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A RANDOMIZED CONTROLLED TRIAL COMPARING ABOVE ELBOW CAST FOR 6 WEEKS VERSUS 3 WEEKS FOLLOWED BY BELOW ELBOW CAST FOR 3 WEEKS IN TREATMENT OF DIAPHYSEAL FRACTURE BOTH BONE FOREARM IN CHILDREN

Orthopaedics

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ABSTRACT

Background and Objectives: Forearm fractures are common. Above elbow cast applied for 6 weeks may lead to stiffness. This study compared outcomes of above elbow cast (AEC) for 6 weeks vs. AEC for 3 weeks followed by below elbow cast (BEC) for 6 weeks.

Materials and Methods: Eligible patients were randomised into two groups i.e. AEC for 6 weeks and AEC for 3 weeks followed by BEC for 3 weeks. Study period was 15 months. Patients were treated by closed reduction and AEC. Patients in second group had their cast converted to BEC at 3 weeks. Cast comfort noted with VAS. At 12 weeks elbow and forearm movements were measured.

Result: Limitations in elbow and forearm movements, union and complications were not statistically significant

Conclusion: AEC for 3 weeks followed by BEC for 3 weeks is as effective as AEC for 6 weeks.

KEYWORDS

above elbow cast, below elbow cast

INTRODUCTION

Forearm fractures are one of the very common injuries in children accounting 13-40% of paediatric injuries.[1] Mechanism of injury can be direct or indirect such as fall on outstretched hand. Closed reduction is usually successful either by longitudinal traction method or by exaggerating the deformity[2]. Upto 10^0 of angulation has been shown to cause no limitation experimentally[3] However some limitation in range of motion of elbow is seen in most cases. This could be due to contracture of soft tissue or malunion of the fracture[4, 5, 6] Colaris JW etal[7] has noted that fracture in diaphysis was associated with greater limitation of pronation and supination than in the metaphysis.

There is no consensus in treatment. Some advice for above elbow cast for 6-8 weeks.[8] Few studies advice for below elbow cast for 6 weeks in distal third fractures.[9, 10] Some studies advice for immobilization of elbow in extension.[11] Conversion to BEC could result in malunion while AEC may cause stiffness by immobilization. No such studies have been done in our region. So we conducted this study to compare the outcome of treatment of both bone forearm in above elbow cast and in those converted to below elbow cast.

MATERIALS AND METHODS

The study was conducted in the Department of Orthopaedics, B.P. Koirala Institute of Health Sciences (BPKIHS) over a period of fifteen months from June 2014 to Aug 2015. It was a prospective randomized controlled trial with 140 patients (70 in each group) using computer based random number generator. Ethical clearance was obtained from Institutional Ethical Research Board. All patients aged below 14 years with closed diaphyseal fracture both bone forearm presenting to BPKIHS within 1 week of trauma and guardian giving a written consent for the trial were included in the study. Exclusion criteria were patients with open fractures, refractures, multiple fractures, polytrauma, fracture dislocations, pathological fractures and compartment syndrome.

Patients presenting to BPKIHS were assessed clinic-radiologically. Closed reduction and above elbow cast was applied with elbow flexed at 90 degrees under adequate anaesthesia. Check x-ray was done and patient was discharged with advice if reduction was acceptable. Acceptable reduction was defined as angulation $<15^0$ (age<9) and $<10^0$ (age 10-14) and having 50% cortical contact. If reduction was not acceptable then remanipulation or open reduction and internal fixation was done on individual basis. Distal neurovascular deficit were assessed on the next day or SOS. Children were followed up in OPD in 1, 3, 6 and 12 weeks with check x-rays at each visit. Range of motion, fracture union, cast complication and cast comfort were checked. If remanipulation was done at any time above elbow cast was applied and case was followed as a new case from the beginning. Patients belonging to second group (AEC/BEC) had their cast converted to below elbow in 3 weeks. Flexion and extension of elbow and pronation and supination of forearm were measured with goniometer. Casts were removed at 6 weeks and physiotherapy started. At 3 months, pronation and supination were scaled using a previously employed grading system[12] with excellent, good, fair, and poor results for, respectively, 0–10, 11–20, 21–30, and ≥ 31 degrees of limitation. Limitation of flexion and extension of the elbow were also assessed. The parents and children were evaluated for comfort of the cast using a visual analog scale (VAS) with highest score for maximal comfort.

All data were entered on Microsoft Excel 2007 and statistical analysis was done using SPSS 20. Chi-square test was applied to find out significant difference between the two groups at 95% confidence interval where $p<0.05$. Table 1. Acceptibility criteria

RESULTS

Of the 140 patients enrolled in the study 1 patient underwent surgery for unacceptable reduction and 9 patients (5 from AEC group and 4 from AEC/BEC group were lost to follow up and hence the analysis was done from remaining 130 patients.

Total cases in group 1 (AEC) were 64 and in group 2 (AEC/BEC) were 66.

Table 1. Pre-reduction variables

Variables		AEC	AEC/BEC	P value
Mean age (S.D)		10.25 (2.88)	9.67 (3.07)	0.267
Sex	Male	55	53	0.264
	Female	10	13	
Mode	Fall on ground	45	40	0.42
	Fall from height	16	20	
	others	3	6	
Fracture level	Distal 3rd	34	44	0.118
	Middle 3rd	25	21	
	Proximal 3rd	5	1	
Anaesthesia	General	21	27	0.338
	Regional	43	39	
Fractured limb	Right	32	32	0.22
	Left	26	40	

Of the total reduction attempted, 95% were successful to achieve acceptable reduction. Remaining cases were remanipulated once again. (One case was operated subsequently)

On 1st follow up 1 week later 14 cases presented with loss of reduction and they were also remanipulated. All the cases had clinical and radiological union at 6 weeks follow up. Cast comfort was statistically significant in two groups (p value - 0.0001). Mean VAS score were 3.97 and 7.14 respectively in AEC and AEC/BEC group. Mean loss of flexion was 12.5 degrees (S.D. - 7.48) in AEC and 10.6 degrees (S.D. - 7.36) in AEC/BEC group at 12 weeks follow up. There was no statistically significant difference between 2 groups (p value -0.64). Mean loss of pronation/supination was 23.2 degrees (S.D.-12.95) in AEC and 22.8 degrees (S.D.-12.73) in AEC/BEC group.

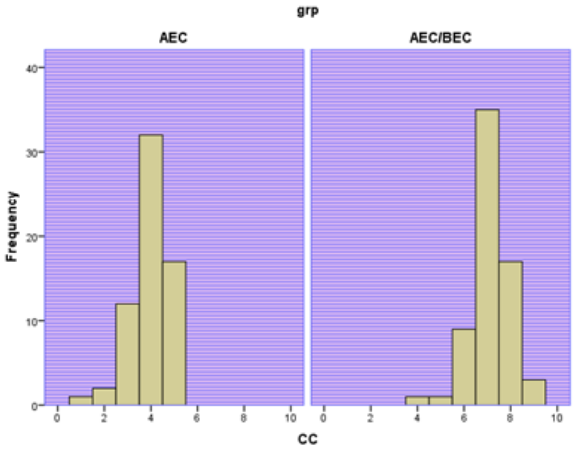

Fig.1. VAS score for Cast comfort

Using previously used grading system (Daruwalla 1979) for limitation of pronation and supination, excellent result was seen in 20.3% cases, good in 25%, fair in 36% and poor in 18.7% in the AEC group while in the AEC/BEC group excellent result was seen in 21.2%, good in 34.8%, fair in 21.2% and poor result in 22.7% of cases.

Table 2. Limitation of pronation/supination

Limitation Grade	AEC (% of total)	AEC/BEC (% of total)
Excellent	20.3	21.2
Good	25	34.8
Fair	36	21.2
Poor	18.7	22.8

Table 3. Complications

	AEC	AEC/BEC	P value
Loss of reduction	8	6	0.53
Malunion	8	9	0.84
Refracture	0	1	0.32
Tight cast	2	2	0.77
Total	18	17	

There was no significant difference in the complications in the two groups. There was no loss of reduction noted after conversion to below elbow cast. All loss of reduction occurred in the 1st week of cast application. Refracture was treated with recasting. Tight cast were removed and cast reapplied at a later time.

DISCUSSION

In our study regarding limitation of pronation and supination, excellent result was seen in 20.3% cases, good in 25%, fair in 36% and poor in 18.7% in the AEC group while in the AEC/BEC group excellent result was seen in 21.2%, good in 34.8%, fair in 21.2% and poor result in 22.8% of cases. There was no statistical significant difference. In the study by Colaris JW etal[13] the results in the AEC group were excellent in 21%, good in 38%, fair in 26%, and poor in 15%. In the group treated with AEC and BEC, the results were excellent in 33%, good in 37%, fair in 27%, and poor in 3% and there was no statistically significant difference as well. So the outcome is similar.

Among the 27 patients with poor result (>30 degrees) 14 had radiological evidence of malunion and 2 cases with radiological malunion had good results. Colaris JW etal[13] found limitation of pronation and supination of ≥ 30 degrees at final follow-up in 15 of 127 children, 8 of whom also suffered a radiographic malunion. Six children with a radiographic malunion at final follow-up showed no limitation of pronation and supination. The similar findings in these studies demonstrate that the cause of limitation of pronation and supination are malunion and soft tissue contractures as stated by other authors.[3,4,5,14]

Colaris JW etal [15] conducted a similar study for metaphyseal forearm fractures comparing above elbow cast vs below elbow cast for 6 weeks in 66 children. They found limitation of pronation and supination 6 months after initial trauma showed no significant difference between the two groups [4.4° (± 5.8) for BEC and 5.8° (± 9.8) for AEC]. Children treated with BEC had significantly higher cast comfort on a visual analogue scale [5.6 (± 2.7) vs. 8.4 (± 1.4)].

There was no significant difference in limitation of elbow flexion in 2 groups with mean limitation of flexion being 12.5 degrees (S.D. - 7.48) in AEC and 10.6 degrees (S.D. -7.36) in AEC/BEC group. Colaris JW etal.[13] noted that the limitation of flexion and extension of the elbow was1.2 (4.4) degrees in AEC and0.5 (1.9) degrees in AEC/BEC group. The cause of limitation in our study could be the fact our assessment was done at 3 months while in the previous study final assessment was done at 6 months.

The loss of reduction in our study was 10.7% (14/130). The range of loss of reduction is 7% – 27% in various studies.[16,17,18] Matthew L. Vopat etal[19] noted it to be as high as 60%. The loss of reduction noted by Colaris JW etal.[13] was 34%. The authors have postulated this high rate in their study to be due to strict malunion criteria, the prospective follow-up with scheduled radiographs and the type of cast used (non-circumferential cast applied directly after reduction followed by circumferential cast 1 week later). The other reason could be that they had applied all the cast in neutral position regardless of fracture level.

There was significant difference in the cast comfort as evidenced by VAS score of 3.97 (S.D. = 0.854) and 7.14 (S.D. = 0.875) respectively in AEC and AEC/BEC group. It is similar to the study by Colaris JW etal[13] where it was 4.4 (2.3) in AEC and 8.1 (1.8) in AEC/BEC group.

There were no significant differences in the complications in both groups. The findings matched the previous study.[13]

There were few limitations in this study. First limitation of this study was that all the fractures were not reduced at the same settings or by the same person. Second limitation is the short time period of follow up (3 months). Thirdly, some cases of loss of reduction were not remanipulated with view of correction over time.

Conclusion

Above elbow cast for 3 weeks followed by below elbow cast for 3 weeks is as effective as above elbow cast for 6 weeks. Patient had better comfort with conversion to below elbow cast. Complications were also not statistically significant. However a larger study with a longer study period is needed.

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