

COMPARATIVE STUDY OF RADIOLOGICAL AND FUNCTIONAL OUTCOME OF EXTRA ARTICULAR DISTAL RADIUS FRACTURE TREATED CONSERVATIVELY WITH RESPECT TO ITS POSITION OF IMMOBILIZATION

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ABSTRACT

INTRODUCTION

Distal radius fracture is one of the common injury in orthopedic trauma. Traditionally, this fracture is being treated with closed reduction and immobilization in palmer flexion and ulnar deviation. This position of immobilization has been shown with poor functional result. So the aim of our study is to compare the radiological and functional outcome of distal radius fracture treated conservatively with respect to position of immobilization.

MATERIAL AND METHODS

Hundred patients, all above 20 years of age with distal radius fracture where treated with closed reduction and below elbow cast application. Patients were randomly allocated to dorsal and palmer flexed plaster cast application, fifty in dorsiflexion group and fifty in palmer flexion group. All patients were followed up at 2nd week, 4th week, 6th week and 12th weeks. Radiological parameters measured in every follow-up and functional parameters measured after removal of cast in last two follow up. The results were scored and compared by Demerit Scoring System of Saito. For comparison, t test and Chi square test were used as necessary.

RESULTS

All fractures united. All individual movements of wrist were significantly better in the dorsiflexed immobilized group as compared with the palmerflexed immobilized group. Radiological parameters were also markedly better in the dorsiflexed group.

CONCLUSION

Both radiological and functional results of the extra articular distal radius fracture are better if the fracture immobilized in the dorsiflexed position after reduction rather than traditional palmer flexion position.

KEYWORDS Cast immobilization, dorsiflexion, palmer flexion, distal radius fracture, radiological outcome, functional outcome.

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INTRODUCTION

Distal radius fracture is one of the most common injury in orthopedic practice accounting about one sixth of the all fracture treated in the emergency room. There is no consensus regarding the description of the condition, the appropriate treatment, or even the anticipated outcome. The treating concept of the distal radius fracture is being changed suggesting the operative treatment for complex intra-articular fractures.¹

Reduction is not a problem but maintaining is. Residual disability after Colles' fractures reported as high as 90%.² It is well accepted that restoration of anatomy and early mobilization ensures better results. Numerous studies have taken the amount of displacement into consideration but very few have done on the role of position of immobilization as a parameter for comparing radiological and functional outcome.

The present study was undertaken to evaluate the functional and radiological outcome of conservatively treated extra-articular fracture when the wrist was immobilized in DF or in PF.

MATERIAL AND METHODS

It was a comparative prospective study done in emergency department and Department of Orthopedic (OPD), Lumbini Zonal Hospital and Meditech International Hospital, Butwal from April 2015 to May 2017. An approval from institutional review board was taken. Written informed consent was taken from included patients. Total 100 patients with distal radius fracture were taken out of which 50 patients were allocated for DF group and 50 patients were allocated for PF group. Randomization of the cast type done by selection of patient alternatively while applying the cast either in DF or in PF of wrist so that every alternate patient will have different type of cast.

Inclusion criteria were closed displaced, extra articular, with or without fracture of ulnar styloid process. Exclusion criteria were age less than 20 years, intra-articular fracture, pathological fracture, open fracture, fracture with neurovascular compromise or with impending compartment syndrome (carpal tunnel syndrome), poly-trauma with head injury, failed closed reduction, more than 50% comminuted fracture, patient arrived after 7 days of trauma, associated fracture of ulna (except tip of ulnar styloid process) and carpal bones, suspected ligamentous injury around wrist and hand, fracture above 2.5cm from distal articular surface of radius.

Fracture was reduced closed in emergency department or operating room under hematoma block regardless of the type

of the cast to be applied. All reductions were done by the author with help of available assistant by appropriate maneuver. (traction, ulnar deviation and flexion at fracture site for Colles type of fracture and traction, ulnar deviation and extension at the fracture site for Smith type fracture).

Once fracture was reduced, it was immobilized by below elbow cast application with wrist either 15 deg DF or 15 deg PF according to randomization of cases. Image intensifier was not used. All patients were explained about the cast complications and send for check X-Ray for the acceptable reduction as per guideline.³



Fig 1 (a, b, c). Plaster application method in the position of wrist dorsiflexion and palmerflexion.

The basic information like age, sex, address, injured side, mechanism of injury, hand dominance were all noted. Pre-reduction radiographic angles as well as post reduction angles were also noted with help of plastic scale and goniometer. Five follow up made for all cases which were next day of plaster application, first week, second week, sixth week and twelfth week. At each follow up lateral and AP radiograph of wrist was analyzed in OPD for acceptance. In first four follow ups, radiological parameter was measured. In last two follow ups clinical and radiological as well as functional parameter were measured.

Radiological parameter^{4,5,6,7,8} Radial tilt- 22-23 deg, range: 13-33 deg, Palmer tilt- 11-12 deg, range:1-21 deg Ulnar variance- 2mm and range :2 to+ 2 mm

At 6 weeks, plaster was removed after radiographic evaluation. Range of motion and grip strength was measured and recorded. Patients were sent to physiotherapy and advised to review at twelve weeks with wrist radiograph. Functional parameter included subjective evaluation, range of motion of wrist and grip strength measured at 6th week and at 12th week. Subjective evaluation was done by asking subjective questions regarding pain, disability, limitation of the motion and restriction of activity' and scored as demerits scoring system of Saito.⁹

Grip strength was measured at 6th week after removal of plaster and at 12th week after physiotherapy with the help of sphygmomanometer and compared with normal contra lateral hand. The cuff of the sphygmomanometer rolled and inflated up to 20 mm of Hg and patients were asked to squeeze as hard as he or she can. A normal hand should be able to achieve 200mm of Hg or more¹⁰

Radiological and functional result of both groups were calculated using Satio's scoring system⁹and adding all the points finally graded as follows Excellent- 0to3, Good- 4 to 9, Fair - 10 to 15, and Poor - 16 to26. Both of DF and PF group were compared with each other on the above mentioned parameter.

Data was entered in Microsoft Excel. Data analysis was carried out using statistical package for social science, version 20 (SPSSTM Inc. Chicago, USA). Student T Test and Pearson Chi Square were done to compare mean of two groups. P value of less than 0.05 was considered statistically significant.

RESULTS

There were 126 patients who after initial assessment were found to be eligible for the study (66 patients in DF group and 60 patients in PF group). They were treated by closed reduction and plaster cast application out of them 20 patients lost follow up (13 patients in DF 7 in PF). Two patients did not give consent. Nine patients had unacceptable reduction (6 patients in DF group and 3 patients in PF group). They were retreated out of them 4 patients were excluded due to unacceptable reduction. (Three patients in DF group and one patient in PF group). They were treated by ORIF.

The mean age of the patients in the DF group was 49.88 years and the mean age of the patients in PF group was 52.74. There were 72 female and 28 male patients participating in study out of which 15 were male and 35 were female in DF group and 13 were male and 37 were female in PF group. There were 48

patients with fracture involving the left extremity and 52 patients with fracture involving the right side. Fall was the commonest mechanism of injury.

Radiological parameters

Table1. Radial tilt, palmer tilt and ulnar variance in successive follow up

Radial tilt (deg)	Pre reduction		p-value	Post reduction		p-value	First week		p-value	Second week		p-value	Sixth week		p-value	12 th week		P-value
	DF	PF		DF	PF		D	PF		DF	PF		DF	PF		D	PF	
<13	23	25	0.69	0	2	0.15	0	5	0.02	3	5	0.46	4	8	0.22	5	9	0.25
13-33	27	25		50	48		50	45		47	45		46	42		45	41	
>33	0	0		0	0		0	0		0	0		0	0		0	0	
Total	50	50		50	50		50	50		50	50		50	50		50	50	
palmer tilt (deg)	Pre reduction		p-value	Post reduction		p-value	First week		p-value	Second week		p-value	Sixth week		p-value	12 th week		P-value
	DF	PF		DF	PF		D	PF		DF	PF		DF	PF		D	PF	
<1	43	43	1.00	8	6	0.15	18	22	0.41	22	26	0.42	22	27	0.32	21	26	0.31
1-21	7	7		42	44		32	28		28	24		28	23		29	24	
>21	0	0		0	0		0	0		0	0		0	0		0	0	
Total	50	50		50	50		50	50		50	50		50	50		50	50	
Ulnar variance)	Pre reduction		p-value	Post reduction		p-value	First week		p-value	Second week		p-value	Sixth week		p-value	12 th week		P-value
	DF	PF		DF	PF		D	PF		DF	PF		DF	PF		D	PF	
<-2	0	1	0.79	0	1	0.33	0	1	0.33	0	1	0.33	0	0	0.11	47	42	0.11
+2 to -2	44	43		47	42		47	42		47	42		47	42		3	8	
>+2	6	6		3	7		3	7		3	7		3	8		50	50	
Total	50	50		50	50		50	50		50	50		50	50		47	42	

Table2. Mean radiological parameters with standard deviation at 6th and 12th weeks

Radiological parameter	SIX WEEKS			TWELVE WEEKS		
	DF group	PF GROUP	P VALUE	DF group	PF GROUP	P VALUE
Radial tilt	---	18.22±3.400	0.495	18.56±3.406	18.22±3.518	0.625
Palmer tilt	4.20±5.897	2.14±8.084	0.149	18.56±3.406	18.22±3.518	0.625
Ulnar variance	1.66±0.939	1.46±1.468	0.387	1.66±0.939	1.46±1.358	0.394

Table 3. Mean range of motion of wrist compared at 6th and 12th weeks

Mean ROM (deg)	SIX WEEKS			TWELVE WEEKS		
	DF group	PF GROUP	P VALUE	DF group	PF GROUP	P VALUE
DF	32.44	18.20	0.0001	46.80	38.70	0.0001
PF	23.70	25.7	0.024	39.30	39.30	1
RD	16.32	12.10	0.003	24.70	20.70	0.0001
UD	25.10	21.3	0.009	30.50	26.90	0.001
Supination	46.80	43	0.03	57.50	52.70	.0001
Pronation	44.80	48.20	0.011	53.80	55.00	0.006

Table 4. Grip strength comparison between two group at 6 weeks and 12 weeks

Grip strength	6wks		P VALUE	12wks		P VALUE
	DF	PF		DF	PF	
NORMAL	5	4	0.001	44	33	0.0009
Loss of 1/2 power	44	29		6	16	
Loss of 2/3 power	1	17		0	1	

Table 5. Comparison of subjective feeling in two groups at 6th weeks and 12th weeks

Subjective feeling	6wks		P VALUE	12wks		P VALUE
	DF	PF		DF	PF	
Excellent	0	0	0.001	30	7	0.0001
Good	29	7		17	36	
Fair	20	33		3	6	
Poor	1	10		0	1	

Table 6. Comparison of finger stiffness at sixth weeks and 12weeks

Finger stiffness	6wks		P VALUE	12wks		P VALUE
	DF	PF		DF	PF	
None	30	7	0.002	45	35	0.0012
None disabling	17	36		5	14	
Disabling	3	6		0	01	

Table7. Comparison of Saito score at 6 weeks and 12 weeks

Saito score	6wks		P VALUE	12wks		P VALUE
	DF	PF		DF	PF	
Excellent	2	2	0.001	42	14	0.0001
Good	28	11		8	34	
Fair	20	33		0	02	
Poor	0	4		0	0	

DISCUSSION

There is still no clear agreement regarding the best position of immobilization for distal radius fracture.¹¹ Regarding pronation and supination different views are claimed to be effective. Sermentio^{12,13} advised for supination of the forearm to reduce the deforming force of brachioradialis while Wahlstrom¹⁴ recommended the pronation of the forearm to neutralize the deforming force of pronator quadrates.

Traditionally, the distal radius fracture is being treated in palmer flexion and ulnar deviation as advised by the John Charnley¹⁵. He says that this position dorsal periosteal hinge provide the stability. But, effectiveness of this method is being challenged in recent time for the increase incidence of re-displacement, poor hand function and acute or chronic carpal tunnel syndrome.¹⁶ The concept of positioning the wrist in dorsiflexion was brought by the Zuppinger's recommendation^{16,17}. He suggested changing the position of wrist from slight palmer flexion at the time reduction to neutral to slight extension with maintaining ulnar deviation after two weeks of initial reduction.

This study shows few similarities with the study done by Gupta A in 1991.¹⁸ He applied plaster cast on 204 patients with displaced distal radius fracture in different position of wrist allocated randomly in three groups: Palmer flexion, neutral or dorsiflexion. They reported that in distal radius fracture

without comminution, the position of the wrist made no significance difference regarding its later displacement. In comminuted fractures, best anatomical results were found in fractures treated with in dorsiflexion. In all fractures, best functional results found in dorsiflexion group.

Our study is more or less similar to the study done by Sunil Rajan et al in 2006¹⁹. They treated 26 distal radius fractures by plaster application. Position of wrist was allocated randomly in either dorsiflexion or palmer flexion. They did six-month follow up which shows both anatomical and functional results were superior in dorsiflexion group which was obtained by Demerit Scoring System of Saito.

A study done by Gupta A¹⁸ also correlates the better result in dorsiflexion group with the bio mechanics of wrist joint with fracture reduction. In PF the dorsal carpal ligament is taut, but cannot stabilize the fracture because of its lack of an attachment to distal carpal row. The deforming forces and the potential displacement of the fracture are parallel, in the same direction. In DF, the volar ligaments are taut and tend to pull the fracture fragment anteriorly. The deforming forces act at an angle which tends to reduce the displacement of the fracture.¹⁸⁻²¹

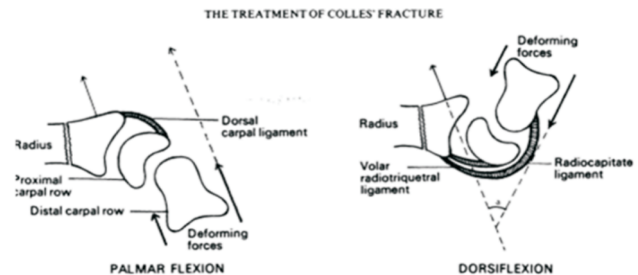


Fig 2. Relation of stability of fracture and attachment of dorsal and volar carpal ligament.

The fracture in reduction easily collapse in straight tube and single curve uniform tube which is formed in palmer flexed position of the wrist. In S shaped double curve tube, the chances of collapse is less, so in the dorsiflexed position of the wrist¹⁸.

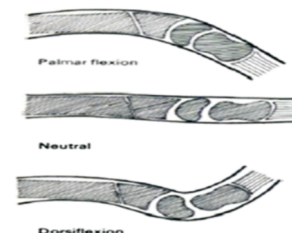


Fig 3. Straight and curved tube phenomenon in relation with fracture collapse.

In this study, we compared the functional and radiological results of the extra articular fracture of the lower end of the radius treated conservatively in two groups, one with wrist immobilized in DF and other in PF. We found the individual movements of DF, PF, supination, pronation, ulnar and radial deviation as well as total range of movement are significantly better when the wrist is immobilized in the dorsiflexion as concluded by Gupta A.¹⁸ Further, grip strength recovery and subjective assessment of the pain, disability and limitation of the movement was also better and faster in dorsiflexion immobilized group.

Radiological parameters as measured by ulnar variance, palmer tilt and radial tilt were not seen differ much at the first follow up between DF and PF wrist immobilized patients. However, maintenance of the parameters in successive follow up was found to be markedly better in DF group as compared to the PF group. The residual deformity seemed to be greater in PF group. Thus, radial tilt, Palmer tilt and ulnar variance all were found to be significantly well maintained in the DF immobilized group as compared to the PF group throughout the follow up stating that later has increased chance of re-displacement.

Since, the wrist extension is the optimal position for hand function and rehabilitation of the finger, along with the fact that PF is associated with the higher rate of fracture displacement, Gupta concluded that flexion at the fracture site is important to make use of the dorsal periosteal hinge but the flexed position need not be maintained at the wrist joint.

It is concluded that better results in DF immobilized wrist and because DF is needed for rehabilitation of fingers and the optimal functional position of for the hand is wrist in extension. Thus in conservatively treated extra articular fracture of the lower end of radius. Flexion should be at the fracture site to make use of the periosteal hinge but the wrist should be immobilized in position of slight extension.^{15,20}

One of the drawbacks of this study is less number of patients in the study. Another drawback is taking limited the radiological measurements as described in previous articles. Measurements of range of motion were also done by goniometer. This may have influenced some results but this is what we usually do in our setting. And in developing country like ours, we have to depend on easily available instruments on many occasions. Grip strength measured with the help of sphygmomanometer which may influence the outcome.

We did not measure others important radiological parameters such as radial length, dorsal tilt of distal fragment, which do have influence in the subsequent of radiological and functional outcome.

CONCLUSION

It is concluded that better results in dorsiflexion immobilized wrist because dorsiflexion is needed for the rehabilitation of fingers, and the optimal functional position for hand is wrist in extension. So, in conservative treatment of distal radius fracture, flexion should be at the fracture side to make advantage of periosteal hinge but the wrist should be immobilized in position of slight extension.^{13,17}

Both radiological and functional results of the extra articular distal radius fracture are better if the fracture immobilized in the dorsiflexed position after reduction rather than traditional palmer flexion position.

CONFLICT OF INTEREST

None declared.

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