



## **Management of Distal 1/3<sup>rd</sup> Closed Forearm Fractures in Children above Elbow Plaster Cast versus Below Elbow Plaster Cast**

**Abbas Memon<sup>1</sup>, Amir Zaffar Abro<sup>1</sup>, Shakeel Ahmed Memon<sup>1\*</sup>,  
Irshad Ahmed Bhutto<sup>1</sup>, Ashfaq Hussain Mirjat<sup>1</sup> and Siraj Ahmed Butt<sup>1</sup>**

<sup>1</sup>Department of Orthopedics Surgery of LUMHS, Pakistan.

### **Authors' contributions**

*This research work was carried out in collaboration among all authors. Authors AM, AZA and SAM designed the study, collect the data, wrote the protocol, and wrote the first draft of the manuscript. Authors IAB and AHM managed the analyses of the study and managed the literature searches. Author SAB performed the statistical analysis. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JPRI/2020/v32i4531091

#### Editor(s):

- (1) Dr. Khadiga Ahmed Ismail Eltris, Ain Shams University, Egypt.
- (2) Dr. Mohamed Fawzy Ramadan Hassanien, Zagazig University, Egypt.
- (3) Dr. R. Deveswaran, M. S. Ramaiah University of Applied Sciences, India.

#### Reviewers:

- (1) Veronica Mîndrescu, Transilvania University, Romania.
  - (2) Cleuza Maria de Faria Rezende, Federal University Of Minas Gerais, Brazil.
- Complete Peer review History: <http://www.sdiarticle4.com/review-history/62291>

**Original Research Article**

**Received 01 September 2020**  
**Accepted 03 November 2020**  
**Published 01 February 2021**

### **ABSTRACT**

**Objective:** To determine if below-elbow casts are as effective as above-elbow casts in the treatment of the distal third closed forearm fractures in children.

**Materials and Methods:** This was a prospective comparative study and was conducted at orthopaedic department of Liaquat University of Medical and Health Sciences (LUMHS). Children 4 to 12 years of age who presented to, distal 1/3<sup>rd</sup> fractures of the forearm were randomized in order to manage with either an above-elbow or below-elbow cast after closed reduction under fluoroscopic guidance. Radiographic analysis was done for angulation and displacement at the injury time, following reduction, and at subsequent intervals of follow-up. At the fracture level, the cast index for evaluating the cast moulding quality was assessed from the post-reduction radiographs. Variations between post-reduction and final values for displacement and angulation, the range of motion of elbow, forearm and wrists and cast indices between the two groups were compared.

\*Corresponding author: E-mail: [dr.samemon@gmail.com](mailto:dr.samemon@gmail.com);

**Results:** Of total 50 study subjects, 26 underwent above-elbow cast and 24 subjects underwent below-elbow cast techniques. Mean age of above-elbow cast group patients was 9.42 year and the mean age in of below-elbow cast group patients was 9.13 years. 15 male and 11 female patients were present in above-elbow cast group; 14 male and 10 female patients were present in below-elbow cast group. The mean cast index of above-elbow cast group was 0.71 and the mean cast index of below-elbow cast was 0.70. In terms of patient demographics, injury mechanism, characteristics of initial fracture, cast index or shift in displacement and angulation during treatment, no significant variances were observed between both groups. In above-elbow cast group, the mean elbow arc of motion on cast removal at six weeks was only 78° compared to 141.6° in below-elbow cast group. There was a significant decline in arc of motion of elbow joint in above-elbow cast group compared to below-elbow cast group in six weeks which became normal at final follow-up in three months. The complication rates in both the groups were similar.

**Conclusion:** Below-elbow cast is the safe reliable and cost-effective method of cast immobilization in distal third forearm fractures in the children of 4 to 12 years of age.

*Keywords: Forearm fractures; injury; orthopedics; immobilization.*

## 1. INTRODUCTION

Forearm fractures are the commonest fractures of long bone in children [1]. The commonest fracture site in the forearm is the distal part of the ulna and radius [2]. It comprises of about 40% of all pediatric fractures. Blount reported that about 75% of forearm fractures take place in the distal 3rd of the forearm [3]. Such fractures were observed to be 3 times more prevalent among boys; though, this proportion may be altered by growing involvement in sports activities by girls at a younger age. While these fractures take place at any time of life, they are highly common at the adolescent period of growth. The fractures are described by location, metaphyseal or physeal, as well as by severity of displacement. The widely recognized Salter-Harris method is used to classify transphyseal injuries. Buckle or torus fractures, incomplete or greenstick fractures, or full fractures, can be classified as metaphyseal injuries [4]. A typical source of injury is a direct fall. A fracture with an extended hand and wrist occurs when the mechanical force is adequate to exceed the bone's tensile strength [4]. Sports are the 2nd most prevalent cause of injury. Snowboarding, skateboarding, soccer goalkeeping, and horseback riding have been shown to be high-risk-sports, but a severe enough fall in any recreational activity can lead to a fracture. There are seasonal disparities with the occurrence and extent of fractures that occur in the summer. Overweight children have weak postural balance, less mineralization of the bone or ligament laxity, and are at higher risk of radial distal fractures. Mostly fractures occur due to the fall on an extended hand with an expansion deformity. Distal fragment angulation or volar displacement

is sometimes caused by a direct fall blow or on a stretched hand and wrist [4]. In either case, there may be a rotational component to the fracture pattern. The distal radius metaphysis is by far the most prominent site of fracturing of the forearm among adolescents and children. Most generally, these take place among boys in non-dominant arm. Because of continuous expansion in the radius and ulna following the healing of fracture, forearm fractures among children should be managed differently than fractures among adults. Given that the growth plates are open, it can appear to remodel. The extent of spontaneous correction relies on the child's age, the distance between physis and fracture as well as the association of the deformity in neighboring joints to the axis of motion. Most are relocated dorsally and even in the joint's axis of motion, and they are adequately transformed [5-8]. Traditionally, cast immobilization and closed reduction have been used as a method of treating most of such injuries. Blount observed that internal fixation and open reduction are almost never needed for these methods [3]. Whether the below-elbow cast (or short arm cast) or above-elbow cast is safer for immobilization following using closed reduction technique in fractures of distal forearm among children is controversial. In our setup, for every distal forearm fracture, we used above-elbow cast following closed reduction. Proponents of above-elbow cast believe that it provides better stability of reduced fracture by preventing flexion, elbow extension and supination and pronation of forearm [9]. The possible explanation is that flexion of the elbow decreases the forces of the muscle, which serve as a factor for fracture displacement. It also limits the activity of a child and decreases the likelihood of fracture

deformation [4]. Proponents of short arm cast believe that a well-moulded below-elbow cast that follows the contours of forearm controls pronation, supination of forearm and provides adequate stability to maintain reduction of the fracture [9]. The benefits of below-elbow cast (or short arm cast) are better patient comfort, easier application, better hand functions for ADL, less elbow stiffness and low cost [10]. To our knowledge, no study has been conducted on comparing the outcome of above-elbow cast and below-elbow cast to immobilize distal 1/ 3<sup>rd</sup> forearm fractures in children after closed reduction in LUMHS till now. The aim of our study is to analyze clinical and radiological results of children with distal third forearm fractures immobilized with both the above- elbow and the short arm casts after closed reduction to determine if short arm cast is as effective as above-elbow cast.

**2. MATERIALS AND METHODS**

This prospective comparative study has been carried out in the Department of Orthopaedics, at LUMHS Jamshoro/Hyderabad. All the cases with age range 4-12 years with closed distal third fractures of radius, radius and ulna and either of gender were included in study. All the patients with epiphyseal injury, intra articular fractures, open and infected fractures, malunited fractures and patients those had lost their follow-up were excluded. Patients were divided randomly in two groups A-group and B-group. Patients of group A underwent above-elbow cast procedure and cases of group B underwent below-elbow cast (or short arm cast) was applied.

For short arm cast, cotton paddings were applied between metacarpophalangeal and elbow joints. Circumferential immobilization short arm cast was used between the tip of olecranon process and the metacarpal heads. Forearm was placed

in pronation. Three point pressures moulding of the cast was done and the maintenance of interosseous space was done by applying pressure in the mid-longitudinal axis of forearm with plastic sticks that come with the POP cast (The wrist was placed in cast in the neutral position).

Above-elbow cast application was performed by extending the below-elbow cast up-to middle of the arm with elbow flexed in 90°. Acceptability of reduction of the fracture is determined during CR by using C-arm image intensifier. Subsequent evaluation of the reduction of fracture was done by radiographs. The patients were followed-up next for evaluation of acceptability of fracture reduction using post-reduction radiographs and for assessment of cast related complications. When reduction of the fracture was not acceptable, one more attempt of CR was done and on still failure the patients were scheduled for operative treatment. Cast index was determined by dividing cast's inner width in Lateral view (sagittal diameter) to that in AP view (coronal diameter) of the radiograph both measured at the level of fracture.

Displacement and angulation of fracture fragments were measured in radiographs using goniometer. Patients were followed-up next day, then every week for first three weeks, at six weeks and finally at three months. The criteria for acceptable reduction and criteria for remanipulation was followed as described by Bohm ER [10] (see tables 1 and 2). Cast was removed after six weeks and elbow, forearm and wrist range of motion were measured using goniometer. Physiotherapy was advised in patients with restricted range of motion. Finally, the patients were evaluated at three months. All the data was recorded via study proforma. Data was analyzed by using SPSS version 20.

**Table 1. Criteria for acceptable reduction**

<b>Isolated distal radius fracture</b>	a) ≤ 10° of angulation on lat. and AP radiograph b) ≥ 80%25 apposition of fracture fragments on lat. and AP radiograph
<b>Isolated distal ulna fracture</b>	a) ≤ 10° angulation on lat. and AP radiograph b) ≥ 50%25 apposition of fracture fragments on lat. and AP radiograph
<b>Combined distal radius and ulna fracture</b>	a) ≤ 10° angulation of either bone on lat. and AP radiograph b) ≥ 50%25 apposition of fracture fragments on lat. and AP radiograph

**Table 2. Criteria for remanipulation**

<b>Isolated distal radius fracture</b>	a) > 25° of angulation on lat. radiograph. b) > 10° of angulation on AP radiograph c) < 50 %25 apposition of fracture fragments on either AP or lat. radiograph
<b>Isolated distal ulna fracture</b>	a) > 10° of angulation on lat. or AP radiograph b) < 25%25 apposition of fracture fragments on lat. or AP radiograph
<b>Combined distal radius and ulna fracture</b>	a) > 10° angulation of either bone on lat. or AP radiograph. b) < 25%25 apposition of fracture fragments on lat.or AP radiograph

(Source: J Bone Joint Surg Am 2006;88:1-8.)

### 3. RESULTS

Total 50 patients were studied. The mean age in study group A was 9.42 year and the mean age in in group B was 9.13 years ( $p = 0.635$ ). In group A 15 were males and 11 were females, while in group B there were 14 males and 10 females. ( $p = 0.963$ ). However sides of injuries are shown in Table 3.

Isolated distal radius fracture was seen in ii patients and 15 patients had combined distal radius and ulna fracture in above-elbow cast group. While in below-elbow cast group, 16 patients were seen with combined distal radius and ulna fractures and 8 patients had isolated distal radius fracture in below-elbow cast group. ( $p = 0.523$ ). The mean delay in closed reduction in above-elbow cast group was higher as 24.46 hours compared to 19.50 hours in the below-elbow cast group. The mean cast index of above-elbow cast group was 0.7104 and the mean cast index of below-elbow cast was 0.7058. ( $p = 0.139$ ) Table 4.

The mean post-reduction angulation of radius in sagittal plane in above-elbow cast group was 2° compared to 2.38° in below-elbow cast group ( $p = 0.601$ ). The mean post-reduction angulation of radius in coronal plane in above-elbow cast group was 0.69° compared to 0.17° in the below-elbow cast group ( $p = 0.174$ ). The mean post-reduction angulation of ulna in sagittal plane in above-elbow cast group was 1.62° compared to 1.92° in below-elbow cast group ( $p = 0.615$ ). The mean post-reduction angulation of ulna in coronal plane in above-elbow cast group was 2.42° compared to 2.50° in below-elbow cast group ( $p = 0.919$ ). Thus, there was no significant difference in mean post-reduction angulation of radius and ulna in both AP and lateral view of X-rays of the forearm in both the groups Fig. 1.

The mean post-reduction displacement of radius and ulna in sagittal plane and post-reduction

displacement of radius and ulna in coronal plane were high in above-elbow cast group compared to below-elbow cast group, while findings statistically insignificant Fig. 2.

Even though there was increase in angulation of radius and ulna in both AP and Lat. view of X-rays taken at six weeks in both the groups compared to the post-reduction X-rays, they were not significantly different Fig. 3.

View of X-ray of forearm at three weeks, it was not significantly different in both the groups compared to the post-reduction values Fig. 4.

In above-elbow cast group, the mean elbow arc of motion at cast removal was only 78° compared to 143.2° on the normal side ( $p = 0.001$ ). However, after three months of injury, the mean elbow arc of motion in above-elbow cast group improved almost equal to normal side.

In below-elbow cast group, the mean elbow arc of motion at cast removal was 141.6° compared to the mean elbow arc of motion of 142.5° on the normal side ( $p = 0.103$ ). After three months it was see 142° which was equal to normal side Table 5.

In above-elbow cast group, the mean forearm arc of motion at cast removal was 121.7°, which was significantly lower compared to mean forearm arc of motion of 150.1° on the normal side ( $p = 0.000$ ). However, at three months follow-up, the mean forearm arc of motion improved to 149.8° which is almost equal to normal side. Similarly in below-elbow cast group, the mean forearm arc of motion at cast removal was 124.5° which was significantly lower compared to mean forearm arc of motion of 151° on the normal side ( $p = 0.000$ ). At three months follow-up, the mean forearm arc of motion improved to 150° which was almost normal Table 5.

In both above-elbow cast group and below-elbow cast group, the mean wrist arc of motion at cast removal were 80.9° and 78.7° respectively, which were markedly decreased compared to the mean wrist arc of motion of 145.7° on the normal side (p = 0.000). After three months follow-up, these were found almost normal Table.5

**Table 3. Distribution of patients according to age, sex and side of injury n=50**

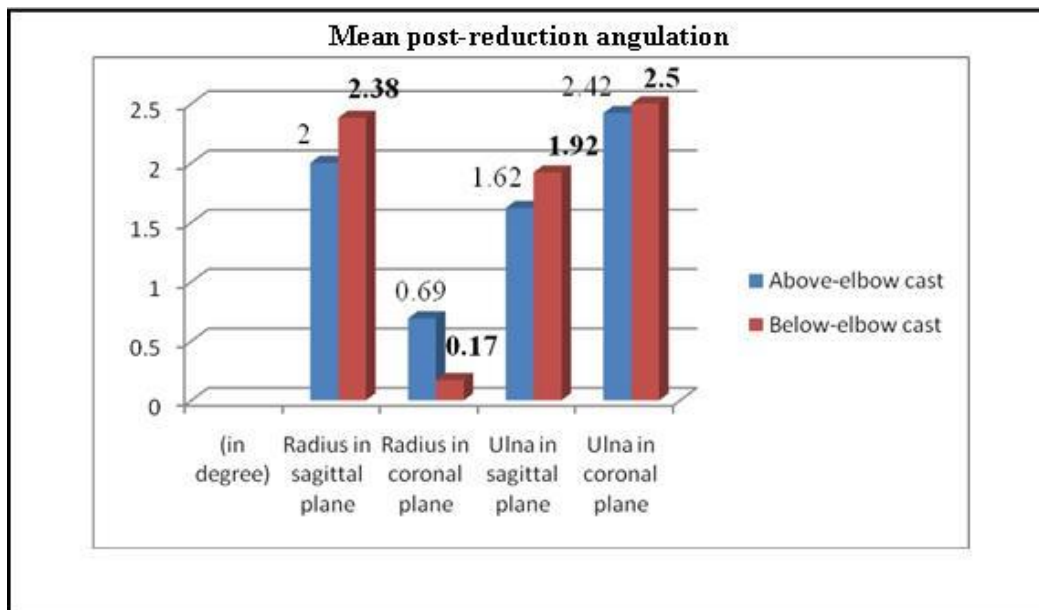
Demographic variables	Study groups		P-Value
	Group A	Group B	
<b>Sex of the patient</b>			
Male	15	14	0.963
Female	11	10	
<b>Age group</b>			
4-8 years	7	9	0.423
9-12 years	19	15	
<b>Side of the injury</b>			
Left	16	14	0.817
Right	10	10	

Group A= Above-elbow cast, Group B= Below-elbow cast.

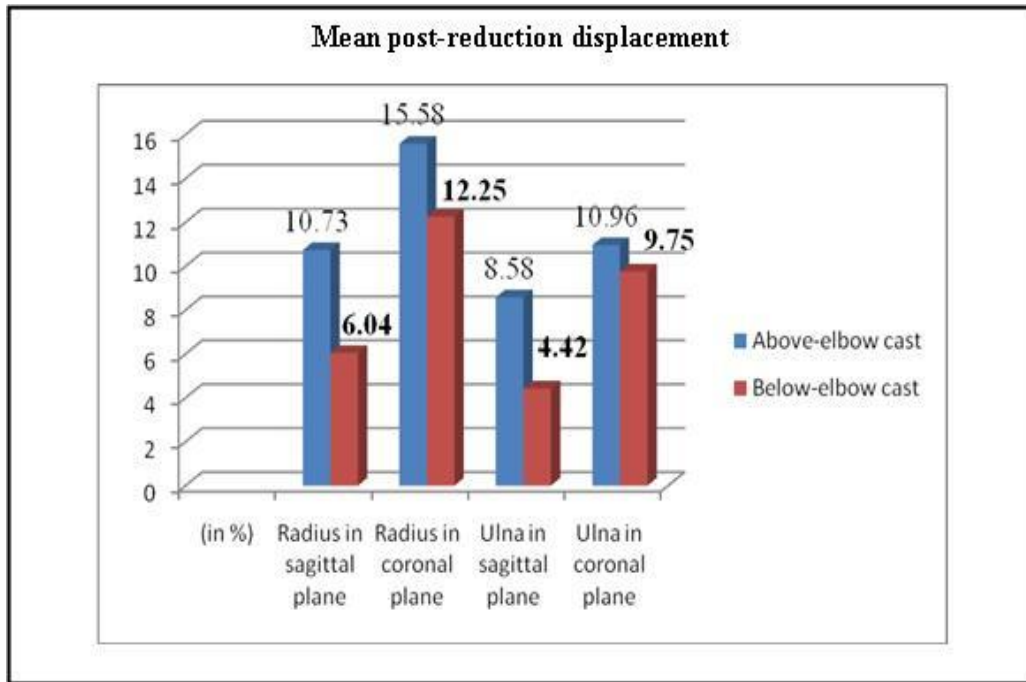
**Table 4. Distribution according to diagnosis, delay in closed reduction and cast indices n=50**

Variables	Study groups		P-Value
	Group A	Group B	
<b>Diagnosis</b>			
Isolated distal radius fracture	11	8	0.523
Distal radius and ulna fracture	15	16	
<b>Delay in closed reduction (in hours)</b>			
Mean ± Std. Deviation	24.46 ± 14.76	19.50 ± 11.13	0.139
<b>Cast Index</b>			
Mean ± Std. Deviation	0.71±0.009	0.70± 0.011	0.139

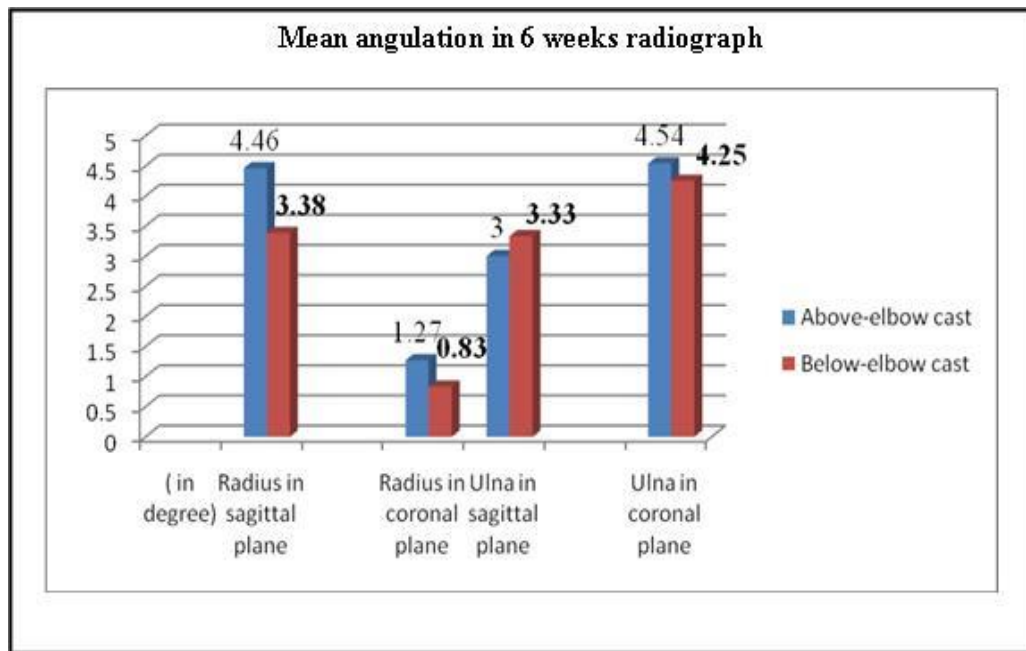
Group A= Above-elbow cast, Group B= Below-elbow cast.



**Fig. 1. Mean post-reduction angulation of radius and ulna**



**Fig. 2. Mean post-reduction displacement of radius and ulna**



**Fig. 3. Mean angulation of radius and ulna at 6 weeks**

**4. DISCUSSION**

Forearm fractures among children are prevalent injuries, and contribute to 45% of all fractures during childhood and 62% of fractures in upper

limb [5]. In the distal 3rd, roughly 75-84% of fractures of forearm occur, 15-18% takes place in middle 3rd, and 1-7% takes place in proximal 3<sup>rd</sup> [40]. When managing the fractures of forearm among children, the core concept is to align the

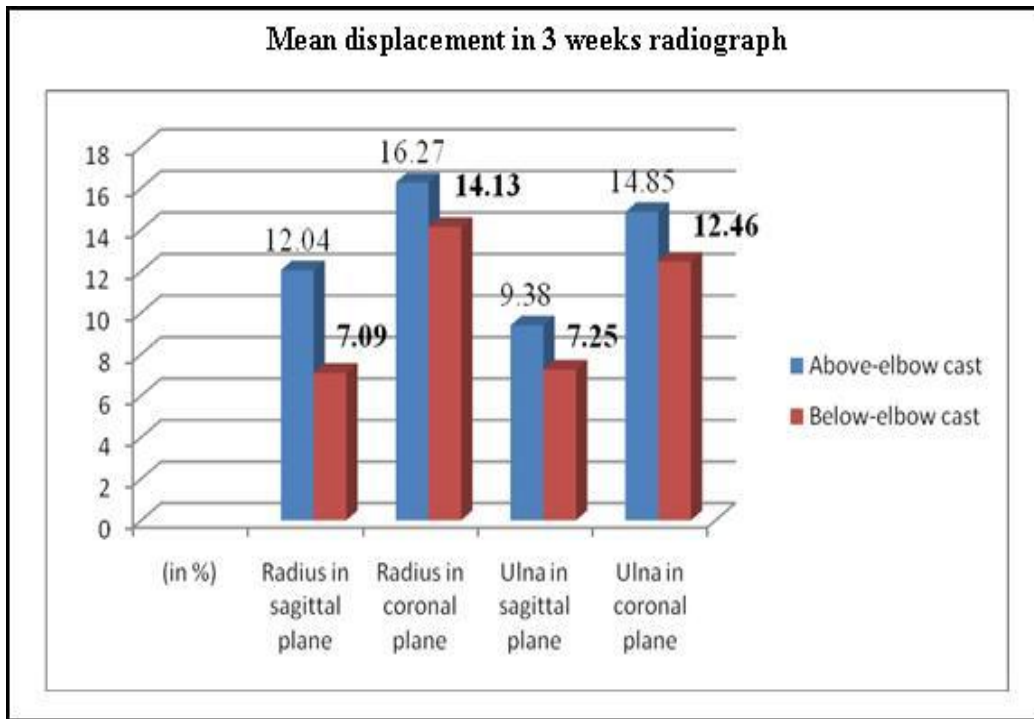


Fig. 4. Mean displacement of radius and ulna at 3 weeks

Table 5. Mean elbow arc of motion, forearm arc of motion and wrist arc of motion between the two groups

Mean arc of motion	Above-elbow cast	Above-elbow cast normal side	Below-elbow cast	Below-elbow cast normal side
<b>Mean elbow arc of motion</b>				
At cast removal	78°	143.2°	141.6°	142.5°
After 3 months of injury	142.8°	143.2°	142°	142.5°
<b>Mean forearm arc of motion</b>				
At cast removal	121.7°	150.1°	124.5°	151°
After 3 months	149.8°	150.1°	150°	151°
<b>Mean wrist arc of motion</b>				
At cast removal	80.9°	145.7°	78.7°	145.2°
After 3 months of injury	145.1°	145.7°	144.5°	145.2°

distal fracture segments with the proximal segments correctly, rotationally and axially, and to retain this alignment until the fractures heal. The majority of displacement of forearm fractures could be managed with well-moulded cast maintenance and closed reduction [5]. With the use of advanced imaging techniques like C-arm image intensifier, accurate reduction of the fracture fragments can be

ensured at the time of closed reduction. Traditionally using the principle of immobilizing one joint above and one joint below the fracture site, above-elbow cast have been used. Studies have shown that below-elbow cast are as effective as above-elbow cast [9,10,11]. In terms of gender, age, side distribution, fracture type, and early fracture characteristics, the above-elbow cast and below-elbow cast groups were

comparable, suggesting that randomization was successful.

The patient's age in this study varied between 04 and 12 years. The age limit for the application of the under-elbow cast has been set at 4 years due to the high risk of cast slippage below this age for small forearm sizes. The maximum age for using above-elbow cast was set at 12 years because above this age, there is less probability of deformity correction. The mean age of patients in above-elbow cast group was  $9.4 \pm 2$  years and below-elbow cast group was  $9.1 \pm 2.4$  years. In a study by Bohm ER [10], the age ranged from four years to 12 years. The mean age in above-elbow cast group was 8.6 years and the mean age in below-elbow cast group was also 8.6 years. In a comparative study by Webb GR [9], the minimum age of patient was four years and the mean age in above-elbow cast group was  $9.5 \pm 3.1$  years and  $10.1 \pm 2.9$  years of patients of below-elbow cast group. However Rahman N et al. [12] reported that the overall mean age of study subjects was  $7.10 \pm 2.18$  year

In this study 58% patients were males and 42% were females with male to female ratio of 1.3:1. These findings were similar to the study of Bohm ER [10] in which 59.8% were males and 40.1% were females with male to female ratio of 1.4:1. On other hand Webb GR et al. [9] found that males were 75.2% and females were 24.8% with male to female ratio. In the study of Cheng JC et al. [2] conducted study in Chinese population and found overall male to female ratio was 2.7:1. However Rahman N et al. [12] reported that the males were in majority as 59.3% and females were 40.7%

In this study, 62% patients had combined fracture in distal radius and ulna and 38% patients had isolated fracture in distal radius. There were no cases of isolated distal ulna fracture in this study. This may be because of the low incidence of such fracture. This is similar to a study by Bohm ER et al. [10] in which there were no cases of isolated distal ulnar fracture.

In this study, the minimum cast index achieved after closed reduction & cast application was 0.68 and the maximum cast index achieved after closed reduction and cast application was 0.72 with the mean cast index of 0.70. This signifies that proper moulding of the cast had been achieved as described by Chess DG. [11] The mean cast index in above-elbow cast group was 0.71 compared to 0.70 in below-elbow cast

group. The cast index in both above-elbow cast and below-elbow cast groups were comparable. This is in contrast to a comparative study by Webb GR [9] in which the cast index differed significantly ( $p=0.045$ ) between short-arm plaster and long-arm plaster casts. The mean cast index for patients with long-arm plaster cast was  $0.81 \pm 0.005$ , which was significantly different from the cast index for all other patients ( $p=0.001$ ). This is probably because of the smaller sample size in this study and strict adherence to application of interosseous moulding with even distribution of cotton padding while applying the cast.

There was a significant difference in the mean elbow arc of motion of the injured limb between above-elbow and below-elbow cast groups after the casts were removed at six weeks. The mean elbow arc of motion of the injured limb in above-elbow cast group was only  $78^\circ$  compared to  $141.6^\circ$  in below-elbow cast group ( $p = 0.000$ ). This is because of the stiffness caused by immobilization of elbow joint. By the time of final follow-up at three months, the mean elbow arc of motion of the injured limb in above-elbow cast group increased to  $142.8^\circ$  which is comparable to  $142^\circ$  in below-elbow cast group ( $p = 0.447$ ). This is because the elbow-joint in above-elbow cast group was immobilized for six weeks whereas the elbow joint in below-elbow cast group was left free to move.

In above-elbow cast group and below-elbow cast group, the mean forearm arc of motions of the injured limbs were significantly decreased compared to  $150.1^\circ$  on the normal side. However, at three months follow-up, these were almost normal. This is obvious because of the application of the cast which prevents pronation and supination of forearm. However after three months of injury, there was no significant difference in forearm arc of motion of the injured limb in both the groups compared to the normal side.

There was no significant difference in the mean wrist arc of motion of the injured limb in above-elbow and below-elbow cast groups. The mean wrist arc of motion of the injured limb at cast removal was  $80.9^\circ$  in above-elbow cast group compared to  $78.7^\circ$  in below-elbow cast group ( $p = 0.149$ ). At three months follow-up, the mean wrist arc of motion of the injured limb increased to  $145.1^\circ$  in above-elbow cast group which is comparable to the mean wrist arc of motion of  $144.5^\circ$  in below-elbow cast group ( $p = 0.552$ ).



This is obvious because of the application of the cast which prevents dorsiflexion and palmarflexion of the wrist. However after three months of injury, there was no significant difference in the wrist arc of motion in both the groups compared to the normal side.

The recovery of elbow, forearm and wrist arc of motion after cast immobilization at three months of follow-up is because of the better counseling of the patients for following active and passive range of motion exercises at home after cast removal. No cases in this study required prolonged physiotherapy.

A significant decline was seen in the cast application price in below-elbow cast group compared to above-elbow cast group. Application of one above-elbow cast required a minimum of four POP casts, one cast padding, one cotton bandage and plaster application. Therefore, there is however a significant decline in the expense of cast application by the utilization of below-elbow cast in comparison to above-elbow cast, even there was minimal fee of cast application in the institution of government.

Two patients with below-elbow cast had swelling of the hand that required bivalving of the cast whereas two patients with above-elbow cast had swelling of the hand that required bivalving of the cast. No any case in the below-elbow cast group had slippage of the cast.

One of the drawbacks of this study is that three patients with above-elbow cast was lost to follow-up. As this is only a prospective randomized study comparing the outcome of below-elbow cast and above-elbow cast in terms of maintenance of the angulation, displacement and range of motion of elbow, forearm and wrist and the cost, its therapeutic level of evidence is low. Measurement of angulation, displacement and range of motion of elbow, forearm and wrist has not been standardized, so the chances of bias are high. However in the study of Rahman N et al. [12] concluded that the below elbow plaster cast' efficacy was almost equal to above elbow plaster cast in thee terms of immobilization of distal forearm fracture and rate of the complication.

## 5. RECOMMENDATIONS

1. Below-elbow cast can be a suitable option for treatment in distal forearm fractures in

children 4 to 12 years of age after closed reduction in places where image intensifier facility is available.

2. Proper moulding of the cast using interosseous pressure and three point fixation is advised to achieve appropriate cast index.
3. To obtain a stronger conclusion with a greater degree of evidence, a randomized controlled trial is recommended, with a longer follow-up period and a large sample size.

## 6. CONCLUSION

Distal 1/3rd forearm fracture is one of the commonest fracture in children. Below-elbow casts are as effective as above-elbow casts in maintaining reduction of fractures of the distal third of forearm in children provided proper moulding of the cast is done.

As the cost of applying the below-elbow cast is significantly less than the cost of applying the above-elbow cast, it is more suitable in our set up.

## CONSENT

Consent was taken from each patient and they were assured that the entire information and records would be kept confidential.

## ETHICAL APPROVAL

The authors collected and retained documented ethical approval in compliance with international standards or university standards.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Thomas EM, Tuson KW, Browne PS. Fractures of the radius and ulna in children. *Injury*. 1975;7:120-4.
2. Cheng JC, Shen WY. Limb fracture pattern in different pediatric age groups: A study of 3,350 children. *J Orthop Trauma*. 1993; 7:15.
3. Blount WP, Schaefer AA, Johnson JH. Fractures of the forearm in children. *JAMA*. 1942;120:111-6.

4. Waters PM. Distal radius and ulna fractures. In: Beatty JH, Kasser JR, editors. Rockwood and Wilkin's fractures in children. 5th ed. Philadelphia (PA): Lippincott Williams & Wilkins. 2001;381-439.
5. Rodriguez-Merchan EC. Pediatric fractures of forearm. Clin Orthop Relat Res. 2005; 432:65-72.
6. Noonan K, Price C. Forearm and distal radius fractures in children. J Am Acad Orthop Surg. 1998;6:146-56.
7. Canale ST. Fractures and dislocations in children. In: Canale ST, Beatty JH, editors. Campbell's operative orthopaedics. 11th ed. Philadelphia (PA): Mosby. 2007;1405-10.
8. Chapman MW. Fractures and dislocations of the elbow and forearm. In: Chapman MW, editors. Chapman's orthopaedic surgery. 3rd ed. Philadelphia (PA): Lippincott Williams & Wilkins. 2001;508-22.
9. Webb GR, Galpin RD, Armstrong DG. Comparison of short and long arm plaster casts for displaced fractures in the distal third of forearm in children. J Bone Joint Surg Am. 2006;88:9-17.
10. Bohm ER, Bubbar V, Yong-Hing K, Dzus A. Above and below-the-elbow plaster casts for distal forearm fractures in children. A randomized controlled trial. J Bone Joint Surg Am. 2006;88:1-8.
11. Chess DG, Hyndman JC, Leahey JL. Short-arm plaster cast for distal pediatric forearm fractures. J Pediatr Orthop. 1994;14:211-3.
12. Rahman N, Anwar W, Iqbal MJ, Ahmad I, Khan MA, Kashif S, Siraj M. Comparison of below the elbow cast with above the elbow cast in treating distal third forearm fractures in children. J Surg Pak (Int). 2011;16(4):140-4.

© 2020 Memon et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*  
*The peer review history for this paper can be accessed here:*  
<http://www.sdiarticle4.com/review-history/62291>