

## Original Research Article

# An analysis of functional outcome following conservative versus surgical management in fractures of the distal radius

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### ABSTRACT

**Background:** Distal radial fractures are one of the most common injuries seen in the orthopaedic department, which can be managed both conservatively and surgically. There are advantages and disadvantages in each method of management. The aim of this study was to compare the functional and radiological outcomes of intra-articular fractures of the distal end of the radius with conservative and surgical management.

**Methods:** 80 cases of intra articular fractures of the distal radius managed by both conservative and surgical means were studied between January 2011 to January 2013 and were followed up for a minimum period of two years.

**Results:** In our series of 80 patients, there 53 males and 27 females. Most of the patients were between 20-30 years of age with the mean age being 40.35 years. RTA was the most common mode of injury (45%). Frykman's type 3 (41.7%) was the most common fracture type seen followed by type 8. All fractures united by the end of 6 months. Excellent results were seen in 47.5% of cases in the surgical group and 30% of cases in the conservative group.

**Conclusions:** From this study, we conclude that surgical management is better than conservative in the treatment of intra articular fractures of the distal end of radius. Therefore, one treatment method of treatment cannot be generalized for all types of fractures and treatment should be individualized to a particular fracture in terms of age, fracture pattern, degree of displacement and amount of comminution present.

**Keywords:** Distal radius, Frykman, Conservative, Fixation

### INTRODUCTION

Fractures of the distal radius are common injuries which constitute approximately one-sixth of all fractures treated in the emergency department. There are three main peaks of fracture distribution: the first peak is in children aged 5 to 14, the second is in males under age 50 and the third peak is in females over the age of 40 yrs. Decreased bone mineral density, female gender, ethnicity, heredity and early menopause have all been shown to be risk factors for this injury.<sup>1</sup> Majority of these fractures are treated with plaster of Paris slab/cast following closed reduction under local anaesthesia. However, certain types of distal radial fractures require surgical management and many modalities of treatment are available. The various

surgical options available are closed reduction and percutaneous pinning with Kirschner wires, bridging and nonbridging external fixators and open reduction and internal fixation with locking compression plates.

The outcome of these fractures is not uniformly good regardless of the treatment instituted. A thorough understanding of the anatomy and biomechanics of the wrist is a prerequisite when treating these types of injuries. There is a strict relationship between the quality of anatomical reconstruction and the long-term functional outcome. The aims of management in these fractures are good anatomical reduction with accurate restoration of the congruity of the articular surface, prevention of loss of reduction and to achieve a good functional outcome

with return to normal functional status of the patient at the earliest possible.<sup>2</sup>

No single treatment is the solution for each type of fracture in every patient. Based on the functional anatomy, we analysed the various treatment modalities possible and aimed to develop strategies in the choice of treatment for different fracture types in different groups of patients and to compare the clinical & functional outcomes of conservative versus surgical management.

## METHODS

This was a prospective study of 80 cases of intra articular fractures of the distal radius treated at Saveetha medical college and hospital, Thandalam from January 2011 to January 2013. Out of 80 patients, 40 were treated by conservative means and the other 40 were managed surgically. Patients to be included in this study were sorted based on preset inclusion and exclusion criteria. Patients aged 20 to 80 years with intra articular fracture of distal end of radius who were willing for the procedures and for follow up, and Grade 1 Gustilo and Anderson compound fractures were included in the study while skeletally immature patients, pathologic fractures, patients with neurovascular injuries, grade 2 and 3 compound fractures were excluded. As soon as the patients were seen in the emergency or the outpatient department, clinical and radiological assessment was done. The affected wrist was immobilized in an above elbow plaster slab and X-rays of the affected wrist were taken which included standard anteroposterior, and lateral views. In select cases with extensive comminution and wide displacement of the fracture fragments, CT scan was taken to get a better understanding of the fracture configuration and to plan for surgical fixation. The fractures were classified according to Frykman's classification. Fractures with minimal displacement and without comminution were assigned to the conservative management group while displaced and comminuted fractures were managed surgically. The patients in the conservative group were mostly managed in the outpatient or the emergency department and were sent home and asked to review at the suggested time frames. The patients who were to be managed surgically were admitted and the appropriate work up for surgery was carried out. Preference was given for management of life threatening emergencies i.e. head injury, blunt trauma abdomen, blunt trauma chest and patients were taken up for Orthopaedic surgery once the patient was out of danger, till then fractures were managed with slab application and limb elevation. Associated injuries were evaluated and treated simultaneously.

The procedures were performed under either general anaesthesia or supraclavicular block under broad spectrum intravenous antibiotic cover which was continued for 3 days postoperatively. The various surgical modes of fixation employed were closed reduction and percutaneous pinning in 10 patients while Ligamentotaxis with external fixator application was

done in 10 patients and the remaining 20 patients were managed by open reduction and internal with locking compression plates through the volar Henry's approach. The patients fixed with locking compression plates were managed by first wound inspection after 48 hours followed by regular dressings and suture removal was done on the 12<sup>th</sup> postoperative day. Active wrist and finger movements were started on the first postoperative day based on the pain tolerance and compliance of the patient. The patients with closed pinning and external fixation application were discharged on the second postoperative day after being instructed to keep the limb elevated and to start active movements of the fingers, elbow and shoulder joints. The Kirshner wires were removed at 3 weeks and active wrist movements were encouraged while the external fixator removal was done after 6 weeks and physiotherapy was started to promote good range of movements of the wrist joint. The patients were followed up at 1, 3 and 6 weeks and at 3, 6, 9, 12 months and at 2 years. At the time of follow up functional and radiological assessment was done and graded according to Demerit scoring system of Gartland and Werley and all the findings were documented accordingly (Table 1). The data collected was analyzed using IBM SPSS Version 22.0. Armonk, NY: IBM Corp. Continuous variables were expressed as mean±SD and categorical variables were expressed as number and percentages. Chi square test was used in the comparison of categorical variables. A P value of less than 0.05 was considered to be statistically significant.

## RESULTS

80 patients with intra articular fractures of the distal radius managed by both conservative and surgical means were studied from January 2011 to January 2013. Age of the patients ranged from 20 to 80 years with the mean age being 40.35 yrs. In the conservative group, the most common age was between 41-50 years (35%) with the mean age being 43.5 years while in the surgical group, most common age was 20-30 years (32.5%) with mean age being 39.97 years (Table 2). There were 53 males (71.7%) and 27 females (28.3%) in our study (Table 3). RTA was most common mode of injury (45%) followed by slip and fall (Table 4). Right side was more commonly affected in 51.25% of patients (Table 5). Frykman's type 3 (41.7%) was the most common fracture pattern followed by type 8. Out of 80 patients, 40 were treated by conservative means and the other 40 were managed surgically (Table 6). Mean time of fracture union at 6 weeks was seen in 45% of the patients in the conservative group and 76.5% of patients in the surgical group (Table 7). Mean pain score for conservative group was 20.3 and 16.7 for the surgical group (Table 8). Mean function score for conservative group was 29.2 and 20.7 for the surgical group (Table 9). Mal-union was seen in 30% of patients in the conservative group and 13.33% of patients in the surgical group. Intra-articular step was seen in 30% of patients in the conservative group while it was 41.7% in the surgical group. Radial inclination was lost in 45% of patients in the conservative group and in 31.2% of

patients in the surgical group. Radial length was lost in 45% of cases in the conservative group and in 33.33% of cases in the surgical group. Mean loss of movements for conservative group was 35.2% and 30.55% for the surgical group. The mean range of movements in the conservative group were: dorsiflexion-58<sup>0</sup>, palmar flexion-58<sup>0</sup>, radial deviation-8<sup>0</sup>, ulnar deviation-16<sup>0</sup>, pronation-75<sup>0</sup>, supination-73<sup>0</sup>, arc of dorsi-palmar flexion-116.3<sup>0</sup> and arc of pronation-supination was 144<sup>0</sup>. In the surgical group the mean range of movements were dorsiflexion-66.8<sup>0</sup>, palmar flexion -68.4<sup>0</sup>, radial deviation-8.5<sup>0</sup>, ulnar deviation-17<sup>0</sup>, pronation-70<sup>0</sup>, supination-81.5<sup>0</sup>, arc of dorsi-palmar flexion-142<sup>0</sup> and arc of pronation-supination was 152.8<sup>0</sup> (Table 10). Average loss of movements for conservative group was 35.2% and 29.6% for the surgical group. Grip strength was >50% compared to the normal wrist in 35% in conservative group and 62% in surgical group while it was <50%

compared to the normal wrist in 65% in conservative group and 38% in surgical group. Complications like Mal-union in conservative group was 30% and the 10% in surgical group. Stiffness of wrist and fingers was seen in 10% in both the groups. Shoulder hand syndrome was seen in 10% in conservative group and none in the surgical group. Osteodystrophy was seen in 5% in conservative group and none in surgical group. In the surgical group, the patients treated with open reduction and plate osteosynthesis did not have any procedure related complications. The patients treated with K-wires and external fixators had pin tract infection in 10 percent of cases but were managed with pin-tract care and antibiotics and responded well to treatment. Excellent results were seen in 30% of cases in conservative group and 45% in the surgical group while poor results were seen in 20% and 2.5% respectively (Table 11). We did not have any deaths till the completion of the study. None of our patients were lost to follow up.

**Table 1: Demerit scoring system.**

<b>1 Subject evaluation</b>		
Excellent	No pain, no disability, no LOM	0
Good	Occasional pain, no disability, slight LOM	2
Fair	Occasional pain, no disability if careful, some LOM, feeling weakness in the wrist, activities slightly restricted	4
Poor	Pain, disability, LOM, activities markedly restricted	6
<b>2 Objective evaluation</b>		
<b>Residual deformity</b>		Range
Ulnar variance		0±2
Palmar tilt		11±10
Radial tilt		23±10
<b>Range of motion</b>		
Dorsiflexion		<45 <sup>0</sup>
Palmar flexion		<30 <sup>0</sup>
Ulnar deviation		<15 <sup>0</sup>
Radial deviation		<15 <sup>0</sup>
Supination		<50 <sup>0</sup>
Pronation		<50 <sup>0</sup>
<b>3 Grip power</b>		
Dominant hand	<than power of opposite hand	1
	<2/3 <sup>rd</sup> power of opposite hand	2
Nondominant hand	<2/3 <sup>rd</sup> power of opposite hand	1
	<1/2 power of opposite hand	2
<b>4 Arthritic changes</b>		
None		0
Minimal	Irregularity/sharpening of the articular margin	1
Moderate	Narrow joint space/osteophytes	2
Severe	Marked osteophytes/ankylosis	3
<b>5 Complications</b>		
Nerve complications		1-2
Stiff fingers		1-2
Ruptured tendons		1-2
<b>6 End result</b>		
Excellent		0-3
Good		4-9
Fair		10-15
Poor		16-26

**Table 2: Age distribution.**

Age in years	Conservative group		Surgical group	
	Number	Percentage (%)	number	Percentage (%)
20-30	10	25	13	32.5
31-40	6	15	12	30
41-50	14	35	7	17.5
51-60	4	10	6	15
61-70	4	10	0	0
71-80	2	5	2	5
<b>Total</b>	40	100	40	100
<b>Mean ± SD</b>	43.50±16.53		39.97±13.84	

**Table 3: Sex incidence.**

Sex	Conservative group		Surgical group	
	Number	Percentage (%)	Number	Percentage (%)
Male	20	50	33	82.5
Female	20	50	7	17.5
<b>Total</b>	40	100	40	100

**Table 4: Mode of injury.**

Mode of injury	Conservative group		Surgical group	
	Number	Percentage (%)	Number	Percentage (%)
Assault	2	5	2	5
Fall from a height	2	5	3	7.5
RTA	10	25	26	65
Slip and fall	26	65	9	22.5
<b>Total</b>	40	100	40	100

**Table 5: Side distribution.**

Side	Conservative group		Surgical group	
	Number	Percentage (%)	Number	Percentage (%)
Left	22	55	17	42.5
Right	18	45	23	57.5
<b>Total</b>	40	100	40	100

**Table 6: Treatment methods used.**

Management	Conservative group		Surgical group	
	Number	Percentage (%)	Number	Percentage (%)
Conservative	40	100	0	0
External fixator	0	0	10	25
K wire fixation	0	0	10	25
Plating	0	0	20	50
<b>Total</b>	40	100	40	100

**Table 7: Time of union.**

Time of union	Conservative group		Surgical group	
	Number	Percentage (%)	Number	Percentage (%)
6 weeks	18	45	35	87.5
3 months	20	50	5	12.5
6 months	2	5	0	0
<b>Total</b>	40	100	40	100

**Table 8: Pain score.**

Pain score	Conservative group		Surgical group	
	Number	Percentage (%)	Number	Percentage (%)
1-10	12	30	19	47.5
11-20	14	35	12	30
21-30	6	15	5	12.5
31-40	4	10	4	10
>40	4	10	0	0
<b>Total</b>	40	100	40	100

**Table 9: Function score.**

Function score	Conservative group		Surgical group	
	Number	Percentage (%)	Number	Percentage (%)
1-10	4	10	7	17.5
11-20	10	25	18	45
21-30	6	15	11	27.5
31-40	8	20	1	2.5
>40	12	30	3	7.5
<b>Total</b>	40	100	40	100

**Table 10: Comparison of range of movements.**

Movements (degrees)	Conservative group		Surgical group		Conservative group average	Surgical group average	P Value
	Min	Max	Min	Max			
<b>Dorsiflexion</b>	10	80	15	80	54.75±22.62	68.12±19.19	0.013*
<b>Palmar flexion</b>	0	90	30	90	61.31±20.80	68.75±14.70	0.119
<b>ADP</b>	10	160	45	170	116.25±42.48	136.88±29.02	0.031*
<b>Radial deviation</b>	0	20	0	20	8.94±5.42	8.87±29.02	0.961
<b>Ulnar deviation</b>	0	30	0	30	16.31±7.96	17.87±6.78	0.439
<b>Pronation</b>	0	90	10	90	23.75±12.65	26.13±9.30	0.413
<b>Supination</b>	0	90	15	90	71.00±25.98	68.13±23.44	0.667
<b>APS</b>	0	180	15	180	73.00±26.57	78.13±16.74	0.365

**Table 11: Results.**

Results	Conservative group		Surgical group	
	Number	Percentage (%)	Number	Percentage (%)
<b>Excellent</b>	12	30	18	45
<b>Good</b>	6	15	13	32.5
<b>Fair</b>	14	35	8	20
<b>Poor</b>	8	20	1	2.5
<b>Total</b>	40	100	40	100

## DISCUSSION

Distal radius fractures are injuries which are commonly seen in the outpatient and the emergency department. The importance of anatomic reduction in getting a good functional outcome have been demonstrated by various studies as available in literature.<sup>3,4</sup> In fractures where the different parameters like articular surface congruency, maintenance of radial height, length and inclination have not been addressed, have generally been associated with an outcome which is not to the optimum level.<sup>5-7</sup>

Therefore, every effort should be made to restore these parameters to the best possible extent. After a good anatomic reduction has been achieved, many methods are available to maintain the alignment and to prevent secondary loss of reduction from happening. Every method has its own advantages and disadvantages. The most common traditional treatment of distal radius fractures has been closed manipulative reduction and cast immobilization. Although cast immobilization alone avoids surgery and many complications, its use is limited in cases of fractures where there is extensive comminution.<sup>8</sup> Loss of reduction usually happens after a

period of 2 weeks of casting in spite of an initial good anatomic reduction.<sup>9</sup> External fixation has been commonly used in the management of these fractures and it serves to improve parameters such as radial length and dorsal tilt. External fixator application can be supplemented with K wire fixation for added stability as and when required.

This was a prospective 80 Patients with Intra-articular fractures of the distal radius. 40 patients were treated with conservative management while 40 were managed by surgical means. Out of 40 surgically managed patients, 10 were treated by closed reduction and percutaneous pinning by, 10 patients by ligamentotaxis with external fixator application and 20 patients with open reduction and internal fixation with plate osteosynthesis.

Mean age and most common age was less in surgical group. Most common age group was 41-50 years (35.0%) with mean age being 43.50 years in conservative group, while in the surgical group the most common age incidence was 20-30 years (32.5%) with mean age being 39.97 years. This compares well to a study by Harish Kapoor et al who reported similar incidence of age.<sup>10</sup>

The best outcome or results were seen among the younger individuals. The excellent and good outcomes in the conservative group were seen only in stable, minimally comminuted and minimally displaced fracture patterns. Excellent and good outcomes were seen in most patients with similar fracture patterns in the surgical group.

Average time fracture union was around 6 weeks in cases managed surgically, while it was around 3 months in the conservative group. Delayed union was seen more among postmenopausal females and aged males. These findings were comparable to a study by Hirashima et al.<sup>11</sup>

The percentage of loss of movement did not correlate very well with time of union. Even the patients with time of union of 6 weeks had greater percentage of loss of movements while patients with time of union of 3 months had good range of movements. Similarly pain and function score at 6 months follow up did not correlate with time of union.

Mean pain score was significantly less associated with surgical management with values being 20.30 in conservative and 16.7 in the surgical group ( $p=0.07$ ). This was comparable to studies conducted by Chin-En Chen et al and Carrozzella.<sup>12,13</sup>

Mean function score was significantly less in patients with surgical management, values being 29.2 for conservative group and 20.7 for the surgical group ( $p=0.004$ ). In the surgical group, it was least in patients treated with external fixators group (8.7) and more in patients managed by K-wire fixation (35.4).

Mean loss of movements was less in surgical group 29.5% compared to the conservative group 35.2%. Among surgical group, it was least in plating (30%) and more in K-wire fixation (35%). In surgical group, all movements were maximum in plating group and minimum in K-wire group.

Mal-union was seen in 30% cases in the conservative group and 10% of cases in the in surgical group. It was seen in 30% of patients treated with K wire fixation. Mal-union was seen in case of fractures with excess initial displacement, excessive comminution treated conservatively or with K-wires. Stiffness of wrist and fingers was seen in 10% of patients in both the groups. Shoulder hand syndrome was seen in 10% of cases in the conservative group and none in the surgical group. Osteodystrophy was seen in 5% in conservative group and none in the surgical group.

Intra-articular step was seen in 30% of cases in the conservative group and in 41.7% in the surgical group. The intra articular step was best corrected by open reduction and plating and the least with external fixator application. These findings were in contrast to a study by Knirk et al who reported that the step was best corrected by ligamentotaxis.<sup>14</sup>

Radial inclination was lost in 45% of cases in the conservative group and 32.5% in the surgical group. Radial inclination was best restored with plating (75%) in our study and least with K-wire fixation (30%).

Radial length was lost in 45% cases of conservative group and 35% in the surgical group. Radial length was best restored with plating (75%) in our study and least with K- wire (70%) In a study by Horesh et al, they reported that the radial length was best restored with external fixation which was in contrast to the findings of our study.<sup>15</sup>

Excellent results were seen in 30% of cases in the conservative group and 47.5% of cases in the surgical group. Excellent and good results were seen in 90% in plating and 50% in K-wire among the surgically managed patients. These results were comparable to a study by Arora et al.<sup>16</sup>

Weber concluded that comminuted fractures requires early, accurate reduction of the articular surfaces with prevention of secondary loss of reduction.<sup>17</sup> Koenig et al made a comparative study between conservative and surgical management and they concluded that open reduction and internal fixation with locking compression plates gives a good union rate with a better functional outcome compared to casting in these fractures.<sup>18</sup> Non-operative treatment would be better suited for elderly individuals with poor bone stock. Bassett-RL in his study concluded ligamentotaxis with external fixators gives better results in the case of comminuted fractures of the distal radius.<sup>19</sup> Fernandez, Geissler in their study of 40 patients with intra articular distal radius fractures showed



satisfactory results in 85% of patients with less amount of complications.<sup>20</sup> They combined ligamentotaxis with K wire fixation with or without open reduction.

All the findings recorded by the studies of other authors were observed and analysed and we compared them with that of observations and inferences that we had arrived at through our study. We observed that conservative management is better in managing undisplaced, minimally comminuted fractures and in fractures with minimal initial displacement. For fractures with minimal comminution, K-wires appeared to be better suited and gave better results if combined with plaster slab or cast application. For highly comminuted fractures where no reconstruction was possible without sufficient purchase for screws, External fixator application was found to be a better option for management. For Barton fractures and comminuted fractures where articular reconstruction was still possible, open reduction and internal fixation with locking compression plates gave better results. Therefore, one treatment method cannot be generalized for all fracture patterns and treatment should be individualized based on various parameters such as age of the patient, quality of the bone, type of fracture pattern, degree of initial displacement and the amount of comminution present. Accurate reduction of the articular surface with restoration of parameters such as radial height, length and inclination are important principles to be followed in the management of these fractures. Early and aggressive physiotherapy is often associated with a good functional outcome.

## CONCLUSION

By this study, we conclude that conservative management is better in managing undisplaced, minimally comminuted fractures and fractures with minimal initial displacement. For fractures with minimal comminution, K-wires appeared to be better suited and gave better results if combined with plaster application. For highly comminuted fractures where no reconstruction was possible without sufficient purchase for screws, External fixator application was found to be a better option. For Barton fractures and comminuted fractures where articular reconstruction was still possible, open reduction and internal fixation with locking compression plating gave better results. Overall surgical management gives better results compared to conservative treatment. Therefore, one treatment method cannot be generalized for all fracture patterns and treatment should be individualized based on various parameters.

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