Original Article

IS CASTING AN ACCEPTABLE TREATMENT APPROACH FOR A DISTAL RADIUS FRACTURE THAT HAS UNDERGONE A SATISFACTORY CLOSED REDUCTION?

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Objective:
To evaluate the radiographic outcome in fractures of the distal radius treated with closed reduction and plaster casting.

Design:

A retrospective study

Setting:

Hand and Upper limb Surgery Centre and Combined Military Hospital Lahore Pakistan.

Patients:

Forty three patients (31 males, 12 females, aged 18-75 years), with fractures of distal radius were seen between January 2011 and December 2011.

Interventions:

Closed reduction and plaster casting of fractures, followed up by good-quality postero-anterior and lateral radiographs to evaluate stabilization and healing.

Main outcome measures:

Radial height (length), radial inclination and volar (palmar) tilt were measured on radiographs obtained preoperatively, immediately postoperatively, and at the time of removal of plaster cast. Data were analyzed by the *t*-test.

Results:

There was an acceptable improvement in the measurements of radial height and radial inclination immediately after closed reduction and stabilization with plaster cast. This improvement was gradually lost and height and inclination were significantly decreased by the time plaster was removed. Improvement in volar tilt was not significant. Results were poor in AO type B and C and acceptable in AO type A fractures.

Conclusion:

Closed reduction and plaster casting is a common method to deal with bone fractures but cannot effectively protect comminuted distal radial fractures from loss of reduction, which may be associated with shortening and re-displacement and malunion.

Keywords: Distal Radius fracture, close reduction for Radial fracture, Malunion in fracture radius.

INTRODUCTION

Fractures of the distal radius are extremely common. These fractures give uniformly good results and the standard of treatment for most distal radial fractures has been closed reduction and immobilization[1, 2]. Although the injury is predominant in the elderly which usually of low energy, but recently ,because of motor vehicle accidents and recreational activities, there has been an increase in the number of high-energy fractures of the distal

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radius seen in young adults, resulting in surgical management of these injuries [3].

Restoration of normal alignment and articular congruity after a displaced fracture can be difficult but is essential for a good functional result [4, 5]. Extra-articular and intra-articular malunion have both been shown in the laboratory [4] and in clinical studies[6, 7], to alter function and the patient's satisfaction with treatment outcome.

Closed reduction and casting as the only option of treatment may result in inability to manipulate displaced or depressed articular fragments [8]. This technique misses associated soft-tissue and ligamentous injuries, which are being recognized with increasing frequency [9, 10]. The purpose of this study was to determine the radiographic outcomes of acute fracture of the distal radius, treated with close reduction and immobilization in cast.

MATERIALS AND METHODS

Study design:

This was a retrospective study of 43 consecutive patients having distal radial fractures, treated by closed reduction and POP cast immobilization at two institutions who were followed up until the fracture was united and the POP cast was removed. The study design included the evaluation of plain radiographs made at the patient's initial visit (pre-operatively), immediate postoperatively and at the time of removal of POP cast.

Patients:

43 consecutive patients (31 males, 12 females) with distal radial fractures were treated by closed reduction and POP cast immobilization in Hand and Upper Limb Surgery Centre and Combined Military Hospital Lahore for a period of one year from January to December 2011. Three surgeons were responsible for that procedure. Patients with open or complicated fractures, who had undergone closed reduction and external fixation or who had associated multiple injuries were excluded from the study. The mean age at the time of the injury was 39 years (range from 18 to 75 years). The mean and standard deviation [SD] ages were 52.4± (9.8) years for female patients and 39± (8.8) years for male patients. Twenty six fractures occurred on the left side and 17 fractures occurred on the right (Table 1).

Table: 1

Clinical Data for 43 Patients: Having Distal Radial Fractures treated by Closed Reduction and Cast Immobilization.

Age, yr	No. of patients
15–20	05
21–30	07
31–40	19
41–50	06
51–60	03
61–70	02
71–80	01

Side of fracture
Left 26
Right 17

Classification of fractures:

All fractures were classified according to the Association for Osteosynthesis (AO) [11] with the help of posteroanterior and lateral radiographs of the wrist made at the time of the initial injury and after the reduction. According to this classification, most of the cases were of B and C type probably because of increased incidence of high velocity injuries. (Table 2)

Table: 2 Types of fracture

Type of fracture	Frequency	Percent	Valid Percent
A2	2	4.7	4.7
A3	4	9.3	9.3
B2	1	2.3	2.3
B3	11	25.6	25.6
C1	7	16.3	16.3
C2	11	25.6	25.6
C3	7	16.3	16.3
Total	43	100.0	100.0

Operative treatment:

Overall, closed reduction and cast immobilization were performed a mean (and SD) of 2.5 (3.2) days (range from 0 to 14 days) after the injury. All operations were performed under fluoroscopic surveillance. (Table 3)

Table:3 Day of Operation					
Day of operation		**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
	.00	3	7.0	7.0	7.0
	1.00	19	44.2	44.2	51.2
	2.00	7	16.3	16.3	67.4
	3.00	3	7.0	7.0	74.4
	4.00	3	7.0	7.0	81.4
	5.00	4	9.3	9.3	90.7
	6.00	1	2.3	2.3	93.0
	7.00	2	4.7	4.7	97.7
	14.00	1	2.3	2.3	100.0
	Total	43	100.0	100.0	

Radiographic evaluation:

To evaluate distal radial fractures postero-anterior (PA) and true lateral radiographs were obtained. All imaging studies were assessed in a blind fashion by 2 independent investigators, and the 2 measurements were averaged. PA view provided information about radial height and inclination. Normal Radial height is 11mm and was measured as the distance between 2 lines perpendicular to the long axis of the radius, one drawn at the tip of the radial styloid and another drawn at the distal ulnar articular surface. Normal Radial inclination is 22 degrees and it was measured as an angle formed between a line drawn through the tip of the radial styloid and the medial corner of the lunate facet and a line drawn perpendicular to the long axis of the radius. In the lateral view, the volar tilt of the distal radial articular surface was measured [12, 13]. Its normal value is 11 degree. These measurements were taken at three stages. Initial X-rays before reduction followed by at two stages of treatment (immediately postoperatively and at the time POP cast was removed).

Analysis of the data:

The differences between various measurements were evaluated by Student's *t*-test. Statistical significance was defined as $p < 0.05$.

RESULTS

Radiographic evaluation in different stages of management:

Distal radial deformity was assessed by measuring radial height, radial inclination and volar tilt at different stages of treatment. There was improvement in Radial height in initial postoperative stage but the reduction was lost by the time POP cast was removed and was only minimally better than initially. Similarly the radial inclination was improved just postoperatively but had decreased by the time of removal of POP cast (Table 4, $p < 0.05$ for all comparisons). The volar tilt of the distal radius improved from an average of –1.42° to an average of 0.65° at the immediate postoperative evaluation, then remained persistent at 0.53° at the time POP Cast was removed. No significant difference was noted between the initial visits before reduction, immediately postoperatively and after removal of the POP cast (Table 4, $p > 0.05$ for all comparisons).

Table: 4 Measurement stages

stage	**R.H (mm)**		**R.I (degrees)**		**V.T(degrees)**	
	Mean	SD	Mean	SD	Mean	SD
Pre-op	7.98	2.4	17.63	3.5	-1.42	7.50
Post-op	10.33	1.7	19.39	3.6	.65	7.7
ROC	9.15	2	18.8	3.2	.53	2.5

RH= Radial Height, R.I= radial Inclination, V.T= Volar tilt, ROC= removal of Cast

Effects of Type of fracture:

Radial height and Inclination were improved in type A. But type B and C fractures of the distal radius did not show the correction effect of radial height and inclination (Table 5, 6).

Similarly Volar tilt was improved after correction of type A and fracture (Preop-Postop period) but was lost significantly by the time cast was removed. So the net improvement was negligible (Preop-ROC period) (Table 5, 6).

Effects of type of Fracture:

Table: 5 Preop-Post Op stage. Improvement on the basis of type of fracture

Type of Fracture	R.H (mm)		R.I (degrees)		V.T(degrees)	
	Mean	SD	Mean	SD	Mean	SD
A	2.7	3.02	5.75	3.5	3.24	3.4
B	2.43	3	4.80	3.7	1.81	3.5
C	1.85	3.1	4.1	3.6	.62	3.6

RH= Radial Height, R.I= radial Inclination, V.T= Volar tilt, ROC= removal of Cast

Table: 6 Preop-ROC Stage. Net Improvement

Type of Fracture	R.H (mm)		R.I (degrees)		V.T(degrees)	
	Mean	SD	Mean	SD	Mean	SD
A	1.35	1.9	2.16	4.26	2.94	4.4
B	0.77	2.17	0.61	6.98	1.38	3.8
C	0.1	4.51	0.52	7.13	-1.18	7.6

RH= Radial Height, R.I= radial Inclination, V.T= Volar tilt, ROC= removal of Cast

DISCUSSION

Closed reduction with cast treatment of all types of distal Radius fractures continues to be the mainstay of treatment in our country. Studies have shown that in distal radial fractures function is related to the radiographic findings 2. Intra or Extra-articular malunited fractures have been shown to alter function and patient satisfaction with the outcome of treatment.

In a study Arora R et al mentioned an obvious clinical deformity in 77% of cast group and malunion occurred in 89% primarily reduced fractures [14].

Evidence in the literature indicates a strong correlation between restoration of bone anatomy and recovery of function [15], because the position of the fracture at the time of union rather than the position at the time of presentation has the greatest correlation with long-term functional results [16].

The purpose of this study was to establish the stabilization effect of casting on fractures of the distal radius. As we have noted, the bony deformity of the distal radius showed improvement in measurements of radial height and inclination immediately after reduction (Table 4), while restoration of volar tilting of the distal radius was not well achieved with POP casting (Table 4).

Assessment of type of fractures was vital to predict the outcome of management. Comminuted intra-articular fractures of distal radius are very difficult to manage. Severe comminution is associated with shortening and re-displacement [12].

Rozental TD et al showed satisfactory results with closed reduction and pin fixation for unstable distal radial fractures [17]. Another study mentioned reasonably nice data for extra-articular fractures reduced in dorsally flexed position then immobilized in casting [13]. We found that Intra-articular fractures i.e Type B and C treated by cast Immobilization negligibly improve the radial height, radial inclination and volar tilt (Table 5,6). Fractures with less comminution got more correction after application of POP Cast, while this

correction was lost gradually by the time it was removed (Table 6).

This corresponded to the viscoelastic characteristics of ligaments. Strong palmar ligaments have been shown to become taut and limit radio-carpal distraction, while the weaker, Z-shaped dorsal ligament complex has yet to reach maximum length [18]. This prevents longitudinal traction alone from restoring volar tilt and may explain why the volar tilt of the distal radius deformity did not improve significantly with POP cast immobilization (Table 6).

For distal radial fractures, a high frequency of ligamentous injuries is commonly associated with both intra-articular and extra-articular fractures[18]. These are the factors involved in the development of redisplacement even after satisfactory reduction and fixation with K-wires [19]. The plain radiographs were probably inadequate to identify acute ligamentous injuries. Even if no ligamentous injuries existed coincidentally and the distal radial fractures were well reduced at the time of initial management, the stretched ligaments will gradually become deformed and the stress relaxed, followed by re-displacement of well reduced fractures as proved in our study.

However conservative measures are acceptable even with disability in elderly people and patients with dementia or multiple medical co-morbidities [20].

CONCLUSIONS

There is increased tendency of young patients to sustain comminuted distal radial fractures due to high energy trauma. POP cast is a popular method that may improve the reduction of type B and C fractures but can not assure the maintenance of reduction. Reduction of distal radial fractures cannot be achieved and maintained reliably using POP cast alone. Most patient suffering from distal radial fractures of Type B and C treated conservatively with POP cast fall into malunion.

Although we can achieve better results in type A fractures by careful conservative measure (POP cast) that is well tolerated in older patients, but one must seek better and advanced measures to correct the deformity in more comminuted fractures particularly in young patients.

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YOUR SUPREMACY OVER OTHERS IS IN PROPORTION TO THE EXTENT (size) OF YOUR KNOWLEDGE AND WISDOM.

Hazrat Ali (Karmulha Wajhay)

PERFECT HAPPINESS COMES WITH KNOWLEDGE, AND PARTIAL HAPPINESS COMES WITH ABSTINENCE (control, forbearance, ZUHD), WORSHIP WITHOUT KNOWLEDGE AND WITHOUT ABSTINENCE MERELY EXHAUSTS THE BODY.

Hazrat Ali (Karmulha Wajhay)