

ORIGINAL RESEARCH

**COMPARISON OF FUNCTIONAL OUTCOMES IN
INTRAARTICULAR DISTAL RADIUS FRACTURES
MANAGED EITHER BY OPEN REDUCTION VS CLOSED
REDUCTION**

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ABSTRACT

Background: To assess and compare the functional outcomes after 1 year in intra articular distal radius fractures - open versus closed reduction.

Materials and Methods: Observational study carried out at Narayana Medical College and hospital. All patients who have reported to the department of orthopedics in Narayana Medical College, Nellore and its allied hospitals.

Results: Majority of the patients (80.5%) who underwent plating were noted to be less than 50 years of age and more than half of the patients (58.3%) who had undergone closed reduction belonged to the age group of above 50. As per the DASH scores, among the patients who had undergone open reduction and plating, 28 (68.29%) patients had excellent outcomes, 6 (14.63%) had good outcomes and 7 (17.07%) had fair outcomes. None of the patients as such had poor outcomes. In patients who had undergone closed reduction, 18 (50%) of the patients had excellent outcome, 2 (5.55%) had good outcome, 15 (41.66%) had Fair outcomes and 1 (2.77%) patient had a poor functional outcome.

Conclusion: Open reduction will give better functionality in patients with articular fractures when compared with closed reduction as per the DASH and Mayo scoring.

Keywords: Articular distal radius fractures open versus closed reduction, Mayo Score, DASH.

INTRODUCTION

Fractures in the distal radius are one of the commonly encountered fractures by the orthopedic doctors.^[1] Of all the bones in our hand, distal radius is susceptible to fracture as it comprises of 80% of the joint surface in the wrist and bears the entire load during Fall on Outstretched Hand (FOOSH). Intra articular involvement is not uncommon in distal radius fractures. 34-43% of all distal radius fractures have articular involvements. It more commonly occurs in young male population as they are susceptible to high energy injuries and older women by fall on an out-stretched hand.

The credits for recognition of the true natures of distal radius injuries are shared between Petit, Pouteau and Colle's.^[1] In 1783 - Distal radius fractures were first described by Pouteau. In 1847, "Malgaigne described the mechanism of injury of distal radius fractures."

More than 20 classifications have been made for distal radius fractures.^[2] These classifications which are meant to understand the pathology and conceptualize the challenges in treatment have many unanswered questions. Despite the numerous studies done till date there is still a flux in the desired management protocol for intra articular fractures. Many stalwarts have contributed towards the Herculean task of understanding and treatment of these fractures.

In this study we have taken patients who had undergone

- i) Closed reduction and casting or K-wiring + casting or K-wiring supplemented by external fixation and
- ii) Open reduction and plating

There are many articles which justify surgical intervention with open reduction as the mainstay of articular fractures in the distal radius for achieving better functionality. There are similarly almost an equal number of articles citing an equivocal result with closed reduction. Few studies have reported that "low demand patients tend to tolerate incongruity and malunion much better."

Here we will strive to quantify the efficacy and quality of treatment by closed reduction versus open reduction using functional outcome scoring systems by the end of a year so as to assess the benefit of operative anatomical restoration.

Aims and objectives

Aim

To assess and compare the functional outcomes after 1 year in intra articular distal radius fractures - open versus closed reduction

Objectives

- 1) To compare functional outcomes between open reduction versus closed in intra articular fractures of distal radius using
 - i) Disabilities of the Arm, Shoulder and Hand (DASH) score
 - ii) Mayo Wrist scores after an interval of a year.
- iii) To compare the functionality of intra articular distal radius fractures in younger(<50yrs) vs older(>50yrs)

MATERIALS & METHODS**Study Setting****Type of study** – Observational study**Study area and setting** –Narayana Medical College & Hospitals**Participants** - All patients who have reported to the department of orthopedics in Narayana Medical College, Nellore.**Inclusion criteria**

Patients with intra articular distal radius fractures - AO Classification type B and C

With or without ulnar styloid fracture

Age – more than 18 years

Exclusion criteria

Age less than 18 years

Extraarticular fractures of distal radius

Pathological fractures

Compound fractures

Patients with associated same side upper limb injuries

Previous history of distal radius surgeries

Arthritic changes in joint

Study duration – 2 years From September 2019 till September 2021**Sampling method:** Convenience Sampling**Data analysis**

Comparison of continuous variable between two group was analyzed by student t test or Mann Whitney U test according to the nature of the data and Chi-square test.

Data analysis will be performed using SPSS Ver 25.0

A p- value <0.05 will be considered statistically significant.

Outcome Parameters

- 1) Disabilities of the Arm, Shoulder and Hand (DASH) score
- 2) Mayo Wrist Score
- 3) Grip Strength
- 4) Range of Movements.

1) Disabilities of the Arm, Shoulder and Hand (DASH) score**Table 1: Disabilities of the Arm, Shoulder and Hand****Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.**

No		No Difficulty	Mild Difficulty	Moderate Difficulty	Severe Difficulty	Unable
1	Open a tight or new jar	1	2	3	4	5
2	Write.	1	2	3	4	5
3	Turn a key	1	2	3	4	5
4	Prepare a meal.	1	2	3	4	5
5	Push open a heavy door.	1	2	3	4	5

6	Place an object on a shelf above your head.	1	2	3	4	5
7	Do heavy household chores (e.g., wash walls, wash floors).	1	2	3	4	5
8	Garden or do yard work.	1	2	3	4	5
9	Make a bed.	1	2	3	4	5
10	Carry a shopping bag or briefcase.	1	2	3	4	5
11	Carry a heavy object (over 10 lbs).	1	2	3	4	5
12	Change a lightbulb overhead.	1	2	3	4	5
13	Wash or blow dries your hair.	1	2	3	4	5
14	Wash your back.	1	2	3	4	5
15	Put on a pullover Sweater.	1	2	3	4	5
16	Use a knife to cut food.	1	2	3	4	5
17	Recreational activities which require little effort (e.g., cardplaying, knitting, etc.).	1	2	3	4	5
18	Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5
19	Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.).	1	2	3	4	5
20	Manage transportation needs (getting from one place to another).	1	2	3	4	5
21	Sexual activities.	1	2	3	4	5
		Not At All	Slightly	Moderately	Quite A Bit	Extremely
22	During the past week, to what extent has your arm, shoulder or hand problem interfered with	1	2	3	4	5

	your normal social activities with family, friends, neighbours or groups? (circle number)					
		Not Limited At All	Slightly Limited	Moderately Limited	Very Limited	Unable
23	During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? (circle number)	1	2	3	4	5
		NONE	MILD	Moderate	Severe	Extreme
24		1	2	3	4	5
25		1	2	3	4	5
26		1	2	3	4	5
27		1	2	3	4	5
28		1	2	3	4	5
		No Difficulty	Mild Difficulty	Moderate Difficulty	Severe Difficulty	So Much Difficulty That I Can't Sleep
29	During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? (circle number)	1	2	3	4	5
		Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
30	I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. (circle number)	1	2	3	4	5
<p>Dash Disability/Symptom Score = _____</p> <p>([(sum of n responses/n) - 1] x 25, where n is the number of completed responses.)</p> <p>A DASH score may not be calculated if there are greater than 3 missing items.</p>						

“The score ranges from 0 to 100.

Higher scores indicate greater levels of disability and vice versa.”

2) Mayo wrist score

Mayo Wrist Score

Clinician's name (or ref) _____ Patient's name (or ref) _____

Please answer the following 12 multiple choice questions.

During the past 4 weeks.....

Section 1 - Pain Intensity

- No pain
- Mild Occasional
- Moderate, tolerable
- Severe to intolerable

Section 2 - Functional Status

- Returned to regular employment
- Restricted employment
- Able to work, but unemployed
- Unable to work because of pain

Section 3 (choose either 3a or 3b)

3a - Range of Motion (% of normal side)

- 100%
- 75-99%
- 50-74%
- 25-49%
- 0-24%

3b - If only injured hand examined

- Greater than 120 degrees
- 90-120 degrees
- 60-90 degrees
- 30-60 degrees
- less than 30 degrees

Section 4 - Grip strength % of normal

- 100%
- 75-100%
- 50-75%
- 25-50%
- 0-25%

The Mayo Wrist Score is 0

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Figure: 1 Mayo wrist score chart

Table 2: Interpretation of Mayo Wrist score

Score	Outcome
90-100	Excellent
90-80	Good
60-80	Satisfactory
Below 60	Poor

3) Grip strength

To be measured with Jammarr’s dynamometer



Figure: 2 Jamar's Dynamometer

4) Range of motion

“Degree of palmar flexion, dorsiflexion, ulnar deviation, radial deviation, pronation and supination were assessed with goniometer”

Implications

“Through this study we will be able to better understand the approach to a patient with intra articular distal radius fractures”

Knowledge Gap

Despite there being numerous studies regarding management of distal radius intra articular fractures there is yet to be a final agreement on the optimal treatment method for fracture fixation. Most of the studies have advocated open reduction and plating as the ideal treatment for intra articular fractures. Some studies have mentioned that in long term, outcomes will ultimately be comparable to each other.

And hence we are left with the query of whether plating is absolutely necessary for achieving optimal outcomes. Here we will try to add on to the knowledge already present and shed some light on the treatment method which can help get a better functional outcome. And the cost effectiveness it can bear to the elderly.

Data collection tool

Questionnaire

Dynamometer to measure grip strength

X-rays taken in Narayana Medical College and its associated hospitals transferred to PC via USB

Microsoft Excel for collection and storage of data

RESULTS

We had selected 84 patients who had presented to our hospital in accordance with the selection criteria from the period of October 2019 till September 2021. Of these 7 patients were defunct to follow up due to diverse reasons. Majority of the patients (80.5%) who

underwent plating were noted to be less than 50 years of age and more than half of the patients (58.3%) who had undergone closed reduction belonged to the age group of above 50. Gender wise, males more often were affected- 52 people (67.5%) and females had lesser incidence- 25 people (32.5%) overall. The most common mode on injury was noted to be fall on outstretched hand followed by Road Traffic Accidents. Dominant hand seems to be more commonly involved with the closed reduction group having 88.9% and open reduction group having 95.1% out of the total inured patients, with an overall incidence of 92.2% fractures happening in the dominant hand. In the closed group, 20 patients (55.6%) underwent casting, 15 patients (41.7%) underwent K wire fixation, and 1 patient (2.8%) underwent external fixation. All the patients in the open reduction group underwent volar plating.

Table 3: Demographics Datasheet

Demography		Group					
		Closed		Plating		Total	
		Count	Column N %	Count	Column N %	Count	Column N %
Age	20 and below	0	0.0%	3	7.3%	3	3.9%
	21 - 30	8	22.2%	8	19.5%	16	20.8%
	31 - 40	5	13.9%	13	31.7%	18	23.4%
	41 - 50	2	5.6%	9	22.0%	11	14.3%
	51 - 60	9	25.0%	5	12.2%	14	18.2%
	Above 60	12	33.3%	3	7.3%	15	19.5%
Sex	F	16	44.4%	9	22.0%	25	32.5%
	M	20	55.6%	32	78.0%	52	67.5%
Diagnosis	LT IA	15	41.7%	12	29.3%	27	35.1%
	RT IA	21	58.3%	29	70.7%	50	64.9%
Mode of Injury	Fall	5	13.9%	3	7.3%	8	10.4%
	Foosh	21	58.3%	24	58.5%	45	58.4%
	RTA	10	27.8%	14	34.1%	24	31.2%
Dominanace	LT	4	11.1%	2	4.9%	6	7.8%
	RT	32	88.9%	39	95.1%	71	92.2%
Procedure	Casting	20	55.6%	0	0.0%	20	26.0%
	External Fixator	1	2.8%	0	0.0%	1	1.3%
	Kwiring	15	41.7%	0	0.0%	15	19.5%
	Volar Plating	0	0.0%	41	100.0%	41	53.2%

Table 4: Patients' mean age in both the groups

	Group	N	Mean	Std. Deviation
Age	Closed	36	51.22	18.176
	Plating	41	39.71	14.509
	Total	77	45.09	17.215

For the period of 1 year patients were pursued and at the end functional scores, range of movements and grip strengths were quantified. Jamar's dynamometer and a goniometer were used to measure the grip strength range of movement respectively. Functional scoring was done using DASH and Mayo wrist scores. As per the DASH scores, among the patients who had undergone open reduction and plating, 28 (68.29%) patients had excellent outcomes, 6 (14.63%) had good outcomes and 7 (17.07%) had fair outcomes. None of the patients as such had poor outcomes. In patients who had undergone closed reduction, 18 (50%) of the patients had excellent outcome, 2 (5.55%) had good outcome, 15 (41.66%) had Fair outcomes and 1 (2.77%) patient had a poor functional outcome. DASH scores were noted to be markedly better in patients who were plated, having a mean score of 6.98 than those who had undergone closed reduction which had a mean score of 13.36. It was noted in particular that all the patients had a common complaint of having difficulty associated with pain while carrying more than 10 pounds of weight in the affected wrist.

Table 5: DASH score compilation sheet showing the Mean, Median, Standard deviation, Mann Whitney test Z value and p value

Group	N	Mean	Std. Deviation	Median (IQR)	Mann Whitney test Z value	p value	
Closed	36	13.26	11.03	8.0(4.2--23.2)	2.809	0.005	Highly Significant
Plating	41	6.98	8.68	3.3(1.7--6.7)			

DASH scores in patients who had undergone Closed reduction in regards with the Mayo wrist scores, patients who had had undergone open reduction excellent and good outcomes were seen in 16(39.02%) patients each and satisfactory in 6 (14.63%) patients. Whereas in patients who had undergone closed reduction, 8(22.22%) had excellent outcome, 12(33.33%) had good outcome and 16(44.44%) had a satisfactory outcome. Mayo wrist scoring also showed that the subjects in the ORIF group had a mean value 83.17 while subjects in the closed reduction had a lesser mean value of 76.81 indicating that open reduction group did much better at the end of a year. Patients' scores were mostly affected by the pain category and movement category where they had mild to moderate pain and decreased range of movement in the 75-100%, but never the perfect 100%.

Table 6: Mayo Wrist score compilation sheet showing the Mean, Median, Standard deviation, Mann Whitney test Z value and p value

Group		N	Mean	Std. Deviation	t value	p value	
Mayo Wrist Score	Closed	36	76.81	10.701	2.61	0.011	Significant
	Plating	41	83.17	10.651			

The range of movements in both the groups was compared with the unaffected side and there was decreased range in all the movement directions in the affected side. On comparing the

movement range in candidates who had plating done versus the ones who closed reduction done showed better recovery in the patients who had undergone plating. Two movements – flexion and pronation showed significant and highly significant distinction among the 2 groups favoring the plated group. On comparison to the normal side grip strength was decreased. Likewise, the grip strength was found to be markedly better in the patients who had undergone plating having a mean of 29.21 while the closed reduction group had a mean of 22.41.

Table 7: Datasheet showing the Mean, Median, Standard deviation, Mann Whitney test Z value and p value of the Range of movements and the grip strength.

Group		N	Mean	Std. Deviation	t test value	p value	
Supination	Closed	36	78.72	6.96	1.196	0.236	Not Significant
	Plating	41	80.37	5.05			
Pronation	Closed	36	76.81	12.37	3.530	0.001	Highly significant
	Plating	41	84.51	6.10			
Extension	Closed	36	57.64	13.50	-1.737	0.086	Not significant
	Plating	41	62.93	13.18			
Flexion	Closed	36	65.00	17.48	-2.550	0.013	Significant
	Plating	41	74.76	16.08			
Radial Deviatin	Closed	36	17.66	3.82	-1.413	0.162	Not Significant
	Plating	41	18.74	2.76			
Ulnar Deviation	Closed	36	30.00	11.11	-1.535	0.129	Not Significant
	Plating	41	33.85	10.89			
Grip Strength	Closed	36	22.41	6.08	-3.911	0.000	Highly Significant
	Plating	41	29.21	8.74			

Mean Grip strength in closed and open reduction in the normal and affected sides Age of the patients was also critical in the functional outcomes wherein the patients above the age of 50 had a lesser functional outcome when compared to those below 50 years.

During this timeframe, the patients who had undergone casting had their cast removed after a period of one month and were started on physiotherapy; those who had undergone K-wire fixation with casting had removal of cast and K-wires at the end of the month with add-on physiotherapy. The patients who had undergone plating were started on physiotherapy after a period of 3 weeks.

Out of all the patients none of the patients had developed any complications like Sudeck's dystrophy, tendon injury, nerve injury, etc.

Overall, the patients who had undergone plating and the patients belonging to the age group of less than 50 showed a significantly better functional outcome compared to those who undergone closed reduction and those above 50 years of age.

DISCUSSION

Fractures of the distal end of the radius are one of the commonest fractures encountered by an orthopedic surgeon. Patients usually present with a varied fracture pattern due the differing mechanisms of injury. The intra articular fractures are usually encountered in younger patients who have had a high energy injury or in elderly individuals even with trivial injury. Ever since the description of the distal radius fractures, treatment modalities have been constantly evolving due to greater comprehension of the biomechanics of the joint and the fracture. Numerous studies exist advocating the better or ideal modality of treatment for the intra articular fractures in the distal radius. A great number of studies have pointed towards open reduction and plating giving a better functional outcome.^[8-12, 16, 23, 25, 29, 30, 34]

In our study of 84 individuals who had sustained intra articular fractures were divided into 2 groups of 42 each. We have broadly divided the treatment modalities as “open reduction (volar plating)” and “closed reduction (casting, percutaneous K-wire fixation and external fixation)”. The treatment modalities were explained to the patients by the operating surgeons and the treatment was tailored to the patient’s choice. Majority of the patients in our study had injures the dominant hand and were males. We have not taken the radiological parameters into account for the functional outcomes in this study.^[36]

In both the groups the patients were called for follow ups at the first, third sixth and twelfth months. All the patients had achieved radiological union. They were started on physiotherapy on the 4th week onwards for the plated patients and 4-6th weeks for the closed reduction patients. Functional outcomes were evaluated at the sixth month and twelfth month. The outcomes at the end of the year were compared between the groups and catalogued.

Age was found to be a major factor on the decision of the treatment and the functional outcomes. The other demographic parameters did not influence the treatment choice to any extent. The patients who were less than 5 decades old showed better outcomes. This might be attributed to the choice of treatment, better physiology, adherence to follow ups and physiotherapy. We observed in our study by the end of the year that the patients who had undergone plating had finer functionality scores, range of movements and grip strength than those in the closed group, but overall, the results were comparable. Our study has the DASH scoring and Mayo Wrist scoring. The mean DASH scores were comparable between the 2 groups and only one patient in the closed group having a score of 36 which was the highest DASH score recorded in our study. The Mayo score took the percentage of range of movement and grip strength too into consideration. All the patients as per the Mayo score had more than satisfactory results and none having a poor outcome. The plated group had more excellent and good outcomes when compared. But overall, all were satisfactory. The range of movements and the grip strength both have pointed towards open reduction giving a better outcome stressing that anatomical reduction is necessary for optimal results in intra articular fractures.^[8-10] Goldfarb,^[36] and Egol,^[38] both had commented a satisfactory outcome in both open reduction and closed reduction giving credence to Colles earliest statement of the wrist at one point on time will gain back a satisfactory movement.

While closed reduction maybe a cheaper and easier option in managing distal radius fractures, the reconstruction of the articular anatomy that we can attain in the open reduction gives a superior functionality, better movement range and better grip strength. Hence closed

reduction can be contemplated in patients with a lower functional requirements and open reduction can be done to patients with greater functional demands.

Drawback of the study: Only 42 patients were in each group. Radiological parameters were not taken into consideration. It was not possible to randomize the patients. The treatment type was decided by the consultant after discussion with the patients. A longer follow up time will give us a better insight into the complications that might occur and any change in the functional outcome.

CONCLUSION

Open reduction will give better functionality in patients with articular fractures when compared with closed reduction as per the DASH and Mayo scoring. The range of movements and the grip strength was greater when the facet anatomy was reobtained in open reduction patients on comparison to the closed reduction groups

The patients who were less than 50 years of age had an overall better functional outcome than those who were more than 50 years of age.

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