

The Efficacy of Side Arm Traction in the Reduction of Supracondylar Fracture Humerus in Children

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Summary

156 consecutive children with supracondylar fracture humerus were reviewed. Of these, 56 children with severely displaced fractures were treated with side arm traction. A retrospective review revealed that a mean post-reduction Baumann angle of 74.2 degrees for boys and 75.9 degrees for girls; and mean post-reduction humero-ulna angle of 11.6 degrees for boys and 12.7 degrees for girls was achieved. A linear correlation was noted between the duration of traction and the age of the patient, older patients requiring longer traction. The region below the line in the graph, plotting the duration of traction (y-axis) versus the age of the patient (x-axis) shows when the fracture is unstable; and the region above the line shows when the fracture is stable and can only be reduced by surgery. 10 children presented late: 6 presented within the unstable period and were successfully reduced with traction; while 4 presented stable and required open reduction. We conclude that traction is an acceptable and safe method for reduction of this fracture, and can be used to reduce late presentations while their fractures are still unstable.

Key Words: Children, Supracondylar Fracture Humerus, Traction, Late presentation

Introduction

The supracondylar fracture of the humerus in children is a common injury worldwide and is noted to be a fracture with many potential complications, most importantly, vascular and neurological. Many treatments have been recommended¹. Surgical intervention has its hazards and anaesthesia as safe as it can be, has very small but real risk of mortality^{2,3}. Iatrogenic nerve injuries as a result of surgery are well known⁴. Various methods of traction have lost popularity in recent times due to the prolonged stay in hospital and the ever increasing cost of hospital beds. However they still are viable methods for the reduction of this fracture and are capable of achieving good results and are free of the risks mentioned above⁵. The position of traction for this fracture has always been, and still is a matter of

controversy. Worlock⁶, Piggot⁷ and El-Sharkawi⁸ have recommended traction in extension; and forearm pronation has been advocated to control distal tilt with brachioradialis tautness⁹. We have been using a side arm traction method of treatment for the severely displaced (Gartland Type 3) supracondylar fracture humerus and wish to report the efficacy of our method in the reduction of this fracture. This is the predominant form of treatment used at this hospital since 1989.

Materials and Methods

Between January 1990 and December 1991, 156 children were treated for supracondylar Fractures of the humerus at the Ipoh Hospital. The medical records of 148 patients were available for study and reviewed. 78

children presented with severely displaced (Gartland Type 3) fractures. Of these, 56 children (37 boys and 19 girls) were treated with side arm traction and their radiographs analysed. 10 patients presented late (defined as more than 2 days after injury).

The traction was delivered by a weight of 2 to 3 pounds (0.9 to 1.36kgs.) and was attached to the affected limb by skin traction. The limb itself was in an abducted and supinated position with slight flexion of up to 5 degrees at the elbow; the whole limb being at a 5 to 10 degree inclination to the horizontal (Fig.1). The traction was modified in selected cases by the addition of weights vertically to the proximal fragment (Dunlop) or by controlling the limb in a small Thomas splint.

After traction was removed all patients were further immobilized with an arm sling and the fracture protected in a posterior plaster with the elbow in 90 degree flexion. The flexion was achieved by allowing the child to actively move the elbow. This procedure took about 5 minutes with encouragement given to the

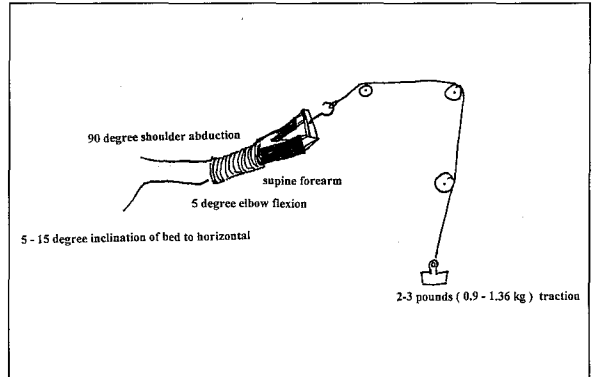
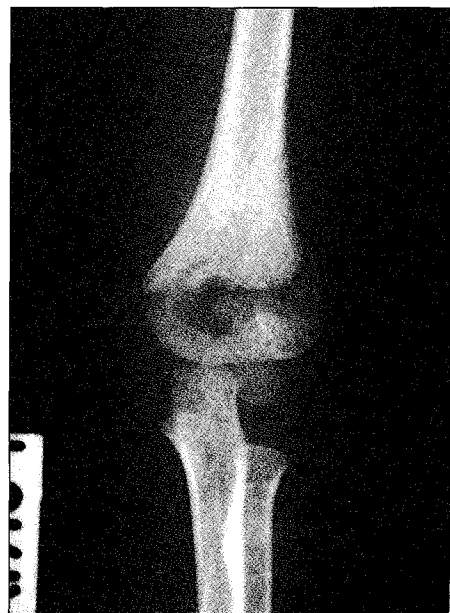


Fig. 1. Line diagram of the limb attitude during traction.

child by the parents. The application and removal of traction, together with the alterations and adjustments in the position of the traction were done without any anaesthesia or sedation and was well tolerated by all our patients.



A



B

Fig. 2. A. Severely displaced fracture at presentation.

B. Fracture reduced after 2 days of traction.

Radiographs were taken at periodic intervals: at presentation, after application of traction (to view reduction - this is usually after 1 or 2 days of traction), at the time of clinical union (painless fracture, usually between 10 and 20 days), and at removal of traction when the elbow was immobilized in flexion and supination within a posterior back slab. Antero-posterior view radiographs of the elbow were analysed at 3 stages for uniformity, i.e., at presentation (to review fracture configuration and classification); after application of traction (to review reduction achieved by traction) (Fig 2); and at the time of clinical union (this confirms maintenance of reduction).

The radiographs were analysed for Baumann angle^{10,11}, metaphyseal-diaphyseal angle¹², humero-ulna angle¹³ and medial epicondyle-epiphyseal angle¹⁴. However, only the Baumann angle and the humero-ulna angle could be measured satisfactorily in most radiographs. The values studied were the values obtained at the time of clinical union, usually between 10 and 20 days after the injury. All measurements were done by 2

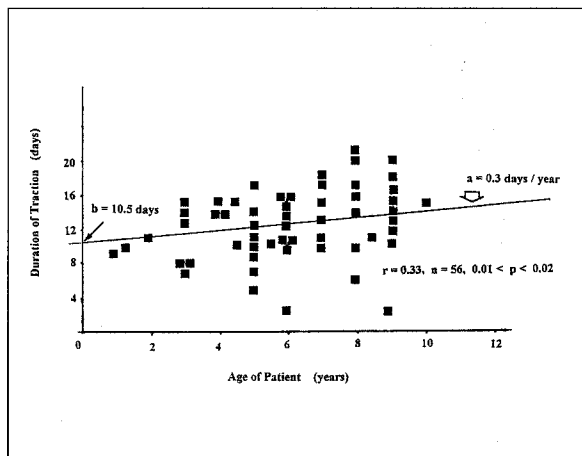


Fig. 3. Scatter plot between duration of traction (in days) against age of patient (in years).

Table I
Duration of Traction and Outcome (Baumann and Humeroulna Angles) of Children with Supracondylar Fractures of the Humerus

	Boys n=37	Girls n=19	Late Presenters n=6
AGE (YEARS)	1 to 10	1.3 to 9	5 to 9
DURATION OF TRACTION (DAYS)	2 to 21	9 to 20	4 to 14
BAUMANN ANGLE (DEGREES)			
Range	57 to 84	60 to 90	62 to 79
Mean	74.2	75.9	72.2
SD*	5.85	7.58	6.53
95% C.I.**	72.26 to 74.14	74.11 to 77.69	66.48 to 77.92
HUMERO-ULNA ANGLE (DEGREES)			
Range	0 to 20	5 to 29	6 to 18
Mean	11.6	12.7	11.4
SD*	4.40	6.24	4.67
95% C.I.**	10.07 to 13.13	11.23 to 14.17	7.3 to 15.50

* Standard Deviation

** 95 % Confidence Interval

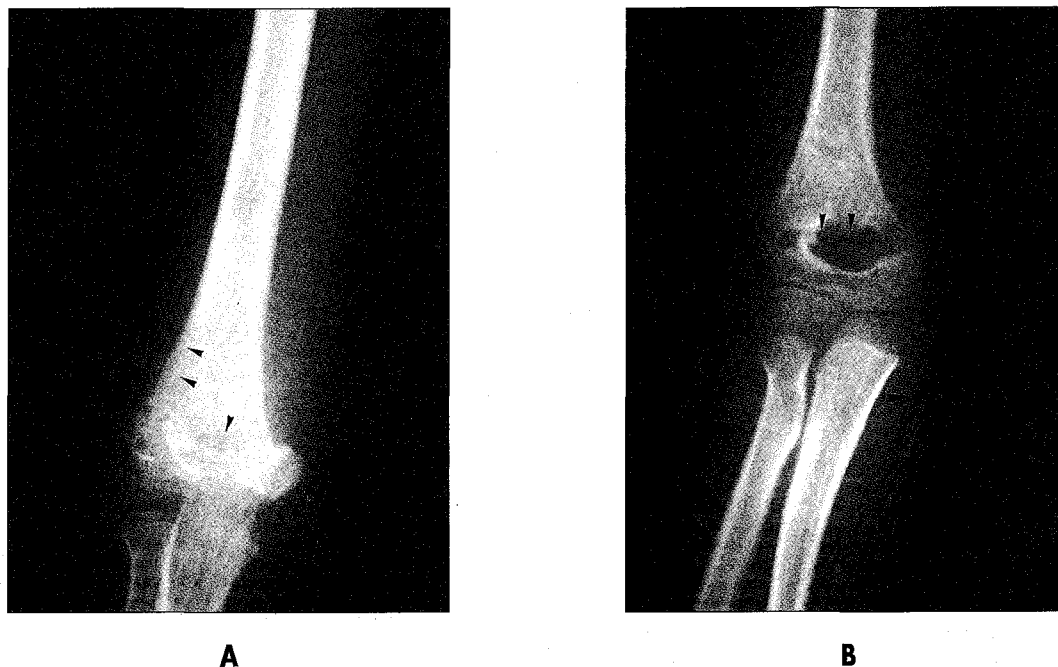


Fig. 4. Late presenter. This 8 year old boy presented 14 days after sustaining a fracture, having received prior treatment from a traditional bone setter. A. Fracture on admission. Note periosteal reaction adjacent to fracture indicating age of fracture. B. Fracture after 3 days of traction reduction. The reduction is satisfactory and the Baumann and Humeroulna angle are within normal limits. Skin traction device is clearly seen on the forearm.

investigators independently; and where there was a discrepancy, remeasurements were made, and the final value was a consensus between the investigators.

Results

56 patients with severely displaced fractures completed the side arm traction described. The mean duration of traction was 14 days with a range of 7 to 20 days. The post reduction angles measured for boys and girls are given in Table I. A scatter plot (Figure 3) of the duration of traction against the chronological age of a patient has a linear correlation ($r=0.33$, $n=56$; $0.01 < p < 0.02$). Significance was tested using the *t* - test. The linear equation, $[Y = aX + b]$ shows the duration of traction required for the fracture to be stable where *Y* is the

duration of traction in days, *X* is the chronological age of the patient, *a* is the regression coefficient of 0.3; and *b* is the constant of 10.5 days, which is the minimum time for this fracture to become stable.

Of the 10 patients who presented late, 6 were well reduced with traction (Table I and Figure 4). Those who were successfully reduced with traction presented within the unstable region of the scatter plot and those who required surgery presented within the stable region of the scatter diagram (Figure 5). All late presenters were male.

Discussion

The merits of shoulder abduction with the elbow in slight flexion and forearm in supination has been

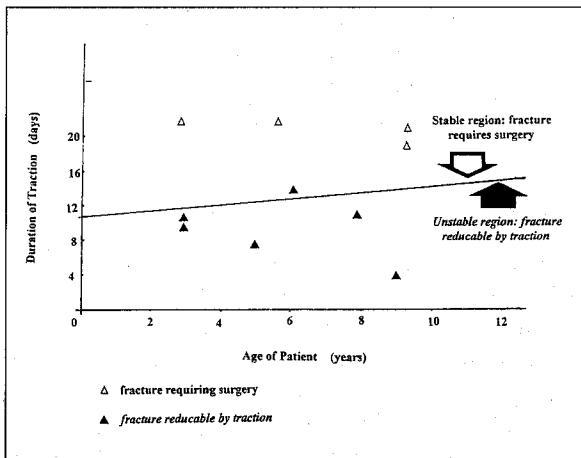


Fig. 5. Late presentations and their mode of treatment in relation to the line which delineates fracture stability.

discussed by Warlock⁶, Piggot⁷, El-Sharkawi⁸ and Webb¹⁵. Traction is simple and safe to apply and is a useful means of achieving and maintaining reduction of the fracture. In our patients no anaesthesia was used in the application of traction, however some patients required a little reassurance or oral sedatives and analgesics. Surgical morbidity and anaesthetic risk is therefore avoided. Traction also allows a gradual reduction, and if valgus or varus deformities are noted, gentle manipulation may be applied throughout the course of traction to gain a cosmetically acceptable result. Posterior displacements can be controlled in this manner too. Direct inspection of the valgus attitude of the elbow is possible. The controversy over the position of forearm immobilization remains. Proponents of the pronated position argue that brachioradialis tautness prevents a cubitus varus deformity⁹. This position is not suitable during side arm traction reduction and difficult to maintain after traction is removed at the end of 2 weeks. We have found it easier to maintain traction in the supinated forearm. Shoulder abduction, slight elbow flexion, and supinated forearm position allows convenient radiological monitoring of the fracture and callus formation. Once fracture stability is ensured by an adequate period of traction in the supinated position;

there is less risk of varus displacement. The straight arm position, with slight elbow flexion is desirable in severely displaced fractures, as these fractures often have a swelling which may impede the brachial artery when attempting to flex the elbow to achieve a stable position in a fresh injury. This "Supracondylar Dilemma" is well known^{7,16}. Extension (straight arm position) is favourable for a fresh fracture with a swollen elbow, however, it is unstable; and therefore requires a continuous traction to maintain stability. The position of elbow flexion in a fresh fracture, although stable; has a very high risk of vascular compromise. Pulse oximetry¹⁷ and doppler studies¹⁸ have been recommended in swollen fresh fractures if immediate reduction is desired, as clinical observation alone may not be adequate. Gross swelling can be allowed to settle initially with this method even when further intervention is planned 2 or 3 days later¹⁹.

Baumann advised that the angle that is named after him should be between 75 and 80 degrees on reduction¹⁰ and Warlock measured the angle to be approximately 75 degrees¹¹. Williamson and Cole²⁰ have reported values in normal subjects to be 72 degrees, with 95% of the normal elbows having an angle of 64 to 81 degrees in a series of 114 normal children. The angle changes on medial-lateral angulation as well as cephalad-caudad angulation²¹ of the X-ray beam. There is also a risk of loss of the angle if the fracture is radiographed while still unstable²². True antero-posterior (AP) views are essential in determining accurately this angle, and true AP views are obtained when the limb is in a straight supinated position²³.

Various studies have quoted normal values for the humero-ulna angle. Smith²⁴ noted that in children between 3 and 11 years, males have mean of 5.4 degrees (range 0 - 11 degrees) and females have a value of 6 degrees (range 0 - 12 degrees). Ashhurst records a variation of 2 to 18 degrees with an average of 11 degrees²⁵. Beal reports girls having greater values, and a mean angle of 15 degrees in subjects 0 to 4 years. He also reports a significant difference in age; adults having a larger average value¹³. In our study the post reduction Baumann and humero-ulna values correspond with the values described above. The antero-posterior displacement is not a very disfiguring deformity and has

been considered by Attenborough to be acceptable as remodelling readily occurs²⁶. The linear correlation that is seen has several implications. The older the child, the longer the duration of traction; and the equation can be used to estimate the duration of traction required before the fracture becomes stable. The number of radiographs required can be reduced since stability can be approximated with the equation.

The constant of 10.5 days is the minimum time taken for this fracture to become stable. All fractures which present below the line are unstable and can be reduced by traction. Of the 10 late presenters reviewed, 6 were reduced successfully by traction as they were unstable at presentation. The remaining 4 required open reduction, because the fractures were stable as confirmed by radiographs and operative findings. The mean post reduction Baumann angle of the late presenters is 72.2 degrees and the mean post reduction humero-ulna angle is 11.4 degrees. These values correlate well with the post reduction values of the early presenters and the normal values as described above. Ating'a²⁷ in his study on a population with a similar socioeconomic background as

the patients in this study, reports that presentation even 3 days after fracture requires surgical intervention. We feel that this form of traction obviates the need for surgery in most cases.

Conclusion

Traction, as described in this study is efficacious in reducing the supracondylar fracture humerus in childhood. This is demonstrated in the mean post reduction Baumann angle and humeroulna angle found in this study. Fractures which present late (after 2 days) can also be reduced by traction, if they are still unstable. Traction is simple, safe and easy to apply. It makes anaesthesia and surgery unnecessary.

Acknowledgements

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- Science
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