Management of grade III supracondylar fracture of the humerus by straight-arm lateral traction

M. Z. Sadiq · T. Syed · J. Travlos

Received: 24 March 2006 / Revised: 30 March 2006 / Accepted: 30 March 2006 / Published online: 17 June 2006
© Springer-Verlag 2006

Abstract Supracondylar fracture of the humerus is a common upper limb fracture in children for which treatment is controversial and often technically difficult, and complications are common. Cubitus varus is the most prevalent complication encountered in such fractures, with a mean incidence rate of 30%. A variety of methods for treating displaced fractures have been recommended. We reviewed 20 cases of severely displaced grade III supracondylar fractures of the humerus in children. There was marked swelling and distorted local anatomy in all these fractures, which were managed conservatively with straight-arm lateral traction. The patients were treated in skin traction for 2 weeks, following which they commenced physiotherapy. The traction was applied with the arm at 90° of abduction and the forearm in supination. None of the patients developed any complication, and all had the full range of movements. None had cubitus varus deformity, and none of these patients required further surgical treatment. There was a complete patient and parent satisfaction. Open or closed reduction with internal fixation is the most common method of treating these injuries, however in some cases this can be very difficult and dangerous. If the local anatomy and swelling do not allow this treatment then non-operative measures have to be adopted. We conclude that straight-arm

lateral traction is a safe and effective method of treating these fractures, especially when the local anatomy is disturbed and the swelling makes operative intervention relatively more risky and difficult. Moreover, this method is also appropriate in areas where access to specialised centres in treating these injuries is either difficult or delayed.

Résumé La fracture supracondylienne de l'extrémité inférieure de l'humérus est une fracture fréquente chez l'enfant, le traitement est assez controversé et la technique chirurgicale souvent difficile. Les complications sont habituelles avec le cubitus varus le plus fréquemment (30%). De nombreuses méthodes de traitement pour les fractures déplacées ont été recommandées. Nous avons revu 20 cas de fractures supracondyliennes de l'extrémité inférieure de l'humérus de grade III de l'enfant. Ces fractures ont été traitées de façon orthopédique par traction latérale cutanée pendant deux semaines. La rééducation a ensuite été commencée. La traction a été mise en place avec le bras à 90° d'abduction et l'avant bras en supination. Aucun de ces patients n'a développé de complications. Tous ont gardé une mobilité complète. Aucun ne présente un cubitus varus et aucun n'a nécessité d'être réopéré. Il s'agit de résultats satisfaisants absolument parfaits pour les parents et les patients. La réduction ouverte ou fermée avec fixation interne est la méthode la plus habituelle de traitement de ces traumatismes. Dans certains cas ceux-ci peuvent être difficiles ou dangereux, néanmoins les lésions anatomiques et les déplacements ne peuvent pas toujours permettre les mêmes traitements. Le traitement orthopédique peut alors être pratiqué. Le traitement par traction latérale du bras est un traitement sûr d'autant plus que la fracture est déplacée et que le traitement chirurgical peut se révéler risqué. De plus, cette technique peut être adoptée dans des centres moins spécialisés, dans le traitement de ces traumatismes où qui ont des difficultés à réaliser ce traitement de façon immédiate.

M. Z. Sadiq · T. Syed
Milton Keynes General Hospital,
Buckinghamshire, UK

J. Travlos
Stafford General Hospital,
Stafford, Staffordshire, UK

M. Z. Sadiq (✉)
16 Malton Close Monkston,
Milton Keynes, UK
e-mail: docjb@hotmail.com

Table 1 Gartland's classification of supracondylar fracture of the humerus

Type I	Undisplaced
Type II	Displaced with intact posterior cortex
Type III	Completely displaced

Introduction

Supracondylar fracture of the humerus is a very common childhood fracture, occurring most often in children aged between 5 and 7 years [5]. The incidence of displaced (grade III) fractures is low (16.7%) [12], and the treatment is very challenging and controversial. Displaced fractures can be associated with various complications, such as neurovascular compromise, skin problems, compartment syndrome and Volkmann's ischaemia. The most common is cubitus varus, the incidence of which has been quoted to be as high as 60% [4]. Various methods of treatment have been used for these fractures, including traction, manipulation under anaesthesia, operative fixation using percutaneous wires and open reduction and internal fixation. All of these methods have their advantages and disadvantages, and the treatment option has to be tailored according to the configuration of the fracture and the expertise and facilities available. We have found that straight-arm lateral traction is very effective in managing some of the severely displaced fractures.

Patients and methods

We reviewed 20 cases of displaced supracondylar fracture of the humerus, all of which involved paediatric patients

who had been admitted from the Accident and Emergency Department following acute trauma. The average age of the patients was 6.5 years, and there were 14 boys and 6 girls. All of the fractures were classified as displaced Gartland's [10] grade III (Table 1). Patients with open fractures were not included in this study.

Two patients had symptoms of radial nerve involvement, one patient had symptoms of involvement of the anterior interosseous nerve and one patient did not have a palpable radial pulse but had a well-perfused distal extremity and the pulse returned after the application of traction.

All of these patients were managed by the same surgeon using straight-arm lateral skin traction. The traction was applied and the patients treated in the manner described by J. Piggot [19]. The arm was held in 90° of abduction with the forearm in supination. The elbow was flexed from 0 to 10°. Counter traction was applied by raising the side of the bed (Fig. 1a,b). The traction was applied using oral analgesia as soon as the patients were admitted to the ward. The patients remained on traction for 2 weeks, after which supervised intermittent physiotherapy was started. The traction was removed completely after 3 weeks and the patients discharged with a collar and cuff sling. Repeated assessment of the carrying angle was made while the patients were in traction for the first 2 weeks and the traction adjusted accordingly.

Results

The results were analysed using radiographs and clinical examination. The radiographic measurements were taken using a goniometer on standard anterior-posterior (AP) and

Fig. 1 a,b Arm in traction

Table 2 Cases managed by straight-arm lateral traction

Age	Sex	Associated complication	Valgus angle at discharge (°)
7	M	None	+2
6	M	None	0
8	F	None	+5
7	M	Absent radial pulse (recovered)	-2
6	M	None	+3
8	F	Radial nerve (recovered in 18 months)	+5
5	M	None	+2
8	M	None	0
7	F	None	+2
6	M	None	+4
5	F	None	+5
5	M	None	0
9	M	None	+2
6	F	None	+4
7	M	None	+2
6	M	Radial Nerve (recovered in 6 months)	+3
5	M	None	+4
8	F	None	+3
5	M	None	0
7	M	None	+2

lateral X-rays. Both the humeral-ulnar and the Bauman's angles were measured. The carrying angle and the range of movement were measured clinically and compared with the normal side.

All of the fractures united (Table 2). There was no case of cubitus varus. All of the fractures remodelled, and there was no residual deformity or loss of function at the end of the follow-up period (Fig. 2a,b). None of the patients required re-surgery, and no complication to the skin arose as a result of the traction.

Discussion

Supracondylar fracture is considered to be the second most commonly occurring fracture in children, with an incidence

rate of around 17.9% [5]. A considerable number of displaced supracondylar fractures of the humerus are associated with various serious complications, the most common of which is cubitus varus, with an incidence rate as high as 60% [4]. Nerve injuries have an incident rate of around 9%, with the involvement of the anterior interosseous nerve being the most common nerve complication [3, 7]. The median nerve is most commonly injured in the posterolateral displacement that occurs in type III fractures [3]. Given all of these major and serious complications, varus angulation of the distal fragment is often overlooked. Cubitus varus is usually graded as a cosmetic deformity, but studies show that it can be associated with tardy ulnar nerve palsy and posterior instability of the shoulder [11].

Displaced grade III supracondylar fractures have been managed by various means, with some authors suggesting that closed reduction and fixation with K-wires is the optimal method [14, 17], while others suggest a low threshold for open reduction and internal fixation [9, 16]. Traction has also been used in the management of such injuries. Skeletal traction with an olecranon screw has shown good results [1, 18]. Dunlop [8] popularised the method of skin traction in 1939. It is still being used with satisfactory results in certain centres and under certain conditions and has been found to be successful in some problem fractures – i.e. when good reduction can not be maintained or when there is a neurovascular compromise [13]. Some studies have advocated skin traction as a temporary measure for the gradual reduction of fracture followed by fixation with K-wires [6].

With the arm in a straight lateral position it is easier to view the carrying angle and compare it with the other side. Traction also has the advantage of being flexible, it can be readjusted and its application does not require any special expertise. It is also considered that in extension, the forces of the extensor and the flexor muscles are neutralised [4]. It is usually recommended that the elbow be flexed to more than 90° after manipulating these fractures [15]. Studies have shown that the compartment pressure increases significantly in hyper-flexed elbows [2]. We propose that in problem cases in which the patient presents late and the

Fig. 2 **a** Displaced fracture, **b** 3-month follow-up

fracture has associated swelling that precludes a safe operative approach, straight-arm lateral traction has a significant part to play. This may be particularly relevant in a setup where the surgical expertise and experience of the surgeons in treating these injuries is less than those found in a major paediatric trauma centre.

The fractures in our study treated by straight-arm lateral traction were markedly displaced with extensive soft tissue damage and the normal anatomy considerably distorted. Both open and closed reduction would have been difficult in these cases and, consequently, straight-arm lateral traction proved to be an effective and safe option.

Conclusion

We believe that straight-arm lateral traction is an effective and successful method of treating displaced grade III supracondylar fractures of the humerus, particularly those which are displaced and swollen. The lessons of history are often discarded by the avant-garde. We recommend the study by J. Piggot et al. [19] and believe that even those surgeons who are adept at surgical methods of treatment might sometimes need a safe non-operative method to treat these injuries. This form of treatment is also particularly useful in areas where access to specialised orthopaedic facilities is difficult.

References

1. Badhe NP, Howard PW (1998) Olecranon screw traction for displaced supracondylar fractures of the humerus in children. *Injury* 29:457–60
2. Battaglia TC, Armstrong DG, Schwend RM (2002) Factors affecting forearm compartment pressures in children with supracondylar fractures of the humerus. *J Pediatr Orthop* 22:431–439
3. Campbell CC, Waters PM, Emans JB, Kasser JR, Millis MB (1995) Neurovascular injury and displacement in type III supracondylar humerus fractures. *J Pediatr Orthop* 15:47–52
4. Chen RS, Liu CB, Lin XS, Feng XM, Zhu JM, Ye FQ (2001) Supracondylar extension fracture of the humerus in children. Manipulative reduction, immobilization and fixation using a U-shaped plaster slab with elbow in full extension. *J Bone Joint Surg Br* 83B:883–887
5. Cheng JC, Ng BK, Ying SY, Lam PK (1999) A 10-year study of the changes in the pattern and treatment of 6,493 fractures. *J Pediatr Orthop* 19:344–50
6. Devnani AS (2000) Gradual reduction of supracondylar fracture of the humerus in children reporting late with a swollen elbow. *Singapore Med J* 41:423–424
7. Dormans JP, Squillante R, Sharf H (1995) Acute neurovascular complications with supracondylar humerus fractures in children. *J Hand Surg Am* 20:1–4
8. Dunlop J (1939) Transcondylar fracture of humerus in childhood. *J Bone Joint Surg Am* 21A:59–73
9. Furrer M, Mark G, Ruedi T (1991) Management of displaced supracondylar fractures of the humerus in children. *Injury* 22:259–262
10. Gartland JJ (1959) Management of supracondylar fracture of humerus in children. *Surg Gynecol Obstet* 109:145–154
11. Gurkan I, Bayrakci K, Tasbas B, Daglar B, Gunel U, Ucaner A (2002) Posterior instability of the shoulder after supracondylar fractures recovered with cubitus varus deformity. *J Pediatr Orthop* 22:198–202
12. Houshian S, Mehdi B, Larsen MS (2001) The epidemiology of elbow fracture in children: analysis of 355 fractures, with special reference to supracondylar humeral fractures. *J Orthop Sci* 6: 312–315
13. Jefferiss CD (1997) Straight lateral traction' in selected supracondylar fractures of the humerus in children. *Injury* 8:213–219
14. Mazda K, Boggione C, Fitoussi F, Pennicot GF (2001) Systematic pinning of displaced extension – type supracondylar fractures of the humerus in children. A prospective study of 116 consecutive patients. *J Bone Joint Surg Br* 83B:888–893
15. Mills MB, Singer IJ, Hall JE (1984) Supracondylar fracture of humerus in children: further experience with a study in orthopaedic decision making. *Clinic Orthop* 188:90–97
16. Mohammed S, Rymaszewski LA (1995) Supracondylar fractures of the distal humerus in children. *Injury* 26:487–489
17. O' Hara LJ, Barlow JW, Clarke NMP (2000) Displaced supracondylar fractures of the humerus in children. Audit changes practice. *J Bone Joint Surg Br* 82B:204–210
18. Palmer E, Niemann KMW, Vesely D, Armstrong JH (1978) Supracondylar fracture of the humerus in children. *J Bone Joint Surg Am* 60A:653–656
19. Piggot J, Graham HK, McCoy GF (1986) Supracondylar fractures of the humerus in children. Treatment by straight lateral traction. *J Bone Joint Surg Br* 68B:577–583