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A prospective observational study to assess the functional outcome of fracture distal end of radius treated with locking compression plate by volar approach

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Abstract

Introduction: Distal radius fractures are one of the most common skeletal injuries in the daily orthopaedic practice. They represent approximately 16% of all adult fractures treated by orthopedic surgeons. Outcome of the displaced extra-or intra-articular fractures require a good anatomical reduction. Various treatments such as manipulation and casting, percutaneous pinning with Kirschner (K) wires, External fixators were being practiced to treat distal radius fractures. Recent advances with Locking compression plates restore anatomical alignment and allow patient to start early mobilisation. The aim of our study is to compare the advantages and disadvantages of intraarticular distal radius fractures fixed with internal fixation using locking compression plate and to analyze the functional and radiological outcomes.

Methods: The present study was carried out on 52 cases of intraarticular distal radius fractures treated by open reduction and internal fixation using locking compression plating (LCP) in Department of orthopaedics, Guntur medical college, Andhra Pradesh between November 2014 and October 2015. Functional outcome of patients was evaluated using Mayo modified wrist score and Lidstrom classification score. Data was analysed using SPSS v17 Software.

Results: 52 Patients with intra articular distal radius fractures who fit the inclusion criteria, were selected and operated. Follow up of patients at 10 days, 6 weeks, 3 months and 6 months were studied according to Mayo modified wrist score. 47 patients exhibited excellent results and 5 patients exhibited good results. Radiological outcome using Lidstrom classification score were measured and 29 patients exhibited excellent results, 19 patients exhibited good results and 4 patients exhibited satisfactory results. Out of 4 patients One developed infection and implant exit was done and another 2 patients developed wrist stiffness and one patient developed hypertrophic scar.

Conclusion: In the present study open reduction internal fixation using locking compression plate with screws was done for intra articular distal radius fractures. This resulted in successful outcome in terms of anatomic realignment, better access with minimal surgical trauma, functional outcomes and fewer complications.

Keywords: observational study, functional outcome, fracture distal end, radius treated

Introduction

Fractures of the distal end of radius are one of the most common skeletal injuries encountered in the Orthopedic Department. Fractures of distal radius represent approximately 16% of all adult fractures treated by orthopedic surgeons [1]. Management of these fractures has remained a controversial issue [2]. Various operative and non-operative treatment options are available, without there being a consensus as to an optimal method [3, 4].

In spite of various new advances, closed reduction and cast immobilization has been the mainstay of treatment of these fractures but mal-union of fracture and subluxation/dislocation of distal radio ulnar joint resulting in poor functional and cosmetic results is the usual outcome [5, 6]. Numerous other methods of treating injuries of this nature like closed percutaneous pinning, external fixation, buttress plating have enjoyed recognition from time to time, testifying the fact that there is no ideal modality of treatment.

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In the early 1950s, James Ellis from England started using a specially designed T plate to buttress the small marginal fragment in Volar Barton's fractures. In the 1970s, AO group designed plates specifically for the treatment of distal radius fractures. There are two types of plates for fractures of the distal radius: (a) Conventional plates and (b) Fixed angle locking compression plates. With conventional plates and screws, stability is achieved by compression of the plate to a bone by bi-cortical screws. With fixed angle locking plates, the locking screws support sub-chondral bone and resist axial forces.

The present study is conducted to study the advantages & disadvantages of open reduction internal fixation using locking compression plate with screws, for intra articular distal radius fractures and to analyze the functional and radiological outcomes.

Methods

This prospective observational study was undertaken in the Department of Orthopedics, Guntur Medical College, Andhra Pradesh for a period of one year between November 2014 to October 2015. 52 patients, aged more than 18 years, with fracture of distal end of radius without fracture of distal ulna were included in the study. Patients with compound injuries and skeletal injuries other than fracture of lower end of radius and ulna were excluded from the study.

Ethical approval for the study was obtained from Institutional Ethics Committee. Written informed consent was obtained from all eligible patients. History was obtained from the patients and they were examined clinically and radiologically. All necessary investigations like blood tests, 2D Echo, ECG and Chest X-ray were done. Pre-anaesthetic checkup was done for all the patients. Surgery was performed, under spinal or general anesthesia, as per standard procedure. Physiotherapy was started on first post-operative day.

All the patients were followed up at 10 days, 6 weeks, 3 months & 6 months after the operation and assessed clinically and/or radiologically. Functional outcome of patients was evaluated using Mayo modified wrist score and Lidstrom classification score.

Data was analysed using SPSS v17. Categorical data was expressed as frequencies and percentages. Continuous data was expressed as mean and standard deviation. Paired T test was used to compare before (pre operative) and after (post operative visits at 10 days, 6 weeks, 3 months and 6 months) mean values. P value less than 0.05 was considered as statistically significant.

Results

Of the 52 total study participants 43(82.69%) were males and 9 were females (17.30%). 29 (55.77%) belonged to 40-60 years age group, 15 (28.85%) to above 60 year age group and 7 (13.73%) to 25-40 years age group. Only 1(1.96%) patient belonged to youngest age group i.e. 18-25 years age group (Table 1a).

Majority i.e. 35(67.31%) of the study participants sustained fracture by road traffic accidents, followed by fall from height or any other way in 17(32.69%). Most of the fractures were on the right side i.e. 30(57.69%) (Figure 1) (Table 1b).

The mean radial inclination pre operatively was found to be $8.58^{\circ} \pm 3.31^{\circ}$. At first follow up after 10 days post operatively,

mean radial inclination has increased and found to be $19.1^{\circ} \pm 3.09^{\circ}$ and this rise in mean radial inclination is found to be statistically significant ($p < 0.0001$). Similarly, mean radial inclination at second follow up was found to be 18.83 ± 3.28 , at 3rd follow up 18.54 ± 3.38 and at last follow up $18.67^{\circ} \pm 3.34^{\circ}$. Increased mean radial inclination on post operative follow up was found to be statistically significant ($p < 0.0001$) in comparison to pre-operative value.

Mean volar tilt pre operatively was $14.56^{\circ} \pm 5.81^{\circ}$, at first follow up post operatively $9.56^{\circ} \pm 1.43^{\circ}$, at second follow up $9.43^{\circ} \pm 1.78^{\circ}$ and at 3rd and last follow up $9.23^{\circ} \pm 1.54^{\circ}$ and $9.17^{\circ} \pm 1.79^{\circ}$ respectively. The mean volar tilt decreased post operatively at every follow up in comparison to pre-operative mean volar tilt and it is found to be statistically significant ($p < 0.0001$) (Table 2a).

Mean intra articular steps pre operatively was $2.23\text{mm} \pm 0.85\text{mm}$ and post operatively at first follow up it was $0.93\text{mm} \pm 0.53\text{mm}$, at second follow up $0.89\text{mm} \pm 0.64\text{mm}$ and at 3rd and last follow up $0.75\text{mm} \pm 0.67\text{mm}$ and $0.81\text{mm} \pm 0.71\text{mm}$ respectively. The mean intra articular steps decreased post operatively at every follow up in comparison to pre-operative mean intra articular steps and is found to be statistically significant [$p < 0.0001$].

Mean ulnar variation pre operatively was $1.51\text{mm} \pm 0.82\text{mm}$ and post operatively at first follow up it was $-0.60\text{mm} \pm 0.70\text{mm}$, at second follow up $-0.60\text{mm} \pm 0.70\text{mm}$ and at 3rd and last follow up $-0.60\text{mm} \pm 0.72\text{mm}$ and $-0.81\text{mm} \pm 0.34\text{mm}$ respectively. The mean ulnar variation decreased post operatively at every follow up in comparison to pre-operative mean ulnar variation and is found to be statistically significant ($p < 0.0001$) (Table 2b).

At first follow up 10 days post operatively 13(25%) patients showed satisfactory and 39(75%) patients showed poor results whereas no patient showed excellent or good results. At second follow up 6 weeks post operatively, results improved and 9(17.31%) patients showed excellent, 37(71.15%) patients showed good and 6(11.54%) patients showed satisfactory results while no patients reported poor result. Further at 3rd follow up 3 months post operatively, 35(67.31%) patients exhibited excellent and 13(25%) patients exhibited good results; only 4(7.69%) patients showed satisfactory results whereas no patients reported poor result. At last follow up 6 months post operatively, 47(90.38%) patients exhibited excellent and 5(9.62%) patients exhibited good results while no patient exhibited satisfactory or poor results (Figure 2) (Table 3).

Radiological outcome according to Lidstrom classification score system was measured and 29(55.77%) patients exhibited excellent results, 19 (36.54%) patients exhibited good results and only 4(7.69%) patients exhibited satisfactory results whereas no patient exhibited poor result (Table 4).

We had to remove the implant in one patient due to infection while another patient had developed reflex sympathetic dystrophy which subsided during the follow up period after conservative management. One patient had developed features of teno-synovitis initially which was treated with anti-inflammatory drugs and the same patient had prominent plate in final follow up. Wrist stiffness developed in two patients and hypertrophic scar in one patient.

Table 1a: Distribution of study patients according to age and gender

S.N.	Age groups (Years)	Male		Female		Total	
		No.	%	No.	%	No.	%
1	18-25	1	2.33	0	0	1	1.92
2	25-40	6	13.95	1	11.11	7	13.46
3	40-60	24	55.82	5	55.56	29	55.77
4.	> 60	12	27.90	3	33.33	15	28.85
Total		43	100	9	100	52	100

Table 1b: Distribution of other demographic and other variables

S.N.	Variables	Respected figure
1.	Mean age at presentation	40.03±30.76 years
2.	Mode of injury	
	a) Road traffic accident	35 (67.31%)
	b) Fall	17(32.69%)
3.	Laterality of injured hands	
	a) Right	30 (57.69%)
	b) left	22(42.31%)

Table 2a: Assessment and comparison of various radiological parameters

	Follow up	Radial Inclination (Mean ± SD)	Paired t test (Between pre op and every follow up)	Volar Tilt (Mean ± SD)	Paired t test (Between pre op and ever follow up)
1.	Pre-op	8.58° ± 3.31°		14.56° ± 5.81°	
2	10 days post op	19 .1°± 3.09°	t= 15.9 p<0.0001	9.56° ± 1.43°	t= 5.96 p<0.0001
3.	6 weak post op	18.83° ± 3.28°	t= 15.7 p<0.0001	9.43° ± 1.78°	t= 6.02 p<0.0001
4	3 month post op	18.54° ± 3.38°	t= 15.03 p<0.0001	9.23° ± 1.54°	t= 6.33 p<0.0001
5	6 month post op	18.67° ± 3.34°	t= 15.32 p<0.0001	9.17° ± 1.79°	t= 6.332 p<0.0001

Table 2b: Assessment and comparison of various radiological parameters

	Follow up	Intra articular steps (mm) (Mean ± SD)	Paired t test (Between pre op and every follow up)	Ulnar variance (mm) (Mean ± SD)	Paired t test (Between pre op and every follow up)
1.	Pre-op	2.23± 0.85	t=9.2,	1.51 ± 0.82	
2	10 days post Op	0.93 ± 0.53	p<0.0001	-0.60±0.70	t=6.02, p<0.0001
3.	6 weak post Op	0.89 ± 0.64	t=8.9, p<0.0001	-0.60±0.70	t=6.02, p<0.0001
4	3 month Post Op	0.75 ± 0.67	t=9.7, p<0.0001	-0.60±0.72	t=5.95, p<0.0001
5	6 month Post Op	0.81 ± 0.71	t=9.15, p<0.0001	-0.81 ± 0.34	t=5.63, p<0.0001

Table 3: Grading of functional recovery of patients according to Mayo scoring system

S.N.	Functional grading	At 10 days (%)	At 6 wk (%)	At 3month (%)	At 6 month (%)
1	Excellent	0(0)	9 (17.31)	35 (67.31)	47 (90.38)
2	Good	0(0)	37 (71.15)	13 (25)	5(9.62)
3	Satisfactory	13(25)	6 (11.54)	4 (7.69)	0(0)
4	Poor	39(75)	0(0)	0(0)	0(0)

Table 4: Radio logical outcome according to Lidstrom classification score system at last follow up [6 months]

S.N.	Functional grading	Out come at 6 month	
		Patients No	Percentage
1	Excellent	29	55.77
2	Good	19	36.54
3	Satisfactory	4	7.69
4	Poor	0	0



Fig 1: Shows in Distribution of other demographic and other variables



Fig 2: Grading of functional recovery of patients according to Mayo scoring system

Discussion

Treatment of distal end radius fracture is still controversial despite continuous refinement in the treatment. There is no customized solution for all fractures of distal end of radius. Treatment is based on fracture type, patient's demand & characteristics, financial status and on treating surgeon's experience and preference.

In this study mean age of the patients was found to be 40.03 years. Chauhan *et al.* [7] reported mean age of 42.8 years, Pratap *et al.* [8] reported mean age of 36.6 years, Jagdev SS [9] reported mean age of 43.2 years. In the present study 55.82% of males and 55.56% of females were in the 40-60 years age group. 27.90% of males and 33.33% of females were in the above 60 years age group.

In this study 67.31% of patients sustained fracture due to road traffic accidents and 32.69% due to a fall. Jagdev SS *et al.* [9] reported that 57.77% of patients sustained fracture due to road traffic accident and 42.33% due to simple fall. Vishwanath *et al.* [10] reported that 64% of the fractures were due to road traffic accidents and Chauhan AN *et al.* [7] reported that 57.1% of the fractures were due to road traffic accidents. In this study 57.69% of the fractures were on right side and 42.31% of the fractures on left side. Jagdev SS *et al.* [9] reported 64.44% of fractures on right side. Vishwanath *et al.* [10] reported 70% of the fractures on right side in their study. Both these findings are comparable to the present study finding and it might be due to the fact that right handed persons are common and people try to protect themselves by

their right hand due to natural reflex response.

In this study pre operative mean radial inclination was observed to be $8.58^\circ \pm 3.31^\circ$ and post operatively at 10 day follow up it became $19.1^\circ \pm 3.09^\circ$ and this change was found to be statistically significant ($p < 0.0001$). After the 1st follow up mean radial inclination remained almost same at every follow up. Similar findings have been reported by Agarwal P *et al.* [11] in their study.

In the present study mean volar tilt was observed to be $14.56^\circ \pm 5.81^\circ$ pre operatively and it changed significantly to $9.56^\circ \pm 1.43^\circ$ at 10th post operative day ($p < 0.0001$). After the 1st follow up it did not change significantly at subsequent follow ups. Similar findings and pattern have been reported by Agarwal P *et al.* [11] in their study. Agarwal *et al.* [12] in their study have described an average change in volar tilt of 0.8 and none of the patients had shown a change in volar tilt greater than 2° . This is not in line with the findings in the present study but they had not mentioned pre-operative values.

Mean pre-operative intra articular steps was found to be $2.23\text{mm} \pm 0.85\text{mm}$ and significantly changed to $0.93\text{mm} \pm 0.53\text{mm}$ at first follow up ($p < 0.0001$). There was no significant change when comparison was made between the post operative values. Similar findings and pattern has been reported by Agarwal P *et al.* [11].

Mean ulnar variance was $1.51\text{mm} \pm 0.82\text{mm}$ preoperatively and this significantly reduced to $-0.60\text{mm} \pm 0.70\text{mm}$ at 1st follow up ($t = 6.02$ $p < 0.0001$). There was no significant change when comparison was made between the post operative values. Agarwal P *et al.* [11] reported almost similar findings.

In this study functional outcomes were assessed by Mayo Scoring system. At 1st follow up on 10th post operative day 25% have shown satisfactory and remaining i.e. 75% poor response. As time passed the functional outcome improved progressively at subsequent follow ups This pattern may indicate the time required for healing. Agarwal *et al.* [12] in their study reported similar pattern. Chauhan AN *et al.* [7] in their study reported excellent results in 45.7%, good results in 42.95% and satisfactory results in 11.4% which were different from the present study findings. This may be due to the fact that Mayo score system was not used in their study.

In the present study radiological outcomes were assessed at last follow up i.e.

after 6 months by Lidstrom classification score system. Excellent results were found in 55.77% of patients, good results in 36.54% and satisfactory results in 7.69% cases. None of the patients showed poor response. Chauhan AN *et al.* [7] reported similar finding with excellent results in 54.3%, good results in 37.1% and fair results in 8.6% using Lidstrom classification score system.

In the present study one patient had develop infection during treatment which required removal of the implant. Pratap *et al.* [8] also reported similar complication but infection was the only complication in their study. One patient had developed reflex sympathetic dystrophy which subsided during the follow up period after conservative management. One patient had developed features of teno-synovitis initially which was treated with anti-inflammatory drugs and the same patient had prominent plate in final follow up. Similar complication was reported by Jagdev SS *et al.* [9] in their study. Wrist stiffness developed in two patients and hypertrophic scar in one patient.

Conclusion

In the present study open reduction internal fixation using locking compression plate with screws was done for intra

articular distal radius fractures. This resulted in successful outcome in terms of anatomic realignment, better access with minimal surgical trauma, functional outcomes and fewer complications.

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