

Gradual Reduction of Supracondylar Fracture of the Humerus in Children Reporting Late with a Swollen Elbow

A S Devnani

ABSTRACT

Aim: To study the outcome of gradual reduction by skin traction of supracondylar fracture of the humerus in children with swollen elbow, who seek treatment two days or longer after the injury.

Method: Fifteen children aged between 4 and 11 years (average 7 years 11 months), who had initially consulted a traditional practitioner, reported between 2 and 21 days (average 7.5) after the injury were treated by skin traction with the elbow kept straight and the forearm in position of comfort.

Results: The average duration of stay in hospital was 14 days. All fractures healed; there was no incidence of myositis ossificans or neurovascular deficit. All patients had functional range of movements at the elbow within 6 months. Five patients developed cubitus varus deformity greater than 5°, they were classified as poor result. Four out of these 5 patients had sought treatment after a delay of 7 days or longer. There were 9 good (60%), 1 fair (7%) and 5 poor (33%) results.

Conclusion: Gradual reduction by skin traction is safe. It is possible to achieve satisfactory reduction if the delay is up to 7 days. The results with regards to deformity and function were comparable with those obtained following open or closed Kirschner wire fixation.

Singapore Med J 2000 Vol 41(9):436-440

INTRODUCTION

Methods of treatment, appropriate for fresh cases of supracondylar fracture of the humerus are not suitable for patients who report few days to a week late with grossly swollen elbow following manipulation or massage. Swelling precludes closed reduction and splintage in flexion because of the risk of causing vascular embarrassment^(1,2). Tissue oedema may cause problems of wound closure and healing following open reduction which is often difficult. Percutaneous pinning has higher risk of ulnar nerve injury as the bony

landmarks are not easily palpable^(3,4). In such a situation gradual reduction obtained by skin traction with the elbow kept straight and the forearm in the most comfortable position as determined by the patient is a safe option.

Between 10% to 20%^(1,5,6) cases of supracondylar fracture of the humerus report late. The common reason for delay in the western countries is transfer from a peripheral hospital after unsuccessful manipulation, locally the delay was due to a common social practice of consulting traditional practitioners.

Presented is the outcome in 15 such children. They were analysed for the duration of stay in hospital, incidence of cubitus varus, neurovascular complications, myositis ossificans and the range of motion at the elbow.

PATIENTS AND METHODS

Between January '90 and December '96 fifteen children sought treatment between two and 21 days (average 7.5 days) following injury. There were 5 girls and 10 boys, aged between 4 and 11 years (average 7 years 11 months). Eleven patients had injured the left and four the right elbow, all were closed fractures. The fracture was classified according to the radiological displacement⁽⁶⁾. Fourteen patients had grade III displacement and the remaining patient had undisplaced grade I fracture. The distal fragment was displaced postero-medially in 7 cases, postero-laterally in 5, strictly posterior in 2, and undisplaced in one case. In 5 of the 7 cases with postero-medial displacement the fragment was angulated (tilted). For details of patient characteristics see Table I. Radial pulse was felt in all patients. No patient had any other fracture in the affected limb or any visceral or head injury. All 15 patients had consulted a traditional practitioner for the initial treatment, some had even been to more than one. The 8 patients who reported to the hospital up to 7 days following the injury formed Group A and the remaining 7 patients with delay of 8 days or longer formed Group B.

Under sedation, the skin traction was applied to the forearm, initially 0.5 to 1 Kg weight was attached over a pulley by the side of the bed. The arm was

Department of
Orthopaedics
School of Medical
Sciences and
University Hospital
Universiti Sains
Malaysia
5990 Kubang Kerian
Kota Baru, Kelantan
Malaysia

A S Devnani
MBBS, MS
(Orthopaedics)
Associate Professor

Correspondence to:
Dr A S Devnani
Tel: (60) 9765 1700
Ext. 2513
Fax: (60) 9765 3370
E-mail:
levnani@kb.usm.my

rested on a pillow with the shoulder in more than 100° of abduction, so that the fingers point towards the head end. This was essential to maintain a valgus carrying angle and avoid cubitus varus. In cases where the distal end of the proximal fragment was prominent anteriorly under the skin, a strap with 0.5 Kg weight was applied to reduce it posteriorly.

Check radiographs were done the following day and the weights were adjusted gradually in steps of 0.5 Kg. Thereafter radiographs were done as required. Neurovascular status was monitored regularly. When the patient could actively lift the arm off the pillow, usually after 12 to 18 days, traction was removed and the elbow was rested in a sling. Active self mobilization of the elbow was encouraged as tolerated. No supervised physiotherapy was advised.

The follow up ranged between 22 months to 89 months (average 49 months). The results were assessed as per criteria of Flynn et al⁽⁷⁾, with some modification, as good, fair or poor (Table II).

The flexion-extension range of motion was measured with a mechanical goniometer placed on the lateral aspect of the elbow with axis of the goniometer centered over the lateral epicondyle of the humerus⁽⁸⁾. The carrying angle was measured with a goniometer placed on the anterior aspect of the upper limb with the elbow in extension and forearm in supination. The axis of the goniometer is placed over the centre of the cubital fossa, its proximal arm is aligned with the humeral shaft and its distal arm lying on a line from the centre of the antecubital fossa to the centre of the wrist⁽⁹⁾. Neuro-vascular deficit was assessed clinically. Radiographs were seen for the presence of myositis ossificans up to one year at follow-up.

RESULTS

All fractures united. The average duration of stay in the hospital was 14 days (range 7 to 19).

Flexion-extension

All patients had flexion movement from 30° to 130° within 6 months of mobilization. Hyperextension between 5° to 15° was noted in 4 patients, limitation of full extension by 5° to 10° was seen in 5 patients. Ten patients had limitation of full flexion by 5° to 10° as compared with the uninjured side.

Deformity

Cubitus varus was seen in 5 patients, all were classified as poor result. Of these 5 patients, 4 had sought treatment after a delay of 7 days or longer. Three patients with cubitus varus of 10° or greater, requested corrective osteotomy. The other 2 patients with cubitus varus of 6° each, were satisfied with the appearance of the elbow and did not request for corrective osteotomy (Table III). The cubitus varus was mostly seen in patients with postero-medial angulation, none of the 5 patients with postero-lateral displacement had the deformity.

Table II. Criteria for grade of result

Grade	Flexion-extension range of movement	Deformity
Good	Up to 5° hyper-extension Up to 10° limitation of flexion	No cubitus varus
Fair	Up to 15° hyper-extension Up to 20° limitation of flexion	No cubitus varus
Poor	Over 15° hyper-extension Over 20° limitation of flexion	Presence of cubitus varus

Table I. Patients' characteristics

Case No.	Age Years - Months	Sex	Side	Injury	Delay in seeking treatment (days)	Displacement (grade)	Stay in hospital (days)
1	11 -	M	L	Fall while playing	6	III	15
2	6 6	F	L	Fall from 6 ft height	21	III	7
3	8 7	F	L	Fall from 3 ft height	2	III	18
4	10 10	M	L	Fall from a bicycle	5	III	18
5	4 7	M	L	Fall down the stairs at home	14	III	18
6	6 8	F	L	Fall in the school	5	III	17
7	8 2	M	L	Fall while playing	3	III	17
8	9 9	M	L	Fall from a bicycle	5	III	19
9	4 -	M	R	Fall from a horse	14	I	7
10	5 7	F	L	Fall from a horse	10	III	9
11	5 10	M	R	Fall while playing	10	III	12
12	8 9	M	L	Fall from 10 ft high tree	8	III	17
13	9 -	M	R	From a horse	3	III	15
14	8 -	F	R	Fall in school	7	III	18
15	11 -	M	L	Fall from bed	9	III	8

Table III. Results.

Case No	Displacement	Range of Flexion-Extension	Deformity	Follow-up in months	Result (Grade)
1	Strict posterior	10° - 130°	None	41	Good
2	Postero-medial, no tilt	-15° - 130°	None	56	Fair
3	Postero-medial, no tilt	5° - 135°	None	44	Good
4	Postero-lateral	0° - 140°	None	71	Good
5	Postero-lateral	0° - 135°	None	51	Good
6	Postero-lateral	0° - 140°	None	70	Good
7	Strict posterior	0° -130°	Cubitus rectus	15	Good
8	Postero-lateral	0° - 135°	None	58	Good
9	Undisplaced	-5° - 135°	Cubitus rectus	26	Good
10	Postero-medial, tilted	0° - 145°	10° varus	70	Poor
11	Postero-medial, tilted	0° - 145°	20° varus	89	Poor
12	Postero-medial, tilted	-5° - 135°	15° varus	50	Poor
13	Postero-medial, tilted	10° - 135°	6° varus	23	Poor
14	Postero-lateral	-5° - 135°	None	22	Good
15	Postero-medial, tilted	5° - 130°	6° varus	22	Poor

Table IV. Incidence of cubitus varus following various methods of treatment.

Method and Author	Number of cases	Unsatisfactory result or cubitus varus
Closed reduction and collar and cuff (D' Ambrosia 1972)	14	0
Open pinning (Weiland et al.1978)	52	13 (25%)
Traction on Thomas's splint (Bosanquet et al.1983)	18	6 (33%)
Straight traction (Piggot et al.1986)	41	10 (25%)
Present study	15	5 (33%)

Two patients had cubitus rectus, one each from group A and B, both were satisfied with the appearance of the elbow and did not request for corrective osteotomy. See Table III.

Neuro-vascular

One patient had median nerve palsy which recovered fully within 3 months. No patient required exploration of the brachial artery. There was no incidence of ischaemic contracture.

Myositis ossificans

No patient had any new bone formation as seen on radiographs done over 12 months following injury or at subsequent follow-up radiographs.

In group A there were 7 good and 1 poor result. In Group B there were 2 good, 1 fair and 4 poor results. The overall result was classified as good in 9 (60%), fair in 1 (7%), and poor in 5 (33%) patients .

DISCUSSION

Open reduction and internal fixation of supracondylar fracture is not easy even in fresh cases, it is certainly

difficult on a swollen elbow. Percutaneous Kirschner wire fixation, advocated by many authors^(2,4,6,10-12) for fresh cases is difficult in late cases .The bony landmarks are obscured by the swelling and the risk of injury to the ulnar nerve becomes higher^(3,4,7). The incidence of ulnar nerve injury, though low in fresh cases increases to between 5 and 10 per cent in delayed cases with swelling inspite the use of a nerve stimulator to locate the nerve prior to insertion of the Kirschner wire^(3,4) .

Treatment by skin traction with the elbow kept straight to avoid vascular embarrassment for fresh cases have been previously described⁽¹⁾. In this study traction was also used to achieve gradual reduction in patients who reported late with a grossly swollen elbow. Reduction could be obtained when the delay was up to 7 days (Figs. 1 a, b, c, d), but none if the delay was longer, as the fragments get "sticky". The acid test of any method of treatment is the incidence of cubitus varus subsequent to it, see Table IV. The deformity was reported in 10 out of 41 (25%) patients with grade II or III fracture treated by traction⁽¹⁾. Bosanquet et al⁽⁵⁾ reported 18 cases treated by traction in a small Thomas's splint, of which 12 had excellent or good result and the remaining 6 (33%) were unsatisfactory or unclassified result. Nacht et al⁽¹¹⁾ reported that the carrying angle decreased by an average of 5.8° (range 2° to 15°) in 20 out of 25 patients treated by percutaneous pinning, but only 3 out of these 20 patients had cubitus varus. Weiland et al⁽¹³⁾ reported cubitus varus in 13 out of 52 (25%) patients after open reduction and Kirschner wire fixation. In the present study 5 out of 15 patients (33%) with grade III fracture had cubitus varus.



Fig. 1a Radiograph on admission A-P view showing near total lateral displacement with angulation.



Fig. 1b Radiograph on admission lateral view showing total posterior displacement.



Fig. 1d Clinical photograph showing comparable appearance of both elbows. The left elbow was injured.



Fig. 1c Radiographs A-P and lateral views at one year showing fracture healed in good alignment.



Fig. 2a A-P radiographs of the elbow showing supracondylar fracture with medial *angulation* this resulted in a cubitus varus deformity. This patient requested for corrective osteotomy.



Fig. 2b In comparison A-P radiographs of the elbow showing supracondylar fracture with medial *displacement* this did not result in a cubitus varus deformity.

There is controversy regarding what position the forearm should be immobilised to avoid cubitus varus. Some authors advise pronation^(9,14,15) while others advocate supination^(1,5). Some have even suggested pronation for medially displaced fracture and supination for laterally displaced fractures^(11,16), but what should be the position when the displacement is directly posterior⁽⁶⁾? The controversy was avoided by letting the patient determine the position of comfort himself. The elbow was rested on a pillow with the traction cord running over a pulley on a universal joint, no splint⁽⁵⁾ or olecranon screw⁽¹⁵⁾ was used. It was observed that the children preferred supine to neutral position when sleeping and prone while sitting. It was further noted that all the patients who developed cubitus varus had postero-medial angulation (Figs. 2a and b), whereas none of the patients with posterolateral displacement had the deformity. Perhaps it is the type of fracture displacement rather than the position of immobilization, which determines the development of the deformity. For children who developed cubitus varus a corrective osteotomy was advised at a later date rather than late open reduction because of the previously mentioned risks.

The advantage of treatment with traction is that it can be practiced even in a minimally equipped hospital. Image intensifier, which is essential to perform closed pinning, may not be available in many district hospitals. The disadvantage being longer stay in the hospital, perhaps that is the price for avoiding operation and consequent complications.

Flexion-extension at the elbow improves with use and remodeling up to a year following injury^(7,10,11,17). All children recovered flexion from 30° to 130° which is adequate for activities of daily living⁽⁹⁾, within 6 months. Supervised physiotherapy is not necessary.

CONCLUSION

It is possible to achieve reduction with skin traction if the delay is up to a week after which the fragments get “sticky”. In 4 out of 5 patients who developed cubitus varus, the delay was longer than 7 days. The incidence of cubitus varus deformity was 33%, which is comparable to other methods. A planned corrective osteotomy was advised for children who developed cubitus varus. All 15 children regained functional range of motion within 6 months, there was no incidence of permanent neurovascular damage or myositis ossificans. All 5 patients with cubitus varus were classified as poor (33%), rest 1 as fair (7%) and 9 as good (60%).

REFERENCES

1. Piggot J, Graham HK, McCoy GF. Supracondylar fractures of the humerus in children: Treatment by straight lateral traction. *J Bone Joint Surg (Br)* 1986; 68B:577-83.
2. Millis MB, Singer IJ, Hall JE. Supracondylar fracture of the humerus in children: Further experience with a study in orthopaedic decision-making. *Clin Orthop* 1984; 188:90-7.
3. Ikram MA. Ulnar nerve palsy: a complication following percutaneous fixation of supracondylar fractures of the humerus in children. *Injury* 1996; 27:303-5.
4. Michael SP, Stanislas MJC. Localisation of the ulnar nerve during percutaneous wiring of supracondylar fractures in children. *Injury* 1996; 27:301-2.
5. Bosanquet JS and Middleton RW. The reduction of supracondylar fractures of the humerus in children treated by traction-in-extension: *Injury* 1983; 14:373-80.
6. Pirone AM, Graham HK, Krajchich JI. Management of displaced extension type supracondylar fractures of the humerus in children. *J Bone Joint Surg (Am)* 1988; 70-A:641-50.
7. Flynn JC, Mathew JG, Benoit RL. Blind pinning of displaced supracondylar fractures of the humerus in children. *J Bone Joint Surg Am* 1974; 56-A:263-72.
8. Morrey BF, Askew LJ, An KN, Chao EY. A biomechanical study of normal functional elbow motion. *J Bone Joint Surg. (Am)* 1981; 63-A:872-6.
9. Arnold JA, Nasca RJ, Nelson CI. Supracondylar fractures of the humerus. *J Bone Joint Surg (Am)* 1977; 59-A:589-95.
10. Paradis G, Lavallee P, Gagnon N, Lemire L. Supracondylar fractures of the humerus in children: Technique and results of crossed percutaneous fixation. *Clin Orthop* 1993; 297:231-7.
11. Nacht JL, Ecker ML, Chung SMK, Lotke PA, Das M. Supracondylar fracture of the humerus in children treated by closed reduction and percutaneous pinning. *Clin Orthop* 1983; 177:203-9.
12. Walloe A, Egund N, Eikelund L. Supracondylar fracture of the humerus in children: review of the closed and open reduction leading to a proposal for treatment. *Injury* 1985; 16:296-9.
13. Weiland AJ, Meyer S, Tolo VT, Berg HL, Mueller J. Surgical treatment of displaced supracondylar fractures of the humerus in children. *J Bone Joint Surg (Am)* 1978 ; 60-A:657-61.
14. D'Ambrosia RD. Supracondylar fracture of humerus - Prevention of cubitus varus. *J Bone Joint Surg (Am)* 1972; 54-A:60-6.
15. Palmer EE, Nieman KMW, Vesely D, Armstrong JH. Supracondylar of the humerus in children. *J Bone Joint Surg (Am)* 1978; 60-A:653-6.
16. Prietto CA. Supracondylar fractures of the humerus: a comparative study of Dunlop's traction versus percutaneous pinning. *J Bone Joint Surg. (Am)* 1979; 61-A:425-8.
17. Attenborough CG. Remodeling of the humerus after supracondylar fractures in childhood. *J Bone Joint Surg (Br)* 1953; 35-B:386-95.