

Original research article

Surgical management of fractures of distal end radius with open reduction and internal fixation using volar rim locking compression plate

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Abstract

Fractures of distal end of the radius are one of the most common injuries which lead to approximately 1/6th of all fractures which are observed and treated. The principle of the volar rim Locking Compression Plate is to have rigid fixation close to the bone and under the soft tissue envelope. Volar Rim Locking Compression Plates are anatomically designed plates to maintain alignment and to prevent collapse of the fracture fragment.

The study included a total of 30 cases of distal end radius fractures that were operated with open reduction and internal fixation with volar rim Locking Compression Plate.

Our study revealed nearly half of the study population with excellent outcome (47%), good outcome of 40% and fair outcome of 13% were noted while none of the patients had poor outcome. Most fractures united by 12 weeks. Complications associated were stiffness, arthritis and EPL tendon irritation.

Keywords: Distal end radius, comminuted, intra-articular, open reduction, internal fixation, volar rim locking compression plate

Introduction

Distal radius fractures crush the mechanical foundation of the man's most elegant tool, the hand. No other fracture has a greater potential to devastate hand function, and no other metaphysis of bone is embraced by more soft tissues. Fractures of the distal radius are among the most common fractures of the upper extremity and account for approximately one sixth (16%) of all fractures seen and treated in emergency rooms ^[1-3].

Fractures of the distal radius have traditionally been discussed with reference to the eponyms Colles, Smith, Pouteau, and Barton. However, it is more important today to determine the nature of the fracture and to describe the pathology involved, than to link diagnosis and treatment to a specific name. The type, direction and amount of displacement are the most important factors relating to treatment ^[4].

It is now generally accepted that for the volar Barton fractures and for Smith fractures, internal fixation is indicated as these fractures are always articular and are associated with actual or potential subluxation or dislocation of the carpus with a distal fracture fragment ^[5].

Regarding Colles fracture however, there still is a lot of discussion. In 1940, Sir Reginald Watson Jones claimed that it must always be remembered that a Colles fracture, if left untreated, usually results in a fully functioning hand and forearm, albeit with displacement and some limitation in movement ^[6].

It is important therefore to ensure that whatever treatment is given, the end result is better than leaving the fracture alone. In 1960, Sir John Charnley wrote: 'It is a fortunate thing that excellent functional results usually follow the common Colles' fracture, because disappointing results occasionally develop even in the most skilful hands' ^[7].

Even though these fractures are so common, significant controversy exists concerning the best method of treatment. Over the last 20 years there has been a significant rise in the interest level and understanding of the importance of treatment of distal radius fractures.

It is now realized that many patients after distal radius fractures definitively do not enjoy perfect freedom in all wrist movements and that they are definitely not exempt from pain even after many months ^[8].

Many fractures of the distal aspect of the radius are in fact relatively uncomplicated and are effectively treated with closed reduction and immobilization in a cast. However, fractures that are either

comminuted and/or involve the articular surfaces can jeopardize the integrity of the articular congruence and/or the kinematics of these articulations.

Methodology

Study design: The study design is 1.5 year prospective study.

Source of Data

Patients who sustained fractures of Distal end radius presenting at Department of Orthopaedics were included in the study.

Sample Size: A total of 30 cases were enrolled in the study.

Sample size calculation

Sample size was calculated considering the average of past three years hospital statistics on patients presenting with distal end radius fractures as below.

Number of cases treated with Volar Rim locking compression plate

- 2016–2017: 28 cases
- 2017–2018: 31 cases
- 2018-2019: 27 cases
- Total: 86 cases

Average: 28.66

Hence a sample size of 30 cases was planned.

Inclusion Criteria

- Fractures of distal end radius of either side with or without ulnar styloid involvement.
- AO MULLER 23 A1, A2, A3, B1, B2, B3, C1, C2, C3.
- For fixation of complex intra and extra articular fractures.
- Age between 18-70 years.

Exclusion Criteria

- Pathological fractures.
- Polytrauma patients.
- Skeletally immature patients.
- Non-union and delayed union.
- Fractures older than 2 weeks.

Data collection

The information such as sex, age, details of injury, duration and progression were obtained through an interview. Patients were subjected to clinical and local examination. These findings were recorded on predesigned and pretested proforma

Results

Table 1: Frykman/AO Type Distribution among subjects

		Count	%
Frykman/AO type	I/A2	4	13.33%
	II/A3	3	10.00%
	III/B3	6	20.00%
	IV/B2	3	10.00%
	V/B3	5	16.67%
	VI/C2	3	10.00%
	VII/C2	6	20.00%
	Total	30	100.00%

In the Study, Frykman/AO type I/A2 was 13.33%, II/A3 was 10.00%, III/B3 was 20.00%, IV/B2 was 10.00%, V/B3 was 16.67%, VI/C2 was 10.00% and VII/C2 was 20.00%.

Table 2: Time from injury to surgery (days) Type Distribution among subjects

		Count	%
Time from injury to surgery (days)	1	16	53.33%
	2	10	33.33%
	3	3	10.00%
	4	1	3.33%
	Total	30	100.00%

In the study, 53.33% got surgery done in 1 day, 33.33% in 2 days, 10.00% in 3days and 3.33% in 4days.

Table 3: Duration of follow up months Type Distribution among subjects

		Count	%
Duration of follow up months	6	25	83.33%
	9	4	13.33%
	12	1	3.33%
	Total	30	100.00%

In the Study, 83.33% had follow up after 6months, 13.33% after 9 months and 3.33% after 12 months.

Table 4: Mean Radial Length, Palmar Tilt and Articular Step off Distribution among subjects

	Mean	Median	SD
Radial length	8.87	9	1.36
Palmar tilt (Degree)	5.77	7.5	4.61
Articular step off (mm)	0.33	0	0.66

In the study, Mean Radial length was 8.87±1.36, Palmar tilt (Degree) was 5.77±4.61 and Articular step off (mm) was 0.33±0.66.

Table 5: Mean Deformity Distribution among subjects

	Mean	Median	SD
Palmar flexion(PF)	70.83	75	9.83
Dorsiflexion(DF)	75.5	80	11.01
Radial deviation(RD)	13	15	3.37
Ulnar deviation(UD)	21.5	20	5.75
Supination	80.67	80	8.68
Pronation	73.67	75	10.08
G&W Score	4.67	4	3.43

In the study, Mean Palmar flexion (PF) was 70.83±9.83, Dorsiflexion(DF) was 75.5±11.01, Radial deviation(RD) was 13±3.37, Ulnar deviation(UD) was 21.5±5.75, Supination was 80.67±8.68, Pronation was 73.67±10.08 and G&W Score was 4.67±3.43.

Table 6: Mean G & W Score Distribution among subjects

	Mean	Median	SD
G&W Score	4.67	4	3.43

In the Study, Mean G&W Score was 4.67±3.43.

Table 7: Complications Distribution among subjects

		Count	%
Complications		28	93.33%
	Arthritis	1	3.33%
	EPL Tendon rupture	1	3.33%

In the Study, 3.33% had Arthritis and 3.33% had EPL Tendon rupture

Table 8: Results Distribution among subjects

		Count	%
Results	Excellent	14	46.67%
	Fair	4	13.33%
	Good	12	40.00%

Results were Excellent in 46.67%, Fair in 13.33% and Good in 40%.

Discussion

In the present study majority that is, 53.33% of the patients had right sided fracture and 33.33% had nature of trauma as fall from outstretched hand. Nearly half of the study population that is, 40% of the patients presented with grade VII& grade III Frykman followed by grade V and grade I.

In this study majority that is, 85% of the patients had clinical union at second follow up and at the same interval 65% of the patients had radiological union. In the remaining the clinical union was noted during third follow up that is clinical union in 15% and radiological union in 35%. The relatively large number of outcome measures available for evaluating wrist and hand function provides clinicians with a wide range of choice, thereby enabling them to use that outcome instrument which is the most appropriate and suitable. The choice of an outcome measure is determined by the clinical condition one wishes to assess; the resources available and the psychometric properties are often additional determining factors. The functional outcome based on GARTLAND & WERLEY demerit score at the end of third follow up revealed nearly half of the study population with excellent outcome (47%) and good and fair outcomes were noted among 40% and 13% respectively while none of the patients had poor outcome. No association was found between mechanism of injury, side involved and type of fracture suggesting that the outcome was independent of etiology, side involved and type of fracture.

Phadnis *J et al.*^[9] in 2011 to report the functional outcome of a large number of patients at a significant follow up time after fixation of their distal radius with a volar locking plate reported 74% of the patients with good or excellent DASH and MAYO score. Statistical analysis showed that no specific variable including gender, age, fracture type, post-operative immobilisation or surgeon grade significantly affected outcome. Complications occurred in 27 patients (15%) and in 11 patients were major (6%). Study demonstrated good to excellent results in the majority of patients after volar locking plate fixation of the distal radius, with complication rates comparable to other non-operative and operative treatment modalities and recommended this mode of fixation for distal radius fractures requiring operative intervention. Rozental *et al.* showed mostly good and excellent functional outcomes in 45 patients at 17 months mean follow up. Similar larger series^[10, 11] have reviewed the outcome of volar plate fixation in cohorts of 150 (24 months follow up) and 114 (12 months) patients respectively. Like our study these both showed good to excellent functional outcome using the DASH score. Rohit Arora *et al.*,^[11] used modified Green and Obrein score and reported 31 excellent, 54 good, 23 fair and 6 poor results. Minegishi H *et al.*^[12] in 2011 to evaluate the functional and radiological results of treating unstable distal radius fractures with the volar locking plates among 15 patients reported 5 patients with excellent outcome, 7 with good outcome, and 3 with fair outcome according to Cooney's Clinical Scoring Chart.

In this study, complication of arthritis was present in 4% of the patients. Maximum (60%) patients had pain at first follow up which sub-sided during second (25%) and third follow up (10%). Similarly swelling was noted also present among maximum patients during first follow up which reduced and during second and third follow up it was seen in only 20% and 5% of the patients respectively. Phadnis *J et al.*^[9] in 2011 reported complications in 15% of the patients major complications among 6% of the patients. Minegishi H *et al.*^[12] in 2011 reported rupture of the flexor pollicis longus tendon occurred in 1 patient.

Locked volar plates are now greatly used as a treatment method for unstable distal radius fractures. They present a biomechanical advantage and a lower risk of tendon complications than shown by dorsal plates. The results from using this type of plate have shown varying incidence of complications. Loss of range of motion and grip strength were also observed, but with few functional repercussions.

Conclusion

The present study demonstrates good to excellent results in the majority of patients based on G&W functional outcome evaluation after volar rim locking plate fixation for distal end radius with lower rate of complications. Hence variable angle volar rim locking plate fixation may be recommended for distal radius fractures requiring operative intervention with early mobilization of wrist joint.

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