperative pain ($n = 20$).

This table show the preoperative and postoperative radiological parameters where no statistically significant difference among them was (Figs. 1 and 2, Tables 1–7).

Table 6. Deceptive analysis for pre and postoperative radiographic parameters (n = 20).

	Preoperative	Postoperative	*P* value
Radial height			0.135
Minimum–maximum	4.0–8.0	11.0–12.0	
Mean ± SD	6.40 ± 0.88	11.45 ± 0.51	
Median (IQR)	6.50 (6.0–7.0)	11.0 (11.0–12.0)	
Radial inclination			0.486
Minimum–maximum	12.0–18.0	20.0–23.0	
Mean ± SD	15.20 ± 1.24	22.15 ± 0.99	
Median (IQR)	15.0 (14.50–16.0)	22.0 (22.0–23.0)	
Volar tilt			0.346
Minimum–maximum	4.0–6.0	12.0–14.0	
Mean ± SD	5.25 ± 0.72	13.35 ± 0.75	
Median (IQR)	5.0 (5.0–6.0)	13.50 (13.0–14.0)	

Table 7. A review of the literature on the dorsal approach to affected intra-articular fractures published after 2005.

Study	No. of cases	Follow-up (months)	No. of plates used	Plate removed (cases)	Tenosynovitis	Flexion/ extension	Pronation/ supination	Strength
Fernandez *et al.*[13]	12	10	2	–	–	48-0-498	75-0-808	75%
Lutsky *et al.*[14]	15	37	2	–	–	53-0-708	76-0-808	87%
Kamath *et al.*[15]	30	18	1	0	0	81-0-888	89-0-878	78%
Simic *et al.*[16]	51	24	1	1	0	54-0-598	84-0-788	90%
Matzon *et al.*[17]	110	27	1	9	8	67-0-718	85-0-858	–
Our study	20	6	1,2,3	1	2	65-0-808	77-0-828	92%

One or two thin plates were used to repair the fractures. Plate loss and extensor mechanism tenosynovitis incidence rates were not reported in all researches.

4. Discussion

The risks of nonoperative treatment for a displaced intra-articular fracture of the wrist include collapse, loss of reduction, and post immobilization stiffness. There is no consensus on the best method of using external fixators. Although modern external fixators have improved, problems such as pin site infections and preserving radial length with a monoliteral fixator following a multiplanar injury persist.[8]

From preoperative fixation to the most recent follow-up, the locked dorsal plate remained in the correct position without collapsing in any of the patients in our case series study with (2.5 mm).

The dorsal approach is still useful for treating some kinds of intra-articular fractures. The robust buttress and locking fixation, along with the capacity to directly control intra-articular congruency, allow for early mobilization. Our results are comparable to those of other surgical approaches to treating high-energy fractures.[9]

Scores of 70 or higher on the DASH scale indicate exceptional functional outcomes; scores of 60 or higher indicate good outcomes; scores of 40 or higher indicate fair outcomes in two of the cases. This disparity in results is probably due to the fact that all of the fractures in this study were closed and not substantially comminuted.

A 10% of the patients had new issues, 5 (5%) cases complained of wrist pain, and 1 (5%) case had limited wrist motion due to an extensor indicis tendon rupture but recovered after revision and repair. Closing the compartments and covering the plate so it does not scrape against the extensor tendons worked effectively for both cases and prevented their problems from returning during physical therapy.

Matzon *et al.* found that after following up with 110 cases treated with a dorsal plate for a year, 8% of the cases developed tenosynovitis.[10]

De Semt reported 10 cases with extensor tendon ruptures or tenosynovitis who were treated with a dorsal plate and monitored for 1.5 years.[11]

Comparatively, our study has a low complication rate to the aforementioned studies, but we achieve the same functional and cosmetic aims at a lower cost by using a fragment-specific plate (2.5 mm) rather than dorsal plates (2.4 mm).

The removal of implants was the most prevalent treatment for tenosynovitis. The bulk of extensor tendon issues were likewise attributed to the dorsal plate.[12]

Since then, the issue has not returned. This difficulty most likely arose while we were gaining experience with this method. Based on the findings of our report, we recommend beginning progressive mobilization exercises no later than 3 weeks after surgery to reduce the risk of stiffness and speed up the case's first recovery from surgery. Cases were first immobilized in a brief dorsal cast for up to 4 weeks postoperatively, as was standard practice for all intra-articular fractures treated in our unit at the time of the research's initiation.

Using of this plate (2.5 mm), as it is more economic, low profile, and functioning.

The limitation in our study is a small number of cases, and short period of follow-up.

4.1. Conclusion

Recognition of unstable distal radial fractures and their appropriate management lead to the best functional results. The fragment specific plate principle offered by the locking plates provides a rigid fixation which minimizes the possibility of re-displacement and allows an early rehabilitation. Also this plate is cheap, helpful, low complications. The fragment specific plate used in this study is suitable for the management of dorsal and dorsoradial dorsoulnar displaced, unstable intra articular fractures.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

Conflicts of interest

The authors declared that there were no conflicts of interest.

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