Comparison of Below The Elbow Cast with Above The Elbow Cast in Treating Distal Third Forearm Fractures in Children

Noor Rahman, Wasim Anwar, Malik Javed Iqbal, Israr Ahmad, Mohammad Asghar Khan, Salik Kashif, Mohammad Siraj

ABSTRACT

Objective — *To compare the effectiveness of below the elbow cast with above the elbow cast in treating distal third forearm fractures in children.*

Study design — *Comparative study.*

Place & Duration of study — *Orthopedic Department, PGMI Hayatabad Medical Complex Peshawar, from March 2010 to June 2011.*

Methodology — *This study was designed to compare above and below elbow casts for distal forearm fracture in patients aged 4–12 year. A total of 108 patients were managed during the study period. They were randomized into two groups of 54 each; group A above-elbow and group B below-elbow cast.*

Results — *The mean age of the children was 7.10 ± 2.18 year. Males were 59.3% and females 40.7%. The right side was the dominant limb in both the groups. 19.6% of children in the above-elbow group required remanipulation as compared to 26.4% in the below elbow group with p value of 0.381. The time from injury to manipulation was not significantly different in the 2 groups. Differences between radius and ulna translation and angulation in the anteroposterior and lateral views of the x-rays were not significant. Twenty three children with above elbow cast and 19 children of below elbow cast had complications but the difference was not significant (p 0.324). Three patients were lost to follow up.*

Conclusion — *Below-elbow casts was as good as above-elbow cast in maintaining reduction of fractures in the distal third of the forearm in children.*

Key words — *Forearm fractures, Distal radius fractures, Above elbow cast, Below elbow cast.*

INTRODUCTION:

Distal third forearm fractures are very common in children accounting for about 75% of forearm fractures.[1,2] Resultant deformities are usually a product of indirect trauma involving angular loading combined with rotational displacement.[3] These fractures are usually dorsally displaced, and remodel satisfactorily due to excellent remodeling potential.[2]

Correspondence:
Dr. Wasim Anwar
Orthopedic Department, PGMI
Hayatabad Medical Complex
Peshawar
E Mail: dr_wasimanwar@hotmail.com

Fractures of the distal third forearm may occur through radius, ulna or both radius and ulna. These fractures may be metaphyseal, physeal or intra-articular. There are various treatment modalities for the management of distal third forearm fractures in children i.e. closed reduction and plaster casting, closed reduction and percutaneous pinning and open reduction and internal fixation.[2, 4]

The widely accepted method of treatment is closed reduction and immobilization of the fracture in plaster cast.[4] The recommended method of plaster casting after closed reduction varies among authors.[5] Above-elbow plaster cast has been used historically to immobilize the elbow joint to neutralize the deforming

forces of muscles that originate above the elbow to prevent redisplacement of fracture fragments.[6-8] Below elbow cast has been used by some orthopedic surgeons, who claimed equally beneficial results.[5,9,10] Well molded below-elbow cast can reduce supination and pronation movement at the wrist, thereby, decreasing the redisplacement and with advantages of easier application, comfort, less elbow stiffness and minimal interference in daily activities.[5,9,10-12] Hence, controversy still persists regarding the length of the plaster cast for the treatment of distal third forearm fracture. This study was conducted to evaluate the effectiveness of below the elbow cast over above the elbow cast for the treatment of displaced distal third forearm fracture in children.

METHODOLOGY:

This comparative study was conducted at Orthopedics Department PGMI, Hayatabad Medical Complex Peshawar from March 2010 to June 2011. All children between 4-12 year of age with displaced distal third forearm fractures were included. Children having greenstick fractures, plastic deformations, intra-articular fractures, pathologic fractures, fractures through pre existing fracture line, Salter Harris type III and IV fractures, open fractures, fractures which required open reduction and internal fixation, were excluded. Criteria for acceptable reduction[10] are outlined in Table I. Loss of reduction and criteria for remanipulation was defined as an increase of >10° angulation and >20% of displacement compared with the post reduction values.

Approval of the hospital ethical committee was obtained. An informed written consent was taken from the parents/guardians. The patients were allocated in two groups by lottery method. Patients in group A were subjected to above elbow cast, while patients in group B were subjected to below elbow cast.

Patients were assessed prior to cast treatment. After enrollment the senior orthopedics resident performed the reduction under sedation / analgesia. After applying the cast, reduction was confirmed by radiographs in two planes i.e. anteroposterior and lateral, on the next day. The swelling of fingers, hand, and distal neurovascular assessment were also done. Swelling was categorized into whether there was no swelling, associated with pain, limitation of movement, and needed slitting of the cast. Radiographs were analyzed for displacement, angulation and over riding at the time of presentation, after reduction, and at subsequent follow up. Plaster of Paris was used as the cast material in this study. For above elbow cast, below elbow component, was applied molded and then extended to above the elbow. Detailed instructions were provided to the patient and family regarding strict elevation of the arm for the first 24-48 hours. In addition, warning signs that would necessitate an immediate consultation in the emergency department were explained to them.

All patients were followed up in the outpatient department at intervals of 1, 2, 3 and 6 weeks. The plaster cast was removed at 6th week of injury. Patients were referred to physiotherapy department for rehabilitation of the forearm. Initial post reduction and fracture alignment at the subsequent follow up and at time of cast removal were compared between the two groups. Redisplacement, angulation, plaster condition, and any complications were observed. Data were entered into SPSS 10 version. Student t-test was applied for comparison.

RESULTS:

In this study 108 patients were included who were divided into two groups of 54 each. The mean age of the children was 7.10±2.18 year. Age ranged from 4-12 years. The mean age of the children in the above elbow cast group were 7.16 ± 2.21 year and mean age of the children in the below elbow cast group was 7.05 ± 2.17 year. The right side was the dominant limb in both groups. Males were in majority as compared to females but their distribution among the groups were equal with insignificant p-value (0.596) as shown in table II.

Distribution of fractures type in above elbow cast group was 28 (51.9%) radial fractures and 26 (48.1%) combined radial and ulnar fractures, where as in below elbow cast group 22 (40.7%) patients had radial fractures and 32 (59.3%) patients had combined radial and ulnar fractures. Neither of the patients presented with isolated ulna fracture. Ten (19.6%) children in the above-elbow group required remanipulation as compared to 14 (26.4%) in the below-elbow group with p value 0.38 which is insignificant table II.

The time from injury to manipulation was not significantly different in the above-elbow and below-elbow groups. Differences between radius and ulna translation in the anteroposterior and lateral views of the x-rays were not significant. Similarly, the difference in angulation of the radius and ulna was not statistically significant in both groups (Table III)

Complications related to the cast were recorded for each group. Twenty three children with an above

elbow cast and 19 children with a below elbow cast had complications, the difference was not significant (p = 0.324). Six children with an above elbow cast were converted to below elbow cast at the three week follow-up visit for reasons of comfort. No child had develop a compartment syndrome despite the acute application of a circumferential cast. Three patients in the series were lost to follow up.

DISCUSSION:

The below and above elbow cast groups were similar with respect to age, gender, dominant injured limb, fracture configuration and time from injury to manipulation which indicated that the randomization had been effective. However, the right side being dominant injured limb was contrary to the findings demonstrated by Barton et al.[13, 14] In our country, time from injury to manipulation was longer which may be due to limited facilities and economic status of the people.

The two cast types were compared with respect to the amount of angulation of the fracture while in the cast. The below elbow casts were found to maintain the alignment of distal forearm fractures in children as good as above elbow casts. Thus, contrary to the fracture care principle of immobilizing the joint proximal to and distal to a fracture, it appears that the immobilization of the elbow obtained by extending a below elbow cast into an above elbow cast offers no benefit in maintaining the alignment of these fractures. This may be because the elbow joint is quite distant from the fracture, and the majority of immobilization is secured over the length of the forearm.[10]

No statistically significant difference were observed in the two cast groups with regard to change in translation and angulation of the radius in anteroposterior and lateral radiographs at the time of fracture union (6 weeks) compared to the post reduction radiograph. However, there was a statistically significant difference in the cast groups with regard to change in the angulation of the ulna on the anteroposterior view (p 0.059), which is similar to the study of Paneru et al.[14]

This study supports the importance of weekly radiographic examination for each of the first three

Table I: Criteria for Acceptable Reduction

Isolated distal radial fractures	< 5° of angulation on lateral and posteroanterior radiographs. > 95% apposition of the fracture on lateral and posteroanterior radiographs
Combined distal radial and distal ulnar fractures.	< 10° of angulation of either bone on lateral and posteroanterior radiographs. > 50% apposition of the fracture on lateral and posteroanterior radiographs.
Isolated distal ulnar fractures	< 10° angulation on lateral and posteroanterior radiographs. > 50% apposition of the fracture on lateral and posteroanterior

Table II: Distribution of Qualitative Variables in the Above-elbow and Below-elbow Cast Groups

Variables		Above elbow cast group	Below elbow cast group	Total	p-value
Sex	Male	31 (57.4%)	33 (61.1%)	64 (59.3%)	0.596
	Female	23 (42.6%)	21 (39.9%)	44 (41.7%)	
Injured limb	Right	34 (63%)	31(57.4%)	65 (60.2%)	0.555
	Left	20 (37%)	23 (42.6%)	43 (39.8%)	
Fracture configuration	Radius only	28 (51.9%)	22 (40.7%)	50 (46.3%)	0.247
	Combined radius/ulna	26 (48.1%)	32 (59.3%)	58 (53.7%)	
Remanipulation	Not required	42 (80.8%)	39 (73.6%)	81 (77.1%)	0.381
	Required	10 (19.2%)	14 (26.4%)	24 (22.9%)	

Table III: Association Between Independent Variables and the Two Different Cast Groups			
Variables	Cast group	Mean ± SD	p-value
Time from injury to manipulation (hour)	AE	14.81 ± 0.636	0.752
	BE	15.18 ± 0.574	
Radius translation (anteroposterior view)	AE	8.11± 3.88	0.233
	BE	7.16 ± 3.49	
Radius translation (lateral view)	AE	6.25 ± 2.75	0.565
	BE	5.88 ± 3.15	
Ulna translation (anteroposterior view)	AE	3.09 ± 4.07	0.359
	BE	3.9 ± 4.18	
Ulna translation (lateral view)	AE	2.34 ± 3.09	0.323
	BE	3.00 ± 3.09	
Angulation of radius (anteroposterior view)	AE	5.97 ± 1.93	0.534
	BE	5.74 ± 1.51	
Angulation of radius (lateral view)	AE	5.36 ± 2.33	0.810
	BE	5.48 ± 2.28	
Angulation of ulna (anteroposterior view)	AE	2.30 ± 2.74	0.059
	BE	3.51 ± 3.09	
Angulation of ulna (lateral view)	AE	2.23 ± 3.05	0.445
	BE	2.74 ± 3.13	

weeks. All of the fractures that lost position and required re-manipulation did so before three weeks. This is consistent with guidelines that have been proposed elsewhere.[3,15] Ten (19.6%) patients required remanipulation in the above elbow cast group, whereas 14 (26.4%) needed remanipulation in the below elbow group. There seems to be a large variation in the residual deformity that various authors have accepted before resorting to remanipulation, with reported rates of remanipulation ranging from 2.5% to 63%.[5,9,10,14,16,17] The remanipulation rate of 29.1% (24 of 108 fractures) in this study compares favorably. The below-elbow cast group contained a higher percentage of combined radial and ulnar fractures (59%) compared with the above-elbow cast group (48.1%). This fracture type is more unstable than isolated radial fractures, which could be the reason for the slightly higher remanipulation rate in the below-elbow cast group. However, even after stratification by fracture type, no difference could be detected between the cast types when they were compared with respect to the amount of fracture angulation and fractures that required remanipulation. It is confirmed that closed management of these types of fractures remains the standard of care, as has been suggested by other investigators.[10, 18]

CONCLUSIONS:

The below elbow plaster cast is equally effective compared to above elbow plaster cast for the immobilization of distal forearm fracture in children, with comparable complication rates. Factors that are associated with a higher risk of loss of reduction include combined radial and ulnar fractures and residual angulation of the fracture after the initial reduction.

REFERENCES:

1. Zamzam MM, Khoshal KL. Displaced fracture of distal radius in children. J Bone Surg [Am] 2005; 87:841-3.
2. Canale ST. Fractures and dislocation in children. In Canale ST, Beaty JH. Cambelle's operative orthopedics. 11th ed. Philadelphia: Elseveir; 2008:1531-725.
3. Noonan KJ, Price CT. Forearm and distal radius fractures in children. 1998;6:146-56.
4. Peter MW, Alexander DM. Fractures of the distal radius and ulna. In: Beaty JH, Kasser JR. Rockwood and Wilkins Fractures in

children. 6th ed. Philadelphia: Lippincott Williams and Wilkins; 2008:337-95.

5. Webb GR, Galpin RD, Arm strong DG. Comparison of short and long arm casts for displaced fractures in distal third of the forearm in children. J Bone Join Surg [Am] 2006;88:9 -17.

6. Hughoston JC. Fractures of forearm in children. J Bone Joint Surg Am 1962;44:1678-93.

7. Jones K, Weiner DS. The management of forearm fractures in children: a plea for conservatism. J Pediatr Orthop 1999; 19:811–15.

8. Rodríguez-Merchán EC. Pediatric fractures of the forearm. Clin Orthop Relat Res 2005; 432:65-72.

9. Chess DG, Hyndman JC, Leahey JL, Brown DC, Sinclair AM. Short arm plaster cast for distal pediatric forearm fractures. J Pediatr Orthop 1994;14:211-3.

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. Worlock P, Stower M. Fractures pattern in Nottingham. J Pediatr Orthop 1998;6:656-60.

12. Aviv B, Bar-On E, Weigl D, Becker T, Katz K. Children daily living activities during immobilization of upper limb fractures with an above or below elbow cast. J Child Orthop 2008;2:221-4.

13. Borton D, Masterson E, O'Brien T. Distal forearm fractures in children: the role of hand dominance. J Pediatr Orthop 1994; 14:496–7.

14. Paneru SR, Rijal R, Shrestha BP, Khanal GP, Karn NK, Singh MP, et al. Randomized controlled trial comparing above- and below-elbow plaster casts for distal forearm fractures in children. J Child Orthop 2010; 4:233–7.

15. Green JS, Williams SC, Finlay D, Harper WM. Distal forearm fractures in children: the roles of radiographs during follow up. Injury 1998;29:309-12.

16. Voto SJ, Weiner DS, Leighley B. Redisplacement after closed reduction of forearm fractures in children. J Pediatr Orthop 1990;10:79-84.

17. Roy DR. Completely displaced distal radius fractures with intact ulnas in children. Orthopedics 1989;12:1089-92.

18. Jones K, Weiner DS. The management of forearm fractures in children: a plea for conservatism. J Pediatr Orthop 1999; 19:811-5.