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Original Research Article

Comparison of functional outcomes for displaced extra-articular distal radius fractures managed by operative and non-operative methods: A prospective cohort study

Muhammed Ehsan Nazeer[1], Jagannath Kamath[1], Muhammed Nazeer[2,*], Harshit Shetty[1], Harish Maheshan[1], Manesh Kumar Jain[1]

[1]*Dept. of Orthopedics, Kasturba Medical College, Mangalore, Karnataka, India*
[2]*KIMS Health Trivandrum, Thiruvananthapuram, Kerala, India*

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ABSTRACT

Background: Fractures of the distal radius are one of the most common injuries seen in our day-to-day practice. It accounts for almost 4% of the injuries seen in the emergency department. Despite its high incidence and the substantial possible implications of suboptimal management, no high-level evidence regarding the best treatment method yet exists.

Aim: The study aimed to compare the functional outcomes of extra articular distal radius fractures managed operatively with those managed conservatively.

Materials and Methods: In this prospective cohort study conducted between November 2018 to September 2020, 18 to 65 years old patients with displaced extraarticular distal radial fracture were treated surgically or conservatively.

DASH and Modified Mayo Wrist Score were calculated after a follow up of one year.

Results: At the end of 12 months the patients were evaluated, and it was noticed that patients who were treated operatively had significantly better functional and clinical outcomes, as indicated by significantly higher Mayo scores than patients treated conservatively by casting (all p values < 0.05). The DASH scores were lower in the patients who had undergone operative management.

Conclusions: Patients treated with volar plate fixation were able to resume activities of daily living few weeks earlier compared to those managed with K-wire fixation and conservative group. Therefore, we can conclude that volar plate fixation gives significantly better clinical and functional results than other methods of treatment.

1. Introduction

Fractures of the distal radius account for an estimated 15-25% of all fractures diagnosed.[1] The importance of distal radius injuries has increased in the recent time due to an increase in lifespan. There is a bimodal distribution noticed in the incidence of such fractures, with younger patients sustaining complicated, high-energy injuries while older patients sustain low energy fractures.

In 1814, Abraham Colle was the first to describe the dorsally displaced extra-articular distal radius fracture.[2] He opined that unreduced fracture results in malunion which might be pain free and may even offer good range of movement, however more recent studies widely differ with this.[3] The consequences of post-traumatic loss of function are comprehensive. Loss of function can impair the individual in performing his day-to-day tasks.

* *Corresponding author*.
E-mail address: m.ehsannazeer@gmail.com (M. Nazeer).

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Extra-articular distal radius fractures are considered relatively harmless but inadequate treatment may result complications such as malunion which can severely impair the function of the individual4. Several treatment modalities to obtain and maintain reduction exist and decision-making is mainly based on patient age, compliance, fracture type, concomitant fractures, soft tissue status and surgeon's preference.[4,5]

Various treatment methods exist ranging from surgical management to a conservative approach. Good results have been reported with both modalities, but a clear consensus does not exist on the ideal treatment method.[6] With advancements in surgical practices over the last 2 decades, there has been a shift in the management of distal radius fractures from conservative treatment to more operative management.[7–9]

Volar locking plates have become increasingly popular as it involves a relatively simple volar approach to the wrist, followed by fracture fixation using fixed angle implants. More importantly it allows the individual to be free from a cast thus allowing for earlier mobilization and return to daily tasks. Open reduction and internal fixation with locking plates allows more accurate reduction and immediate stable fixation.[6,7] The fracture stability allows for early mobilization and may therefore result in an improved recovery of function. K-wire fixation is a minimally invasive procedure between open reduction plate fixation and conservative treatment and numerous authors have reported good results with this technique.[8,9]

In recent decades there has been a shift in how to assess the functional outcome after distal radius fractures. However, clinical parameters do not represent patients' perspectives and seem less relevant for outcome evaluation. Patient-reported outcomes like DASH score and Modified Mayo wrist score seem to be more relevant and are used as standard for this purpose.[10]

Very few studies have been performed comparing conservative treatment with operative treatment in patients with extra-articular distal radius fractures.[11,12]

The aim of this prospective cohort study is to compare the functional outcomes between the conservative and surgical methods, assessed using the Disability of the Arm Shoulder and Hand Score (DASH) and the Modified Mayo wrist score and to determine whether we are undertreating or overtreating these injuries.

2. Materials and Methods

This study was conducted in Kasturba medical college and its allied hospitals. The study population consists of consecutive patients diagnosed with displaced extra-articular distal radius fractures admitted to Kasturba Medical college hospital (n=90) from November 2018 to September 2019 and were followed up for at least 1 year. The studies were combined in September 2020 to reach the estimated sample size within a reasonable time frame. Ethical approval was obtained from the Ethics Committee.

2.1. Inclusion criteria

1. Patients aged 18-65 years,
2. Unilateral unstable extra-articular distal radius fracture (AO/OTA types A2 and A3).
3. A minimum follow-up of 12 months.

2.2. Exclusion criteria

1. Age less than 18 years.
2. Intraarticular fractures of distal radius.
3. Pathological fractures.
4. Open fractures.
5. Patients with associated same side upper limb injuries.
6. Previous history of distal radius fractures.
7. Arthritic changes in joint.

A total of 90 patients were identified fulfilling our criteria. All of them were offered surgery based on the fracture configuration. After detailed discussion and counseling, 45 patients consented for surgery and underwent either closed reduction percutaneous K-wire fixation or open reduction and volar plating, while 45 patients declined surgery and were hence treated conservatively with cast immobilization. There was no randomization of the patients into the operative or nonoperative group.

2.3. Casting protocol

The casting protocol consisted of wrist immobilization in below elbow cast after the initial manipulation and reduction under hematoma block. X-rays were taken after the procedure to check the reduction and was found to be satisfactory. A repeat x-ray was taken after 2 weeks to check for collapse of the fracture. The cast was maintained for 4-5 weeks more with free mobilization of digits, elbow, and shoulder. After removal of the cast the patient was advised both active assisted and passive physiotherapy which they continued at home. Patient was advised to carry out day to day tasks.

2.3.1. Volar locking plate protocol

The radius was approached via a volar Henrys approach. We used standard 2.4mm fixed angle locking plates. Fracture reduction was verified with fluoroscopy. When feasible, the pronator quadratus muscle was repaired to protect the flexor tendons. The wrist was mobilized from day 2 post surgery. Regular follow up of the patients were done.

2.3.2. Percutaneous K-wire protocol

Fixation using K-wires was performed percutaneously after indirect fracture reduction. Two K-wires 1.5 mm were used to transfix the fracture site. They were passed in a Criss cross

fashion. One was passed through radial styloid, and the second wires entry point was dorsolateral. The K-wires were not buried. A below elbow cast was applied for 4-6 weeks duration. The plaster and K-wires were then removed in the outpatient department at 4-6 weeks, and all patients were prescribed physiotherapy program involving active motion of wrist and grip strengthening.

ROM – The ROM was calculated in both the injured and normal hand with a goniometer. The ROM in the study is expressed as % with that of the normal hand.

2.4. Statistical analysis

Categorical and quantitative variables were expressed as frequency (percentage) and mean ± SD respectively. Independent t test was used to compare quantitative parameters between categories. Chi-square test was used to association between categorical variables. For all statistical interpretations, $p<0.05$ was considered the threshold for statistical significance. Statistical analyses was performed by using a statistical software package SPSS, version 20.0.

3. Results

3.1. Patient demographics

The study comprised 94 individuals who fulfilled the inclusion and exclusion criteria from November 2018 to September 2020. 4 patients were lost to follow up.

Both the operative and non-operative group consisted of 45 individuals.

It was noted that the female population was more susceptible than males to sustaining fractures of the distal radius (60% in non-operative & 66.7% in operative group). The study also noted that the non-dominant hand was injured more often in both the groups (60% in operative and 66% in non-operative).

Among the patients who underwent operative procedures most patients were treated with closed reduction and K-wire fixation (57.1%) and were maintained on a below elbow cast foe a period of 4-6 weeks.

3.2. Clinical outcomes

All the findings were noted at the end of one year follow up.

3.3. Flexion-extension

Both flexion and extension were significantly better in patients who had undergone operative procedures. A mean extension and flexion of 84.7% and 83.6% were noted in the group which was managed conservatively which was significantly lesser than 88.1 and 89 degrees noted in the operative group. It was also noted that patients who underwent plating had significantly better extension and flexion when compared to patients who had undergone K – wiring. A mean extension of 91.8% and flexion of 93.9% was noted in the group which had undergone plating.

3.4. Pronation-supination

No statistically significant difference was noted between the two groups.

Radial-ulnar deviation: Both radial and ulnar deviation were statistically significant and better in the operative population.

3.5. Grip strength

At the end of 12 months follow up the grip strength was significantly better in patients who had undergone operative procedures.

3.6. Functional outcomes

Both DASH and MAYO scores were calculated after 12 months.

The DASH score was calculated based on the questionnaire with higher scores denoting higher disability. Higher DASH scores were noted in patients who had undergone non- operative management.

Among the patients who had undergone operative management, patients who had undergone closed reduction and K-wire fixation were noted to have higher DASH scores when compared to patients with plate fixation (35.3 – operative group and 36.4 in non-operative group) (36.5 in patients who had undergone closed reduction with K- wiring and 33.4 in patients who had undergone plating).

Considering the Mayo wrist score, a mean score of 64.1 was noted in patients who had undergone non- operative management with 34% of the patients showing poor results.

A mean Mayo score of 75 was noted in patients who had undergone operative management. 14% of the patients showed excellent results while 37% of the patients showed good results. None of the patients in the operative group showed poor results. Mayo score is also significantly higher in the patients who have undergone plating when compared to patients who underwent K-wiring (82.3 and 69.5 respectively).

Fig. 1: Measurement of grip strength with Jamar dynamometer

Table 1: Distribution of the sample according to procedure

Sex	Non operative		Operative		c2	p
	Count	Percent	Count	Percent		
Male	18	40.0	15	33.3	0.43	0.512
Female	27	60.0	30	66.7		

Table 2: Distribution of the sample according to procedure

Procedure	Count	Percent
CRIF with K Wire	26	57.8
ORIF with plating	19	42.2

Table 3: Comparison of ROM in both operative and non-operative groups

	Non operative			Operative			t	p
	Mean	SD	N	Mean	SD	N		
Extension	84.7	5.4	45	88.1	7.1	45	2.61*	0.011
Flexion	83.6	8.0	45	89.0	7.8	45	3.25**	0.002
Ulnar deviation	79.3	12.1	45	90.4	11.0	45	4.54	p<0.01
Radial deviation	75.8	13.6	45	88.5	15.2	45	4.15	p<0.01
Supination	80.1	5.7	45	81	6.5	45	0.72	0.471
Pronation	75.8	8.3	45	77.4	8.8	45	0.87	0.386

Table 4: Comparison of ROM in operative group

Table Comparison of selected variables based on procedure in operated cases

	CRIF with K Wire			ORIF with plating			t	p
	Mean	SD	N	Mean	SD	N		
Extension	85.4	5.1	26	91.8	7.8	19	3.28**	0.002
Flexion	85.5	6.8	26	93.9	6.4	19	4.17	p<0.01
Ulnar deviation	86.7	12.1	26	95.5	6.9	19	2.84**	0.007
Radial deviation	85.4	15.4	26	92.6	14.4	19	1.6	0.117
Supination	81.2	6.4	26	80.9	6.9	19	0.13	0.897
Pronation	77.7	9	26	76.9	8.9	19	0.26	0.795

**: - Significant at 0.01 level

Table 5: Comparison of DASH scores

Group	Mean	SD	N	t	P
Non operative	35.9	2.5	45	1.9	0.061
Operative	35.0	2.3	45		

Table 6: Comparison of MAYO scores in both groups

MAYO	Non operative		Operative	
	Count	Percent	Count	Percent
Poor	9	20.0	0	0.0
Satisfactory	34	75.6	20	44.4
Good	2	4.4	16	35.6
Excellent	0	0.0	9	20.0

Table 7: Comparison of DASH and MAYO Scores based on procedure in operated cases

DASH score					
Procedure	Mean	SD	N	T	P
CRIF with K Wire	36.1	2.2	26	4.53	p<0.01
ORIF with plating	33.5	1.5	19		
MAYO scores					
CRIF with K Wire	71.9	7.2	26	5.73	p<0.01
ORIF with plating	84.2	6.9	19		

Fig. 2: Measurement of ROM

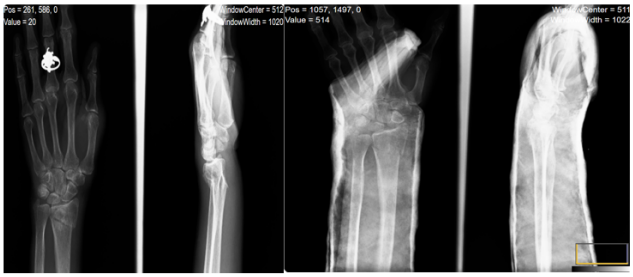

Fig. 3: 50 year old female treated conservatively with reduction and casting (DASH score - 35.2, MAYO Score - 70)

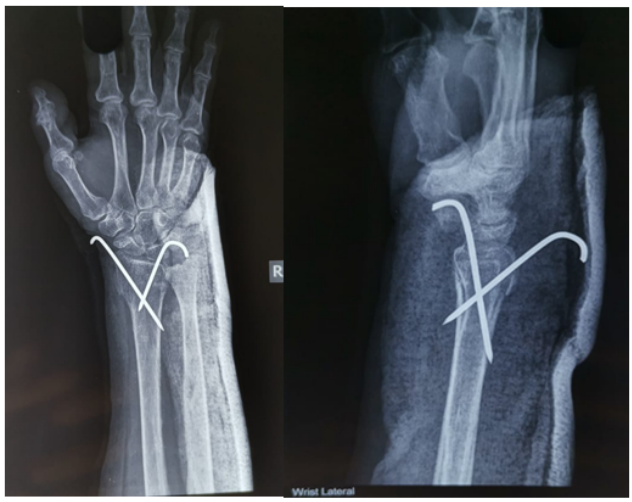

Fig. 4: 76 year old male who had undergone closed reduction and K-wiring (DASH score - 34 MAYO Score - 70)

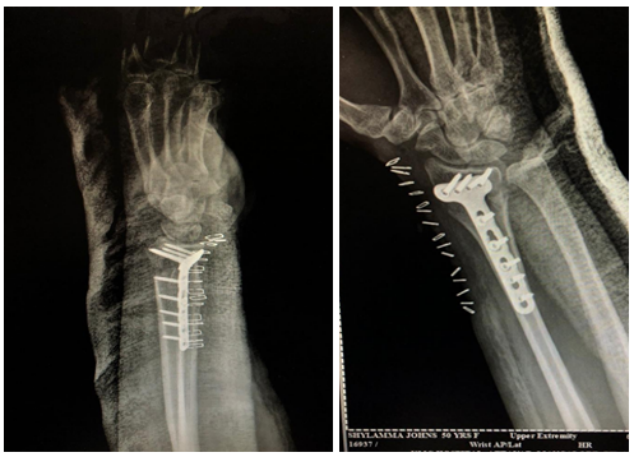

Fig. 5: 50 year old female patient who was treated with ORIF with plating (DASH score - 32.2 MAYO Score - 90)

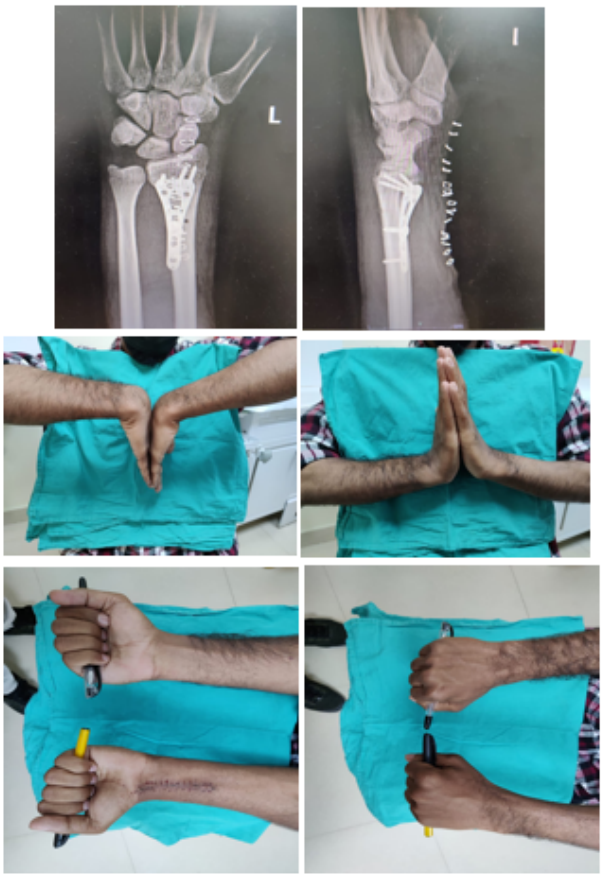

Fig. 6: 44 year old male (DASH score - 31.2 MAYO Score - 90)

4. Discussion

Some sort of discomfort and loss of function is seen in most patients with distal radius fractures up until 1 year. The first 2 months after injury, the patients reported problems with many daily activities, but after 1 year most patients were comfortable and had minimal complaints.[13]

We deliberately used patient derived functional outcome measures rather than radiographic assessments because we think that the patient's own assessment of the result is more important.

We felt that the patient will be better able to comprehend the changes they have in their daily life and the functional differences they face. However, we acknowledge that radiographic assessments of the quality of the reduction may have a bearing on the long-term functional result, particularly in younger patients.[9,10]

This prospective cohort study conducted in Kasturba medical college and its allied hospitals showed that extra-articular distal radial fractures demonstrated better functional outcomes after 12 months when treated surgically compared with nonoperative treatment when the Modified Mayo Wrist Score was considered. However, the DASH scores at 12 months are not significant though the scores are better in the operative group showing lesser disability. Significantly better DASH score and Modified Mayo Wrist Score were noted for ORIF with volar LCP group when compared with patients who had undergone K wiring.

In 2 randomized controlled trials, Arora et al. and Bartl et al. compared ORIF with plaster immobilization in elderly patients.[14,15] Neither study showed any difference in wrist function between the 2 treatment groups at 6 and 12 months. These results are consistent with results of 2 previous retrospective studies by Arora e al. and Egol et al.[16,17] However, all these studies were conducted in an elderly population and included both extra- and intra-articular fractures. In 2009, Koenig et al.[18] evaluated whether ORIF was preferable to nonoperative treatment for acceptably reduced distal radial fractures. The authors concluded that ORIF was the preferred treatment, especially in young patients, and reported a long-term gain in quality-adjusted life years.[17] The results of our study were like the trends observed in the above-mentioned studies where surgically treated patients tend to achieve greater motion and better grip strength during recovery and significantly better functional outcomes. In a recent RCT comparing surgical vs conservative treatment in extra-articular fractures by Mulders et al.,[13] with follow up until 12 months, surgically managed patients had significantly better functional outcomes.[12]

Surgical treatment by closed reduction percutaneous k-wire fixation and with open reduction volar plate fixation showed better functional results at 1 year in the group who had undergone plating which contradicts previous identical studies.[7,8,18]

Over the last 2 decades, open reduction and volar plate fixation has been increasingly utilized. Although the true reasons for this increase are unknown, it has been suggested that functional outcomes are positively correlated with adequate reduction, especially in young patients.

A few limitations of our study should be noted. Firstly, this was a prospective cohort study and there was no randomization of treatment groups. Secondly, radiological outcomes were not assessed. Thirdly, only short-term outcomes (12 months) were measured in this study. Although the sample sizes in the operative and nonoperative groups (45 each) after the criteria were applied were by no means small, a larger and ideally, a prospective randomized trial looking into both the short- and long-term outcomes will provide more information and a higher level of evidence.

5. Conclusion

In patients 18 to 65 years old with an extra-articular distal radial fracture surgically managed patients had clinically relevant better Mayo wrist scores with nonoperatively managed patients. Better ROM and grip strength were also noted in patients who had undergone operative management. The DASH scores at the end of 12 months were comparable but a lesser level of disability was noted in the operative group. Therefore, we can conclude that surgery is the ideal treatment approach for displaced extra articular distal radius fractures.

Further prospective randomized controlled studies with larger numbers will be required to evaluate the potential long-term benefits of surgical treatment along with economic evaluation determining the cost-effectiveness of each treatment option.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare no conflict of interest.

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Author biography

Muhammed Ehsan Nazeer, Junior Resident

Jagannath Kamath, Professor

Muhammed Nazeer, Consultant https://orcid.org/0000-0003-4355-6861

Harshit Shetty, Junior Resident

Harish Maheshan, Junior Resident

Manesh Kumar Jain, Senior Resident

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