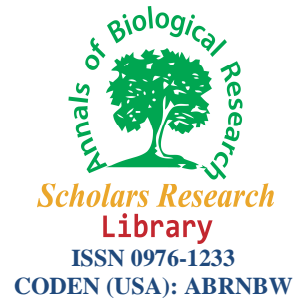




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## Outcome assessment in the treatment of A2-OTA type fractures of the distal radius by short arm cast versus long arm cast

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### ABSTRACT

Distal radius fracture (DRF) is among the most common fractures of the long bones, which comprise one sixth of all fractures. Due to its high prevalence, effect on patients' everyday life, and cost on national health resources, its proper management is very important. we performed this prospective randomized clinical trial on 100 patients with DRFs. 50 patients were treated in each group either by short or long arm cast. Patients were visited during the 6<sup>th</sup> and 18<sup>th</sup> weeks after the reduction regarding loss of reduction and possible complications. There were no significant differences between groups regarding age, gender and the type of fractures. In long arm cast group the range of elbow flexion and extension and forearm supination and pronation were significantly lower than the short arm cast that were decreased along the time. There was no significant difference regarding the stability of distal radio ulnar joint. Numbers of wounds and blisters in long arm cast group were significantly more than the other group. There was no malunion, nonunion, carpal tunnel syndrome and compartment syndrome in any patients. According to this short-term study, short arm cast with three-point molding provides adequate therapeutic result in A2-OTA type fracture with low cost and good acceptability.

**Level of Evidence:** level I, Therapeutic

**Keywords:** A2-OTA type, Distal radius fracture, Long arm cast, Short arm cast

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### INTRODUCTION

Distal radius fracture (DRF) is among the most common fractures of the long bones which comprise one sixth of all fractures [1-2]. It is not a life-threatening condition, but can cause an obvious disability that has an impact on patients' everyday life and efficacy it can be due to sport injury.[3,4,29]. Due to its high prevalence, effect on patients' everyday life, and cost on national health resources, its proper management is very important [3].

Since long time, investigations regarding classification, treatment outcome and complications of this kind of fractures continued up until now [5,6]. The optimal treatment of DRF should restore hand function with minimal post-treatment complications at a reasonable cost and patients' satisfaction. So different treatment options that included closed reduction and casting, external fixation, pin fixation and open reduction and internal fixation (ORIF)

have been introduced [7,8]. While all of these options can be considered according to clinical situation and surgeon's preference, closed reduction and cast immobilization has traditionally been accepted as the most common treatment modality for stable form of this fracture [2, 9].

Since adequate immobilization was needed for good union and optimal functional outcomes, the form of the casting such as its position and its length has been discussed several times [10,11]. Although orthopedic text books do not support clearly either short arm cast (SAC) or long arm cast (LAC), there are some studies that showed SAC has the same therapeutic effects with lower complications and more patient satisfaction [9,12]. Therefore, there is still controversy regarding the application of long or SAC [1, 9, 13,14].

To our best knowledge, there are few studies comparing long and short arm cast. This current multicenter study has attempted to compare the results of closed reduction and cast immobilization by the means of short versus long arm cast in type A2 DRFs.

## MATERIALS AND METHODS

After obtaining institutional review board (IRB) approval, we performed this prospective randomized clinical trial on patients with DRFs admitted in three medical centers from September 2010 to February 2011. Patients signed the consent form prior to enrolment. We included the patients older than 20 years with closed distal radial physis and initial radiographic evidence of extra articular DRF with at least one non-comminuted cortex. All fractures were type A2 according to the AO classification. We considered fractures with dorsal angulations of more than 20 degrees, radial shortening of more than 10 millimeters and extensive cortical comminution as unstable fractures. Patients with unstable fractures were excluded from this study. Other exclusion criteria were the existence of multiple fractures or open fracture in the affected limb or other limbs, cerebral palsy, paresthesia of the affected limb due to the pervious cerebro-vascular accidents, previous severe deformity of the affected limb, diabetes and severe osteoporosis. We also excluded patients who had less than two consecutive follow-up visits. All eligible patients signed the informed consent. One hundred four patients were eligible to be included in this study; we excluded four patients, as they did not tend to participate in the process of follow-up. We divided 100 remaining patients into reduction with SAC or reduction with LAC groups based on the table of random numbers.

We performed plain anterior posterior (AP) and lateral radiograph of the affected wrist in all patients initially to determine fracture severity. Based on the radial height, radial inclination and palmar tilt in initial radiograph, patients were divided into the following groups shown in table-1. As illustrated in table-1, there were no significant differences between the groups regarding the pre-operative fracture characteristics. Most of the fractures were reduced under local anesthesia but general anesthesia or regional block were performed for selected patients. The technique of reduction was by slight traction and counter-traction and manipulation methods. In SAC group, we positioned the forearm in neutral rotation and volar-ulnar deviation. We applied The cast from the metacarpophalangeal joints dorsally and proximal palmar crease volarly, extending to one inch distal to antecubital fossa anteriorly and the olecranon posteriorly. Three points and inter osseous molding was performed. We did the same technique in the LAC group. Additionally, we positioned the elbow in 90 degrees of flexion and extended the plaster to the middle of the arm.

We performed lateral and AP radiographs of the forearm after reduction and casting and measured the radiographic parameters (radial height, radial inclination and dorsal angulations). In all cases, anatomical reduction was considered a successful reduction. Immediately after reduction, patients started active motion of the fingers and tried to elevate the limb to the level at or above the heart. The surgeons examined all patients regarding compartment syndrome. Besides, they informed the patients about compartment symptoms too. Many patients were treated in an ambulatory setting and discharged after six hours observation, but some patients were hospitalized and then discharged within two days after reduction. We checked the alignment radiographically during the second week after the reduction. In the suspicious cases for the loss of reduction, comparison was done with contra-lateral wrist radiography. We performed repeated reduction for those cases with unacceptable displacement. The reduction was unacceptable if there was more than five millimeters of displacement or more than five degrees of angulations.

The surgeons converted LAC to SAC during the fourth week and removed casts after six weeks. The patients started active and passive motion of the wrist, elbow and fingers as the cast was removed. Patients referred to the clinic during the 6<sup>th</sup> and 18<sup>th</sup> weeks after the reduction. AP and lateral plain radiography of the wrist were performed in each visit. The examiners evaluated the patients regarding loss of reduction, malunion, nonunion, carpal tunnel syndrome, compartment syndrome, limitation in elbow and forearm range of motion (ROM), number of wounds and blisters, patient's satisfaction and stability of the distal radioulnar joint. In cases with unstable distal radioulnar joint during the 6<sup>th</sup> week visit, casting was continued for three more weeks in forearm supination position. In these cases

forearm ROM was examined during the 9<sup>th</sup> and 18<sup>th</sup> weeks. We considered the instability of distal radioulnar joint (DRUJ) when there was tenderness on DRUJ and pain on its mobility. For assessing the forearm pronation and supination, the patient tried to range the forearm by holding a pen in the fist with the elbow at 90 degrees flexed and adducted. Limits of ROM were abnormal if there was more than 10 degrees of difference comparing with the unaffected side.

We scored patients' satisfaction by using the Visual Analog Scale (VAS) at 18th week follow-up. VAS consists of ten-point from zero (extremely dissatisfied) to 10 (extremely satisfied). Data was recorded and analyzed using SPSS version 16. The independent-Samples t-test and chi square test were used for statistical analysis when appropriate. The level of significance was set at  $P < 0.05$ .

## RESULTS

Participants included 100 patients with extra articular DRFs that underwent reduction with long or short arm cast. Each group contained 50 patients that aged between 20 and 78 years. The LAC group included 26(52%) men and 24 (48%) women with mean age of  $39 \pm 13$  years. SAC group contained 28(56%) men and 22(44%) women with mean age of  $38.6 \pm 12$  years. There were no significant differences between groups regarding age and gender.

There were only two patients with unacceptable loss of reduction at first visit in each group that reduction and casting was repeated for them. Table-2 summarized comparisons of the function of the upper limb in both groups at 6th and 18th weeks.

There were significant differences between two groups regarding the range of elbow flexion and extension and forearm supination and pronation that were decreased along the time. There was no significant difference regarding the stability of DRUJ between the two groups. There was no malunion, nonunion, carpal tunnel syndrome and compartment syndrome in any patients. Numbers of wounds and blisters in LAC group were significantly more than the other group (five cases in LAC and one case in SAC) ( $p < 0.05$ ). The extent of the wound in short cast group was smaller than long cast group. Patients' satisfaction score in SAC ( $=8.3$ ) was significantly more than LAC ( $=5.2$ ) group. ( $p < 0.05$ )

**Table 1: preoperative characteristics of the fracture in the long and short arm cast groups**

Fracture characteristics		Type of the cast		P -value
		Long arm cast N (%)	Short arm cast N (%)	
Radial inclination in plain antero-posterior view	≤10 degrees	0	0	0.52
	11 - 15 degrees	15(30%)	19(38%)	
	>15 degrees	35(70%)	31(62%)	
Dorsal tilt angulations in lateral view	≤ 9 degrees	34(68%)	30(60%)	0.53
	10- 19 degrees	16(32%)	20(40%)	
	≥20 degrees	0	0	
Amount of radial shortening in plain AP view	≤ 5 millimeters	38(76%)	40(80%)	0.6
	6-9 millimeters	12(24%)	10(20%)	
	≥10millimeters	0	0	

**Table 2: Evaluation of the patients at 6<sup>th</sup> and 18<sup>th</sup> week follow-up**

	Time of examination after reduction	LAC	SAC	P- value
Limitation of Range of flexion - extension of the elbow	6 <sup>th</sup> week	26(52%)	0	<0.05
	18 <sup>th</sup> week	4 (8%)	0	<0.05
Limitation of Range of supination and pronation of the forearm	6 <sup>th</sup> week	28(56%)	1(2%)	<0.05
	18 <sup>th</sup> week	5(10%)	0	<0.05
Distal radioulnar joint Instability	6 <sup>th</sup> week	1 (2%)	2(4%)	>0.05
	18 <sup>th</sup> week	0	0	

## DISCUSSION

Fractures of the distal end of the forearm can be treated by casting whether the fracture is stable or the patient is a low demand old one [2, 7, 15,16]. Since proper and well-molded cast is needed for obtaining optimal functional outcome, the type of casting is very important. For many years, surgeons have applied LAC due to the concept of adequate elbow immobilization; but casting complications such as blister formation and limitation of ROM encouraged some surgeons to apply SAC [5, 17,19]. Some researchers believe that SAC can maintain the same functional outcomes with lower complications and more patient satisfaction [5, 13, 20]. In the current study, patients underwent casting either long or short to compare the results.

LAC and SAC were compared frequently regarding success of treatment [21]. Some studies concluded that there is no significant difference in outcome between SAC and LAC [20, 22-23]. In this study, we evaluated maintenance of reduction and achieving a desirable ROM as two clinical parameters of success of treatment, and we could maintain the reduction by SAC as well as LAC. There were only two loss of reduction in each group and there was no significant difference regarding maintenance of reduction between two groups. Range of elbow flexion and extension and forearm supination and pronation in LAC were significantly lower than SAC.

The literature has introduced the amount of radial shortening and volar inclination as predictors of early instability and radial inclination, radial shortening, volar tilt and age as predictors of late instability [2]. In this study, patients were randomly divided into SAC or LAC groups. There were no significant differences between these two groups regarding age, sex, severity of fracture, radius height and the angle of radial tilt and inclination. Therefore, these factors did not have any interfering effect on our results.

The casting technique especially three-point molding and the ulnar deviation of the cast plays an important role in maintenance of the reduction [6]. Position of immobilization also remains as a controversial issue. Rajan et al [10] carried out a research on sixty-four patients with extra articular fractures and divided the patients with short casting into two groups; posterior flexion (dorsal) and anterior flexion (palmar) position. After at least a six-month follow up, ROM or muscle strength of the wrist in the group with immobilization in dorsal flexion position was better than the other group. There is also dilemma regarding the choice of immobilization in internal rotation (pronation) or external rotation (supination) of the forearm. Sarmiento [11, 24] advised the immobilization in external rotation (supination) position to reduce the brachioradialis deforming force, but Whalstrom [25] insists on the immobilization in internal rotation (pronation) position. Whalstrom believes that pronator quadratus muscle is the leading cause of redisplacement. Nonetheless, Linden et al [26] in a comparative study achieved similar results in different positions of immobilization. They finally concluded that the position of immobility plays a small role in the outcome. In the current study, we tried to position the limb in volar and ulnar deviation and neutral rotation. In addition, three-point mold casting was performed.

Casting complications such as pain, stiffness, limitations of ROM and blister formation are important factors, which influence on patients' satisfaction and function. The duration of casting and the length of the cast are two factors that affect on the rate of complications [27-28]. Prolonged immobilization may lead to joint contracture, muscle atrophy and weakness, disuse osteopenia and possibly financial hardship that affect the patient's function [9]. Edmonds et al [17] compared the duration of immobilization that needed for good alignment of the fracture line in SAC with LAC. They reported that there was no difference between two groups in time of casting. In the current study, the period of cast immobilization in both groups was the same. However, the complications of casting such as the blisters in the elbow together with muscle weakness were significantly lower in SAC than LAC.

Regarding to the limitation of ROM and muscle weakness, it seems that physical therapy is much more needed after LAC removal. Therefore, the cost and time to return to work will be increased.

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