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Comparison between Closed Reduction with Breaking and without Breaking of the Intact Cortex of the Greenstick Metaphyseal Radial Fracture in Children : A Randomized Controlled Trial

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Abstract **Introduction** : The greenstick metaphyseal radial forearm fracture is one of the most common fracture in children. Generally, the treatment is closed reduction. The closed reduction with breaking and without breaking the intact cortex are the two accepted methods of which its use depends on the surgeon's opinion.

Research Question : What are the differences in the results of treatments by the closed reduction with breaking or without breaking the intact cortex of the greenstick metaphyseal radial fracture in children ?

Patients and Methods : Fourteen patients with 14 greenstick metaphyseal radial fractures of distal radius were randomized to treat with closed reduction with either breaking (group A 7 children, 4 boys, 3 girls) or without breaking (group B 7 children, 6 boys and 1 girl) the intact cortex. The outcomes of the treatment were assessed in the angulation of the fractures by radiography every week of the first month after the initial treatment, and at 6, 8 and 12 weeks after reduction. The union rate, the range of motion of the wrist and the elbow and the complication were assessed after the treatment.

Results : Both groups were comparable with regard to age, sex, side and type of injury and degree of the angulation before reduction as shown in both anteroposterior and lateral views of the forearm. No statistically significant differences in general characteristics, degrees of angulation at 12 week follow up, union rate and range of motion of wrist and elbow after immobilization between the two groups. However there was a statistically significant difference in angulation between 2 groups only at second week. Two cases of both group with associated ulnar fractures required remanipulation. The fractures in both groups healed well with good and acceptable alignment and without any complication.

Discussion : We found a significant difference between the angulations of both groups at second week after the initial treatment. Careful monitoring for loss of the reduction should be done. The remanipulation should be done immediately before healing of the fracture especially in the first two week. The reason for good results in this study come from the good and proper long arm neutral casting with less than 10 degrees of acceptable angulation with cast index less than 0.7.

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Table 1. General characteristic of both group

	Group A (with breaking) number 7	Group B (without breaking) number=7	P value
1. age(years)	7.7	7.5	0.8
2. sex(male/female)	4/3(57%/43%)	6/1(86%/14%)	0.6
3. side(left/right)	3/4(43%/57%)	3/4(43%/57%)	1.0
4. type (apex volar/apex dorsal)	4/3(57%/43%)	4/3(57%/43%)	1.0
5. angulation preop.			
degree AP view(mean)	11.7	19.3	0.084
degree Lat. view(mean)	3.4	23.4	0.064

Table 2. Comparison of outcome variables between group A and B

Outcome Variables	Group A	Group B	P value
1. Angulation(week after fracture)			
week 0 after reduction(mean)			
AP view(degree)	5.1	4.3	0.6
Lat. view(degree)	6.0	4.6	0.1
week 2 AP view(degree)	6.0	3.0	0.03
Lat. view(degree)	10.3	4.0	0.046
week 12 AP view(degree)	7.6	5.0	0.06
Lat. view(degree)	8.7	5.4	0.08
2. Range of motion(mean)			
pronation/supination(degree)	81.4/84.3	82.0/80	0.88/0.34
3. Union rate(%)	100	100	1.0
4. Complication(%)	0	0	1.0

Conclusion : This study we could not find the clinical and statistically significant difference between closed reduction with breaking and without breaking the intact cortex of greenstick metaphyseal radial fracture in children.

Introduction

The metaphysis of the distal radius is the most common site of forearm fracture in children and adolescents[1)2)]. Incomplete or greenstick fracture occurs with a combination of compressive and rotatory forces, generally a dorsiflexion and supination force and get volar tension side failure in most of the cases[2)~4)]. After treatment the loss of alignment has been tolerated because of the remodeling potential of the distal radius. The treatment of greenstick distal radius fracture depends on the surgeon opinion regarding deformity. Most surgeons agree that the displaced greenstick fracture should be reduced closed. The areas of controversy are :

1. The degree of acceptable deformity, it has been reported to be from 10-25 degrees in patients less than 10 years old[5)~8)].

2. The position of the forearm during immobilization by cast. The differences in opinions were whether the pronation of the forearm in apex volar[3)], supination[9)10)] or in neutral position[11)]. Some advocate that each fracture has its own preferred position of stability[5)12)].

3. Whether the intact cortex should be fractured(broken)or not.

Controversy exists regarding the completion of greenstick fractures. Some surgeons advocate completion of the fracture to reduce the risk of subsequent loss of reduction from the

a|b|c

Fig. 1.

a : Apex volar metaphyseal fracture of both radius ulnar
b : Closed reduction with completion of the fracture(group A)
c : At sixth weeks after fracture

a|b|c

Fig. 2.

a : Apex volar metaphyseal fracture of radius and ulna
b : Closed reduction without completion of the fracture(group B)
c : At seventh weeks after fracture

intact periosteum and concave deformity acting as a tension band to redisplace the fracture. But in the case of completion of the fracture, it increase the risk of instability and malunion[4)~6)11)~16)]. The purpose of this study is to compare the effectiveness of closed reduction for the greensick metaphyseal radial fracture by 2 different techniques, with breaking (group A) and without breaking (group B) the intact cortex.

The study design was the simple randomized controlled trial.

Patients and methods

From November, 2001 to January, 2003, children younger than 14 years of age with closed greenstick metaphyseal radial fracture were included in the study. The exclusion criteria

were an open fracture, fracture occurred more than one week before treatment, fracture associated with an ipsilateral elbow fracture, vascular injury, compartmental syndrome and abnormal growth and development. Written informed consents were taken from the parents after an explanation of all informations about the study. The children were randomly divided into two groups. Group A consisted of 7 children, 4 boys and 3 girls. The closed reduction with completion of the fracture(breaking the intact cortex) was performed. Group B consisted of seven children, 6 boys and 1 girl. The closed reduction without intention to complete the fracture(without breaking the intact cortex) was done. All cases were done under general anesthesia in an operating room by 3 point molding techniques after traction. The acceptable angulation of the fracture after reduction was 10 degree in all direction. All cases were put in long arm midposition(neutral) cast[11] with cast index less than 0.7[17]. The remanipulation was performed under close observation if the angulation of the fracture was greater than 10 degree. The follow-up period was scheduled in every week in the first month after the initial treatment in the first, second, third and fourth week then at the sixth, eighth and twelfth week (week 1, 2, 3, 4, 6, 8 and 12). After 6 weeks of casting, the cast was removed and the parent received the same program for physical therapy at home to increase the range of motion of the elbow, forearm and wrist.

The outcomes of the treatment were measured in the following variables :

1 The degree of angulation in both AP (anteroposterior) view and Lat. (lateral) view of the radiography of the forearm.

2. The range of motion in pronation and supination of the forearm.

3. The union rate of the fracture.

4. The complication rate.

Results

All 14 children were completely analysed with an average of 16 weeks (12-20 weeks) follow-up period. As shown in table 1, the general characteristics of both group in age, sex side and direction of angulation were comparable without any statistically significant difference ($P>0.05$). All fractures healed in good and acceptable both in alignment and function without complication such as neurovascular injuries, compartmental syndrome, infection etc. before and after treatment. Two cases in both groups required remanipulation and both cases were with associated ulnar fractures. One case in group B the intact cortex was unintentionally broken but ended with good result. During casting, close monitoring of the loss of reduction was checked by the radiography in each of the first four weeks. No statistically significant difference was found in both groups in any week except only in the second week in which the angulation of the fracture in group A was statistically significant higher than that in group B. As shown in table 2, the outcome variables : angulation at the end of the treatment, range of motion of the forearm, union rate, and complication rate were not statistically significant different. The radiograph of group A are shown in Fig. 1-a-d and group B are shown in Fig. 2-a-d.

Discussion

The treatment of greenstick metaphyseal radial fracture in children in this study gave

good results with close reduction either with breaking or without breaking of the intact cortex of the fracture. The reasons could be that :

1. The long arm neutral position castings were good and proper which kept the cast index less than 0.7 at all time.

2. Closed monitoring of redisplaced fracture was scheduled in every week of the first month after initial treatment, especially at second week.

3. The acceptable angulation of the fracture was less than 10 degrees in all directions until healing, and remanipulation was done immediately before healing if the fracture displaced and angulated more than 10 degrees.

Conclusion

From this study, we could not find any clinical and statistically significant difference between both method of treatment of greenstick metaphyseal radial fracture.

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