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Comparative Analysis of Functional Rehabilitation Outcomes in Intraarticular Distal Radius Fractures: Surgical versus Conservative Management

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INTRODUCTION

Intraarticular distal radius fractures represent a common yet challenging orthopedic injury, accounting for a significant proportion of upper extremity fractures. The management of these fractures has traditionally involved a spectrum of treatment modalities, ranging from non-operative approaches such as closed reduction and casting to surgical interventions including open reduction and internal fixation.[1,2,3,4] While the primary goal of treatment is to restore anatomical alignment and function of the wrist joint, the optimal approach to achieving this outcome remains a topic of ongoing debate among orthopedic surgeons.[5,6]

In recent years, there has been a growing interest in evaluating the functional outcomes associated with different management strategies for intraarticular distal radius fractures. Understanding the long-term impact of surgical versus conservative management on patient-reported functional outcomes, pain relief, range of motion, and quality of life is essential for guiding clinical decision-making and optimizing treatment algorithms.[7,8,9,10,11]

This study aims to contribute to the existing body of evidence by conducting a comprehensive comparative analysis of functional rehabilitation outcomes in intraarticular distal radius fractures treated with surgical and conservative approaches. Drawing upon data from a rigorous review of the literature and clinical experience, our research seeks to provide valuable insights into the effectiveness and safety of each treatment modality through a meticulous examination of functional outcomes, including grip strength, wrist range of motion, Disabilities of the Arm, Shoulder, and Hand (DASH) scores, and patient-reported satisfaction, we aim to elucidate the advantages and limitations of surgical versus conservative management in achieving optimal functional recovery.[8]

This study holds the potential to inform evidence-based decision-making, facilitate shared decision-making between clinicians and patients, and ultimately improve the quality of care for individuals with intraarticular distal radius fractures. We anticipate that our findings will contribute to the ongoing discourse surrounding fracture management strategies and pave the way for further research aimed at optimizing outcomes in orthopaedic trauma care.

Methods and methodology

This prospective study was conducted at Saveetha Medical College and Hospital in Chennai from january 2021 to january 2022, with the aim of investigating the outcomes of various treatment modalities for distal end radius fractures. The study enrolled a total of 60 patients who presented at our outpatient or emergency services. Patients providiving consent for the procedure, presents within 3 weeks after sustaining the injury, skeletal mature patients and with no ipsilateral upper limb fractures were included. Patients who are unfit for surgery and those who are

not willing for surgery and follow up were excluded from participation. This study was approved by the ethical committee of our institution.

Upon enrollment, all patients underwent thorough clinical and radiographic examinations. Radiographic assessments included obtaining anteroposterior and lateral views of both wrist joints. These radiographs were carefully analyzed for indicators such as loss of palmar tilt, presence of dorsal tilt, radial shortening, and loss of radial inclination. Fractures were classified according to the AO classification system, categorizing them into type A (extra-articular), type B (partial articular), and type C (complete articular).

Following pre-anesthetic evaluation, patients were assigned to either receive treatment via plaster of Paris (POP) cast or undergo surgical intervention. Patients under group A underwent conservative management with pop were given below elbow POP after closed reduction checked under image guidance for 6 weeks. Patients under group B underwent open reduction internal fixation with plate osteosynthesis (ORIF). Preoperatively antibiotic prophylaxis was given and continued for 2 days after post operatively with injection cefazolin 1gm. Subsequently, patients were followed up for a period of two years, with evaluations conducted at specific intervals: 6 weeks, 12 weeks, 6 months, and 1year post-treatment.

Throughout the follow-up period, radiological assessments were focused on evaluating residual dorsal angulation, radial shortening, and loss of radial inclination. These radiographic findings were graded according to Sarmiento's modification of Lindstrom Criteria, providing a standardized framework for assessment.

At the final follow-up, clinical and functional evaluations were performed using the DASH score. The data gathered was analyzed with IBM SPSS Version 22.0 software. Continuous variables were expressed as mean ± SD, while categorical variables were presented as numbers and percentages. To compare categorical variables, the chi-square test was used, with statistical significance set at a P value below 0.05.

Results

In a prospective study comprising 30 patients with distal Radius fractures, the demographic data revealed 20 males (66.7%) and 10 females (33.3%). The age spectrum ranged from 21 to 78 years, with an average age of 40.35 years. Notably, the most prevalent age bracket differed between the treatment groups: for conservative management, individuals aged 41-50 years constituted 35% of cases, while in the surgical cohort, those aged 20-30 years accounted for 32.5% of cases. Road Traffic Accident (RTA) was the most common mode of injury (45%). Frykman's type III fractures were the most frequently encountered, comprising 41.7% of cases, followed by AO type C2.2 fractures at 19%.
Mean union time at 6 weeks was 45% in the conservative group and 76.5% in the surgical group, while at 3 months, it was 50% in the conservative group and 13.5% in the surgical group. Mean pain score (VAS) was 6 for the conservative group and 4 for the surgical group at 12 weeks follow up, while mean function score (DASH) was 21.2 for the conservative group and 17.5 for the surgical group at 12 weeks follow up. Malunion occurred in 4 patients of the conservative group and in 2 patient involving the surgical external fixator group. Intra-articular step was observed in 3 patients of the conservative group and 2 patients in the surgical group. Loss of radial inclination was seen in 4 patients of the conservative group and in 1 patient of the surgical group, while radial length was lost in 3 patients of the conservative group and in 2 patients of the surgical group. Mean loss of movement was 35.2% for the conservative group and 30.55% for the surgical group. Mean dorsiflexion was 58º for the conservative group and 66.8º for the surgical group, while mean palmar flexion was 58° for the conservative group and 68.4° for the surgical group. Mean radial deviation was 8º for the conservative group and 8.5° for the surgical group, while mean ulnar deviation was 16° for the conservative group and 17° for the surgical group. Mean pronation was 71° for the conservative group and 70° for the surgical group, while mean supination was 73° for the conservative group and 81.5° for the surgical group. The average arc of dorsopalmar flexion was 116.3° for the conservative group and 142° for the surgical group, and the average arc of pronation-supination was 144° for the conservative group and 152.80° for the surgical group. The average arc of radio-ulnar deviation was 23.7°

for the conservative group and 28.80° for the surgical group. Grip strength was >50% compared to the normal wrist in 35% of the conservative group and 62% of the surgical group, while it was <50% in 65% of the conservative group and 38% of the surgical group. Loss of radial inclination was 45% in the conservative group and 32.5% in the surgical group, while loss of radial length was 45% in the conservative group and 35% in the surgical group. Intra-articular step occurred in 30% of the conservative group and 40% of the surgical group. Complications such as malunion occurred in 30% of the conservative group and 10% of the surgical group. Stiffness of wrist and fingers was seen in 10% of both groups. Shoulder hand syndrome was observed in 10% of the conservative group and none in the surgical group. Osteodystrophy was seen in 5% of the conservative group and none in the surgical group. In the surgical group, the plating group did not have any procedure-related complications. The K-wire and external fixator group had pin tract infection in 10% of cases, managed with pin-tract care. Excellent results were seen in 30% of cases in the conservative group and 47.5% in the surgical group.

Discussion

Distal radius fractures are not uncommon. The importance of anatomic reduction has been demonstrated by various clinical studies as well as laboratory assessment of the force and stress loading across the radiocarpal joint. In these fractures with dorsal angulation >9°, loss of radial inclination >3°, loss of radial length >2 mm, and articular surface displacement >2 mm, suboptimal results have been reported.[10] Therefore, every effort should be made to restore the normal length and alignment, as well as articular surface congruency of the distal radius. After the anatomic reduction has been achieved, many methods are available to maintain the alignment and prevent repeat displacement. Immobilization methods include casting, external fixation, internal fixation with plates, and internal fixation combined with external fixation depending on the different types of fractures. Every method has its advantages and limitations. The most common traditional treatment of distal radius fractures is closed reduction and cast immobilization. Three-point fixation with a well- fitted cast is essential for adequate immobilization. Results of objective evaluation in terms of clinical and functional evaluation Group Dorsifiexion.[12,13,14,15,16] Although cast immobilization alone avoids surgery and many complications, it cannot maintain the distraction to correct length or control the rotation of the distal fragment when comminution is present. Loss of reduction usually happens after 2 weeks of casting despite a perfect initial anatomic reduction[17,18]. Leung et al [19] proposed that Colles' type of extraarticular fracture be managed conservatively if acceptable reduction can be achieved; otherwise surgery is necessary to obtain a good functional result. In our study, 13 of the 15 patients treated by closed reduction and POP cast reported good to excellent results on subjective evaluation. The other 2 patients had fair results. Conservative treatment was chosen because most of them had simple extraarticular fractures. For these patients finger and wrist stiffness was the major concern. External fixation is popular for the treatment of displaced fractures of the distal radius. With this method, the radial length and dorsal tilt can be improved significantly.[20,21,22] For certain intra-articular fractures, percutaneous wires through the radial styloid can be used as a supplement.[23] In our study distractor was used in 7 patients and on subjective evaluation, 6 had good to excellent response and only 1 patient reported fair result who had marked metaphyseal comminution. Wrist stiffness and arthritic changes were seen in this group. Margaliot et al[24] performed a meta-analysis on outcomes of unstable distal radius fractures managed by external fixators (EF) vs. plate osteosynthesis. They concluded that there was no evidence to support that the use of ORIF is superior to EF. However, there were significantly higher rates of postoperative neuritis, infections, pin loosening and hardware failure in the EF group. Westphal et al performed a retrospective comparative study and found no differences between EF and ORIF outcomes. A randomised controlled trial on displaced intra-articular fractures of the distal radius was conducted by Kapoor et al[28]. They concluded that ORIF provided the best anatomical restoration with patients least likely to develop arthritis. However ORIF should be avoided in severe comminuted fractures as the fixation may not be stable and would likely result in poor functional outcomes. EF was found to maintain the radial length best due to the sustained countertraction utilising the principle of ligamentotaxis. EF provides the best results in severely comminuted fractures. With meticulous pin insertion and pin site care, complications are minimal. In our study 8 patients received ORIF and plating. According to the demerit point system of Gartland and Werley for functional evaluation, 67% had excellent results, 33% had good and no one had fair/poor functional recovery. Patients treated by distractor, with or without pinning, showed a less satisfactory result: 27% being excellent, 67% good and 6%

fair.[25,26,27,28,29] All of the above observations emphasize that stabilizing the fracture fragments with a volar plate and screws is an effective method to maintain the reduction till union and prevent collapse of the fracture fragments; even when the fracture is intraarticular/unstable and/or osteoporotic bone. This technique has excellent functional outcome with minimum complications. It is applicable for all three AO types of distal end radius fractures, whether in young patients with good bone stock or in elderly osteoporotic patients. But operating surgeon should be skilful with the technique. Distractor combined with pinning is also an effective method, especially in the highly comminuted fractures with or without compounding. Complications such as pin tract infection, pin loosening, loss of reduction in osteoporotic bone, suboptimum reduction in intra-articular fractures, wrist stiffness, etc. preclude its use in every case.[30,31,32,33] Closed reduction together with POP cast gives a better result in the extra-articular type of fracture. It is easy to obtain reduction but difficult to maintain the reduction by simple plaster cast. Union in displaced position leads to poor functional and cosmetic results. Complications such as suboptimum reduction in intra-articular/comminuted fractures, loss of reduction in osteoporotic bone, chances of Sudeck's atrophy on repeated manipulation, wrist/ finger stiffness, and malunion preclude its use in every case.

Conclusion

Based on our study findings, we conclude that different fracture patterns require individualized treatment approaches. Conservative management is preferred for undisplaced and minimally comminuted fractures, while K-wires, especially when combined with plaster, are effective for minimal comminution. External fixation is preferable for highly comminuted fractures where reconstruction is not feasible without sufficient purchase for screws. Plating yields better results for Barton fractures and comminuted fractures with potential for articular reconstruction. Overall, treatment decisions should be based on the specific characteristics of each fracture rather than a one-size-fits-all approach.

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Patient no.	Age	Sex	Side	Mode of injury	Fracture classification		Method of fixation	Radiological union	Dash scores 6 weeks	VAS scores 6 weeks	DASH scores 12 weeks	VAS scores 12 weeks	Movements at degrees									LOM in(%)	Complications
					AO	FR							DF	PF	APD	RDD	UDU	ARU	Pro	Sup	APS		
1	70	M	R	RTA	B1.1	VIII	C	6m	58	7	22	5	2090		110	15	30	45	90	90	180	20	malunion, shoulder hand syndrome, stiffness
2	50	M	L	RTA	B1.2	III	C	8w	64	7	18	5	6070		130	5	15	20	80	70	150	34	
3	53	F	R	SF	C2.2	III	C	3m	55	6	16	4	4560		105	5	15	20	60	60	120	44	malunion
4	60	M	R	RTA	B2.2	IV	C	4m	52	7	24	5	3040		120	0	15	15	60	70	130	43	malunion, stiffness
5	45	F	L	RTA	B3.1	III	C	3m	61	5	16	5	6030		90	5	15	20	90	90	180	36	stiffness
6	78	M	R	SF	C3.1	VIII	C	3m	55	6	18	6	6045		105	10	15	25	90	80	170	31	
7	48	M	R	RTA	B1.1	III	C	6w	54	6	20	5	8080		160	10	15	25	90	90	180	19	
8	50	F	L	SF	B3.1	IV	C	4m	58	5	22	4	6070		130	15	5	20	70	70	140	35	malunion
9	38	M	R	RTA	C3.2	III	C	3m	60	5	24	5	5045		95	10	10	20	45	80	125	45	osteodysdrophy
10	65	F	L	SF	B2.1	VIII	C	3m	50	7	16	4	6045		105	10	15	25	90	80	170	31	
11	55	M	R	RTA	B3.1	III	PO	6w	52	6	20	5	6070		130	5	10	15	70	70	140	39	
12	40	M	L	RTA	C2.2	III	PO	6w	58	5	22	3	8080		160	10	20	30	80	90	170	18	
13	35	F	R	RTA	C3.2	III	PO	8w	52	5	18	3	7080		150	10	20	30	80	80	160	21	
14	46	M	R	RTA	B3.2	VIII	PO	6w	55	5	16	2	8080		160	10	15	25	80	80	160	22	
15	28	F	L	RTA	C3.1	III	PO	8w	58	6	19	2	6075		135	20	40	20	45	60	105	41	
16	68	M	R	FFH	B3.2	IV	PO	8w	60	4	16	2	6070		130	5	15	20	60	70	140	35	
17	70	F	L	SF	C2.2	III	PO	6w	52	5	18	3	8075		155	10	15	25	70	90	160	23	

18	35	M	R	RTA	C2.2	VIII	PO	6w	48	4	20	3	8070	150	10	15	25	90	90	180	21	
19	28	M	R	RTA	C3.1	III	PO	3m	58	5	21	3	6060	120	5	10	15	60	70	130	43	
20	30	F	R	FFH	C3.2	IV	PO	6w	60	4	18	3	8585	170	15	20	35	90	90	180	10	
21	25	M	R	RTA	B1.1	VII	EF	6w	54	6	22	2	8090	170	10	20	30	90	90	180	13	
22	55	M	L	SF	B1.2	VII	EF	3m	62	6	20	2	8070	150	10	20	30	90	90	180	19	pin site infection
23	34	F	R	RTA	B3.2	III	EF	3m	52	7	18	2	3045	75	0	20	20	45	70	115	51	
24	26	M	L	RTA	B2.2	VIII	EF	6w	55	5	16	3	4580	125	0	0	0	45	50	95	59	malunion
25	39	M	R	FFH	B1.1	III	EF	8w	50	4	20	3	6050	115	20	10	30	45	45	90	41	
26	45	M	R	RTA	C2.2	VIII	EF	4m	54	6	18	2	8080	150	10	20	30	80	80	160	19	
27	29	M	L	RTA	B1.2	IV	K-wire	3m	58	6	22	3	1530	45	0	15	15	10	70	80	70	pin site infection
28	52	F	R	SF	C2.2	VI	K-wire	6w	61	4	18	3	9070	160	5	15	20	90	90	180	22	
29	21	M	R	RTA	B1.2	III	K-wire	6w	58	6	20	2	8060	140	0	15	15	10	90	100	44	malunion
30	40	F	L	FFH	B2.2	III	K-wire	3m	50	5	16	2	6080	140	10	15	25	80	90	170	25	

Complications	Conservative management (n=10)		Surgical management (n=20)		P value
	No	%	No	%	
Radial Inclination					
Lost	18	45.0	13	32.5	0.344
Retained	22	55.0	27	67.5	
Radial length					
Lost	18	45.0	14	35.0	0.453
Retained	22	55.0	26	65.0	
Intra articular Step					
Lost	28	70.0	24	60.0	0.553
Retained	12	30.0	16	40.0	

Mal Union					
Absent	28	70.0	36	90.0	0.050*
Present	12	30.0	4	10.0