



FUNCTIONAL OUTCOME ANALYSIS OF DISTAL RADIUS FRACTURES MANAGED BY VOLAR LOCKING COMPRESSION PLATING VS VARIABLE ANGLE VOLAR LOCKING COMPRESSION PLATING

Orthopaedics

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ABSTRACT

Introduction Distal radius fractures are mostly insufficiency fractures in osteoporotic bone of elderly and following high velocity injuries in young patients. Treatment options for distal radius fractures vary widely from closed reduction and casting, percutaneous pinning or external fixation, and open reduction and internal fixation. More recently, variable-angle locking screw volar plates have become available providing greater versatility with plate and screw fixation for the management of distal radius fractures. We have analysed functional outcome of distal radius fractures managed by volar locking compression plating Vs variable angle volar locking compression plating. **Materials and methods:** We did a prospective review of 30 cases with distal radius fracture of which 15 cases treated by volar locking compression plating and 15 cases by variable angle locking compression plating. A detailed preoperative clinical and radiological assessment of the fracture pattern was done before surgery. Functional outcomes were measured using Mayo wrist score. Skin condition and bony union and wrist range of movements were assessed in the followup visits. **Results:** In our study radiological outcome was found by calculating mean radial height, palmar tilt and radial inclination. In Volar LCP patients they were 8.24 mm, 7.33 degree and 15.96 degree respectively at 9 months. In VA-LCP patients they were 10.23mm, 9.8 degree and 19.82degree respectively at 9 months, which are statistically highly significant ($p < 0.05$). At 9 months mean mayo wrist score was similar in both group. **Conclusion:** In this study, there was no significant difference in Satisfaction or Mayo Wrist Scoring in both groups but radiological outcome seems to be better in VA LCP than Volar LCP. Rate of complications and secondary operation in each group was not significantly different.

KEYWORDS

Distal radius fractures, volar locking compression plate, variable angle locking compression plate.

INTRODUCTION:

Distal radius fractures are among the most common fractures treated, accounting for 10% to 25% of all fractures^{1,2,3}. It has bimodal age distribution. Distal radius fractures are mostly insufficiency fractures in osteoporotic bone of elderly and following high velocity injuries in young patients.

Due to its high energy association, now most of the distal radius fractures are associated with other long bone fractures. So much of importance is given in treating long bone fracture fixation and neglecting distal radius fracture which results in poor functional outcome.

As life expectancies increase and the prevalence of osteopenia climbs, it is estimated that the incidence of these injuries will continue to increase over the next decade. Although once believed that Colle's fractures do well non surgically in all cases, it is now understood that anatomic restoration of the distal radius and its articular surface is central to avoiding the development of post-traumatic arthritis, wrist instability, and painful range of motion⁴⁻⁶.

Treatment options for distal radius fractures vary widely from closed reduction and casting, percutaneous pinning or external fixation, and open reduction and internal fixation (ORIF). Although closed reduction and casting remain viable options with satisfactory long-term outcomes in certain fracture characteristics, the role for ORIF has grown with its ability to more reliably restore wrist anatomy, minimize immobilization, and establish acceptable outcomes⁷⁻¹².

Open Reduction and Internal Fixation options include volar plating, radial plating, dorsal plating, fragment specific fixation, and intramedullary nailing. In recent years, volar locked plating has grown in popularity due to its consistent surgical approach, capacity to provide stable fixation of periarticular fractures despite osteopenia or comminution, and ability to facilitate early motion and rehabilitation^{13,14}. More recently, variable-angle locking screw volar plates have

become available providing greater versatility with plate and screw fixation for the management of distal radius fractures

AIM OF THE STUDY

To analyse the “**Functional outcome of distal radius fractures managed by Volar Locking compression plating Vs Variable Angle Volar locking compression plating**” done in our Institute of Orthopaedics and Traumatology, Madras medical College and Rajiv Gandhi Government General Hospital between the period of June 2018 and November 2020.

MATERIALS AND METHODS

This study was designed to review and compare the functional outcome analysis of distal radius fractures managed by volar locking compression plating and variable angle volar locking compression plating. Ethical committee approval was obtained. Patients with distal radius fractures were randomly classified into two groups based on certain demographic criteria, one group was treated with fixed angle locking compression plate and the other group treated with variable angle locking compression plate through volar approach.

Inclusion Criteria:

1. Age more than 18 years
2. Closed Fractures
3. Intraarticular Distal Radius fracture with either volar or dorsal displacement
4. AO type A Extraarticular ,type B and type C Distal Radius intraarticular fracture associated with or without ulnar styloid fracture

Exclusion Criteria:

1. Age less than 18 years
2. All open fractures
3. Severe osteoporosis with limited functional capacities
4. Medical co-morbidities

Patients of both sexes were recruited in the study according to the devised inclusion and exclusion criteria.

OBSERVATION & RESULTS

In our study the following observation were made

Age Incidence

Patient's age ranged from 23-75 yrs. The mean age is 39yrs.

Age distribution		
	Frequency	Percent
21 - 30 years	8	26.7
31 - 40 years	10	33.3
41 - 50 years	7	23.3
Above 50 years	5	16.7
Total	30	100.0
Mean $\pm$ SD = 39 $\pm$ 12 years		

Sex Incidence

In our study male predominated with the ratio of 4:1

Gender distribution		
	Frequency	Percent
Female	6	20.0
Male	24	80.0
Total	30	100.0

Age		Surgical procedure		Total	χ^2 - value	p-value
		Volar LCP	VA Volar LCP			
21 - 30 years	Count	5	3	8	1.243	0.743 #
	%	33.3%	20.0%	26.7%		
31 - 40 years	Count	4	6	10		
	%	26.7%	40.0%	33.3%		
41 - 50 years	Count	3	4	7		
	%	20.0%	26.7%	23.3%		
Above 50 years	Count	3	2	5		
	%	20.0%	13.3%	16.7%		
Total	Count	15	15	30		
	%	100.0%	100.0%	100.0%		

No Statistical Significance at $p > 0.05$ level

Gender		Surgical procedure		Total	χ^2 - value	p-value
		Volar LCP	VA Volar LCP			
Female	Count	3	3	6	0.000	1.000 #
	%	20.0%	20.0%	20.0%		
Male	Count	12	12	24		
	%	80.0%	80.0%	80.0%		
Total	Count	15	15	30		
	%	100.0%	100.0%	100.0%		

No Statistical Significance at $p > 0.05$ level

Side Of Injury

In our study 18 patients had left sided injury accounting for 60% of the total patients

Side of injury		Surgical procedure		Total	χ^2 - value	p-value
		Volar LCP	VA Volar LCP			
Left	Count	10	8	18	0.556	0.456 #
	%	66.7%	53.3%	60.0%		
Right	Count	5	7	12		
	%	33.3%	46.7%	40.0%		
Total	Count	15	15	30		
	%	100.0%	100.0%	100.0%		

No Statistical Significance at $p > 0.05$ level

Mode Of Injury

RTA was the predominant mode of injury in our series

Mode of injury		Surgical procedure		Total	χ^2 - value	p-value
		Volar LCP	VA Volar LCP			
Accidental fall	Count	3	2	5	1.581	0.664 #
	%	20.0%	13.3%	16.7%		
Fall from height	Count	1	2	3		
	%	6.7%	13.3%	10.0%		
H/o Assault	Count	0	1	1		
	%	0.0%	6.7%	3.3%		
RTA	Count	11	10	21		
	%	73.3%	66.7%	70.0%		
Total	Count	15	15	30		
	%	100.0%	100.0%	100.0%		

No Statistical Significance at $p > 0.05$ level

Fracture Classification

All fractures are distributed to according to AO Classification

AO		Surgical procedure		Total	χ^2 - value	p-value
		Volar LCP	VA Volar LCP			
A2	Count	2	1	3	7.652	0.265 #
	%	13.3%	6.7%	10.0%		
A3	Count	1	0	1		
	%	6.7%	0.0%	3.3%		
B1	Count	2	0	2		
	%	13.3%	0.0%	6.7%		
B2	Count	1	1	2		
	%	6.7%	6.7%	6.7%		
B3	Count	4	7	11		
	%	26.7%	46.7%	36.7%		
C1	Count	5	3	8		
	%	33.3%	20.0%	26.7%		
C2	Count	0	3	3		
	%	0.0%	20.0%	10.0%		
Total	Count	15	15	30		
	%	100.0%	100.0%	100.0%		

No Statistical Significance at $p > 0.05$ level

Out of 30 patients only 8 presented with significant co-morbid illness in the form of systemic hypertension or Diabetes mellitus which were controlled prior to surgery.

18 patients had associated skeletal injuries which were treated appropriately.

Associated injuries		Surgical procedure		Total	χ^2 - value	p-value
		Volar LCP	VA Volar LCP			
Absent	Count	6	6	12	0.000	1.000 #
	%	40.0%	40.0%	40.0%		
Present	Count	9	9	18		
	%	60.0%	60.0%	60.0%		
Total	Count	15	15	30		
	%	100.0%	100.0%	100.0%		

No Statistical Significance at $p > 0.05$ level

Radiological Outcome

Variables	Groups	N	Mean	S.D	t-value	p-value
Palmar tilt	Volar LCP	15	7.3	1.4	5.819	0.0005 **
	VA Volar LCP	15	9.8	0.9		

** Highly Statistical Significance at $p < 0.01$ level

Variables	Groups	N	Mean	S.D	t-value	p-value
Radial height	Volar LCP	15	8.2	0.9	8.342	0.0005 **
	VA Volar LCP	15	10.3	0.5		

** Highly Statistical Significance at $p < 0.01$ level

Variables	Groups	N	Mean	S.D	t-value	p-value
Radial inclination	Volar LCP	15	15.9	1.7	6.138	0.0005 **
	VA Volar LCP	15	19.8	1.8		

** Highly Statistical Significance at $p < 0.01$ level

Functional Outcome

Variables	Groups	N	Mean	S.D	t-value	p-value
Mayo wrist score	Volar LCP	15	81.7	13.0	0.553	0.585 #
	VA Volar LCP	15	84.0	9.9		

No Statistical Significance at $p > 0.05$ level

Mayo wristscore	Volar LCP	VA-LCP
Excellent	6	8
Good	5	5
Satisfactory	3	2
Poor	1	0

Fracture	Functional Outcome	
	Volar LCP	VA-LCP
A2	Excellent	Excellent
A3	Poor	-
B1	Good	-
B2	Good	Excellent
B3	Satisfactory to good	Excellent
C1	Good	Good
C2	-	Good

RESULTS

All 30 cases admitted reporting to emergency and outpatient department were considered for the study. Majority of patients in both the group were found in age group 30 to 40 years. Total male and female patients in our study were 24 and 6 respectively. In our study there were 18 cases of left sided involvement and 12 cases of right sided involvement. Road traffic accident (RTA) was the leading cause of fractures in 21 patients respectively. Other causative factors were fall from height and assault. All patients were operated in the range 3-15 days from injury to surgery. The average delay in surgery was 7 days. Neurovascular status was intact in all patients in our study. Tourniquet was used in 6 patients and haemostasis was achieved using diathermy in all patients before closure of surgical wound. All the patients were approached by modified Henry approach for distal radius. 15 patients were treated with volar locking compression plating and 15 were treated with Variable angle volar locking compression plating. The average duration of surgery was 1 hour and 15 minutes with range being 45 minutes to 1 hour and 30 minutes. The reduction of distal radius were confirmed with C-arm during the fixation and ensured before closure of the surgical site. Radiographic evaluation confirmed fracture healing in all patients by 3 months. In our study radiological outcome was found by calculating mean radial height, palmar tilt and radial inclination. In Volar LCP patients they were 8.24 mm, 7.33 degree and 15.96 degree respectively at 9 months. In VA-LCP patients they were 10.23mm, 9.8 degree and 19.82 degree respectively at 9 months, which are statistically highly significant ($p < 0.05$). It implies that radiological outcomes are much close to natural wrist radiology in variable angle volar locking plate group. At 9 months mean Mayo wrist score was similar in both groups. This shows that variable angle volar locking plate group has similar functional outcome compared with volar locking plate group. The most common complication was finger and wrist stiffness which was in 2 cases and 1 case in Volar LCP and VA-LCP respectively. Wound infection was in 1 case of Volar LCP, which was superficial infection successfully treated with antibiotics. No deep infections were noted in our study. Residual pain was seen in 2 cases of Volar LCP.

DISCUSSION

Fractures of the distal end radius particularly requiring anatomical reduction of radio-carpal and radio-ulnar joint congruency must be treated with open reduction and internal fixation for better radiological and functional outcomes. The return of better hand and finger functions has been attributed with early wrist movements.

Age

	Minimum age in years	Maximum age in years	Average age in years
Fowler et al	16	89	57
Park et al	18	78	48
Marlow et al	17	90	57
Regar CL et al	18	65	42
Our study	23	75	39

The average age of 39 years in our study is comparable to Regar CL et al and Park et al¹⁵ who had an average age of 42 & 48 respectively. Our study had a male preponderance with 24 of 30 cases and is comparable to Marlow et al and Regar CL et al which were 80% and 70% respectively. The higher incidence among the males would be due to higher involvement in road traffic accidents.

Involved Side

In our study the right side was involved in 12 cases and left side involvement was 18.

	Right side	Left Side
Regar CL et al	102	54
Marlow et al	16	9
Chen et al	21	26
Our study	12	18

Mode Of Injury

In our study 70% (21 cases) of the patients had Road traffic accident and 30% had Domestic fall

Study	RTA	Domestic fall
Regar CL et al	101	55
Khatri et al	18	4
Our study	21	9

Type of Fracture

Based on AO classification, we had 3(10%) cases are A2(Extraarticular fracture of radius, simple & impacted) type fractures, 1(3.3%) is A3(Extraarticular fracture of radius, multi fragmentary), 2(6.7%) cases are B1(partial articular fracture of radius, Sagittal), 2(6.7%) case is B2(Partial articular fracture of radius, dorsal rim), 11(36.7%) cases are B3(, Partial articular fracture of radius, volar rim), 8(26.7%) cases are C1(Complete articular fracture of radius, articular and metaphyseal simple), and 3(23.3%) cases are C2 (Complete articular of radius, articular simple and metaphyseal multi fragmentary) fractures.

Based on AO classification Kavin Khatri et al¹⁶ reported 4 cases by A3, 9 cases by C2 and 10 cases by C3.

Based on AO classification William J. Marlow et al¹⁷ reported 27 cases by A, 8 cases by B, and 72 cases by C.

Based on AO classification Regar CL et al Group A(volar lcp) had 6 type B1, 12 type B2, 18 type B3, 15 type C1, 17 type C2, 10 type C3. Group B(VA LCP) had 5 type B1, 4 type B2, 18 type B3, 15 type C1, 22 type C2, 14 type C3.

Complications:

We encountered Five complications (16.6%) in our study. Three being Wrist stiffness, another developed Superficial Infection and one developed residual pain.

William J. Marlow et al¹⁷ A total of 5 (7.69%) complications were observed in VA-LCP, A total of 5 (11.91%) complications were observed in Volar LCP,

Regar CL et al (14% complication in Volar LCP, 4% in VA-LCP) Khatri et al reported an overall complication rate of 21.7%

Mehrzad and Kim et al¹⁸ (the proportion of hardware complications in those patients with the fixed angle plate (12%) was significantly higher ($P < 0.001$) than the proportion observed in those treated with the polyaxial locking plate.

Results Compared With Other Studies

In our study we had Excellent results in (53% in VA-LCP, 40% in volar LCP) Good in (33% in Both groups) Satisfactory in (20% in Volar LCP, 13% in VA LCP) Poor in (6% in volar LCP). In Our study functional outcome is similar in both groups but radiological outcome seems to be better in VA-LCP.

Fowler et al (32) reported excellent clinical outcomes at 1-year follow-up in patients treated with VA-LCP.

Khatri et al¹⁶ reported the use of variable-angle locking plates in treating unstable distal end radius fractures is associated with excellent to good functional outcomes with minimal complications.

Chen et al¹⁹ report favorable clinical and radiographic results using the VA-LCP system compared to the FA-LCP.

Mehrzad and Kim et al¹⁸ suggest that treatment of unstable distal radius fractures with a volar bearing variable angle plate fixation is safe and effective

Regar CL et al²⁰ reports that patients treated with variable angle volar plate showed better results in functional and radiological outcomes at 12 months follow-up but limitations include short duration of follow up.

CONCLUSION

- Complex and unstable fractures of the distal radius can be optimally managed with volar locking plates.
- Both variable angle and fixed angle locking plate designs are effective in maintaining radiological reduction of complex distal radius fractures and both systems are user friendly.
- In this study, there was no significant difference in Satisfaction or Mayo Wrist Scoring in both groups but radiological outcome seems to be better in VALCP than Volar LCP
- Rate of complications and secondary operation in each group was not significantly different.
- Variable angle locking plates may provide the potential advantage of flexibility in implant positioning and enhanced intra-

fragmentary fixation in certain fractures.

- The limitation of this study includes small study group, short follow up period.

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