

# CONSERVATIVE TREATMENT OF DISPLACED SUPRACONDYLAR HUMERUS FRACTURES OF THE EXTENSION TYPE IN CHILDREN

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Numerous methods for the treatment of displaced supracondylar humerus fractures of the extension type are described in the literature.

From 1974 until 1988, we treated conservatively 33 children with such fractures with Dunlop traction. Twenty-nine patients (88%) were re-examined. Four patients (12%) were interviewed by telephone. Good or excellent results were obtained in 31 patients.

The Dunlop method is a simple, well-tolerated and safe method that permits surveillance for possible complications. In comparison with other methods, it yields good and reproducible results.

**Keywords** : supracondylar fractures of the humerus ; children ; conservative treatment ; Dunlop traction.  
**Mots-clés** : fractures supracondyliennes de l'humérus ; enfant ; traitement orthopédique ; traction de Dunlop.

## SAMENVATTING

*M. URLUS, P. KESTELIJN, E. VANLOMMEL, M. DEMUYNCK en L. VANDEN BERGHE. Conservatieve behandeling van verplaatste supracondylaire fracturen van het extensietype bij het kind.*

Vele methoden voor de behandeling van deze fracturen zijn beschreven.

Van 1974 tot en met 1988 werden 33 kinderen met een verplaatste supracondylaire humerusfractuur van het extensietype conservatief behandeld door middel van Dunlop-tractie. Negenentwintig patiënten (88%) werden opnieuw onderzocht. Vier patiënten (12%) werden telefonisch geïnterviewd. Bij 31 patiënten werd een goed of uitstekend resultaat bereikt.

De Dunlop methode is een eenvoudige, weinig belastende en veilige methode, met een goede controle

ten opzichte van mogelijke complicaties. In vergelijking tot andere technieken geeft zij goede en reproduceerbare resultaten.

## RÉSUMÉ

*M. URLUS, P. KESTELIJN, E. VANLOMMEL, M. DEMUYNCK et L. VANDEN BERGHE. Traitement conservateur des fractures supracondyliennes de l'humérus avec déplacement chez l'enfant.*

De nombreux modes de traitement sont proposés pour les fractures de ce type. De 1974 à 1988 nous avons traité consécutivement 33 enfants pour fracture supracondylienne de l'humérus, avec déplacement en extension, par traction de Dunlop.

Vingt-neuf patients (88%) furent réexaminés. Quatre patients (12%) furent évalués par téléphone. Trente-et-un patients ont obtenu un résultat bon ou excellent.

La traction de Dunlop est une méthode bien tolérée et fiable. En comparaison avec les autres techniques de traitement elle donne des résultats favorables et reproductibles.

## INTRODUCTION

The supracondylar fracture of the humerus is the most frequently encountered fracture of the elbow

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in children and adolescents (8, 9, 15, 21, 25). It occurs most frequently between 3 and 10 years of age, more often among boys than among girls, and more frequently on the left side than on the right side.

Two types are distinguished, the so-called "flexion" and "extension" types. The extension type is the most frequently occurring (96%-99%) (8, 21). It is caused by falling on the outstretched hand with the elbow slightly flexed. The distal fragment displaces posteriorly.

These fractures are known to cause complications such as ischemic Volkmann's contracture, myositis ossificans, vascular lesions and irreversible nerve lesions (5, 22, 28, 29). Fortunately, these complications are not frequent, although they may result in considerable functional loss.

A more frequent complication, to which often less attention is paid, is an alteration in the carrying angle, usually resulting in a cubitus varus deformity (3, 4, 7, 12, 13, 17, 23, 24, 26, 27).

Small alterations of the carrying angle may be acceptable. However when the carrying angle is transformed into a cubitus varus a serious cosmetic problem arises, for which a supracondylar osteotomy may even be indicated (17). In the literature a varying incidence is described of up to 57%, with an average of 30% (27).

A large variety of conservative (3, 8, 9, 10, 15, 18, 21, 25, 26) (table I) and surgical treatment methods (2, 6, 11, 14, 16, 20, 30, 31) (table II) are described.

In the present article, we report a retrospective study of our treatment results in 33 consecutive patients who were treated conservatively by means of Dunlop traction, whether or not preceded by a reduction under anesthesia.

## MATERIALS AND METHODS

Between 1974 and 1988, 33 consecutive children with a displaced supracondylar humerus fracture of the extension type were treated at our hospital by means of Dunlop traction. Depending on the degree of displacement, the traction was preceded by reduction under general anesthesia.

Twenty-nine (88%) patients could be followed up and underwent clinical re-examination. Four patients (12%) were interviewed by telephone.

Follow-up varied from 1 to 16 years after the trauma (mean follow-up was 8.4 years) (fig. 1).

The patients' ages varied from 3 to 12 years (the average was 7.5 years) (fig. 2). Twenty boys and 13 girls were treated during this period. All patients were always examined by the same two clinicians.

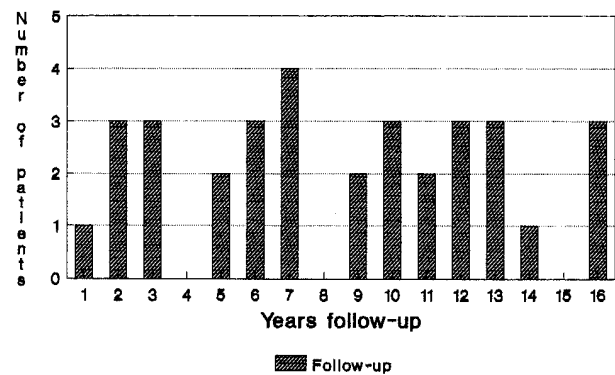


Fig. 1. — Follow-up.

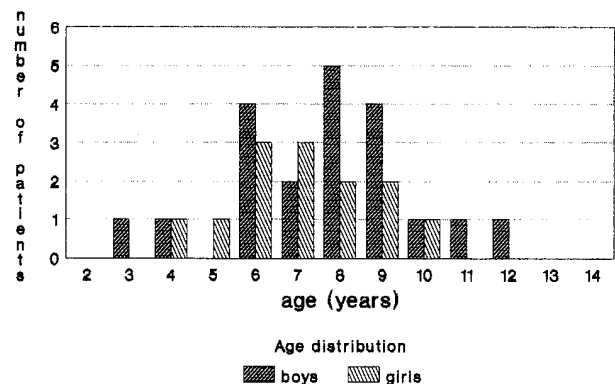


Fig. 2. — Age distribution.

None of the children had serious associated lesions. Two children had ipsilateral fractures of the distal radius and/or ulna.

In all patients, Dunlop skin traction was applied to the forearm, while the upper arm was kept in 90° abduction and the elbow in 90° flexion. A weight of 0.5-1 kg was attached to the upper arm with a sling on the distal third. As such, the elbow remained visible, which permitted frequent surveillance.

Table I. — Comparison of the literature data on the results of conservative treatment

Treatment	Number of patients	Number of patients at follow-up	Good/excellent	Patients with c. varus
Lateral traction in extension (Piggot, 25)	205	98	90	4
Dunlop traction (Dodge, 8)	79	48	90%	4
Closed reduction + plaster immobilization or skeletal traction (Hoyer, 15)	52	44	36	22
Reduction and plaster immobilization (El-Sharkawi, 10)	115	72	62	10
Reduction + traction in plaster immobilization (Madsen, 18)	30	30	83%	4

Table II. — Comparison of the literature data on the results of surgical treatment

Treatment	Number of patients	Number of patients at follow-up	Good/excellent	Patients with c. varus
Open reduction and fixation (Gruber, 14)	31	23	14	2
Open reduction and fixation b.m.o. 2 crossed Kirschners (Weiland, 31)	58	52	—	25%
Percutaneous pinning (Arino, 2)	189	184	85%	26
Percutaneous pinning (Flynn, 11)	72	72	49	3

Reduction under anesthesia was performed before application of the traction in 22 (67%) patients. This resulted in complete reduction in 18 patients. In 5 patients after 3 to 7 days (average 5.4 days) a second reduction was undertaken, in 1 case because of incomplete reduction, in 4 cases because of secondary displacement.

Thus, 11 patients were treated by means of Dunlop traction only.

The duration of the traction varied from 5 to 27 days (average 18.0 days). When sufficient callus appeared radiologically, a plaster cast was applied with the elbow in 90° flexion and the forearm in neutral position. The patient was discharged from the hospital the same day.

The duration of the cast immobilization varied from 8 to 25 days (average 16.1 days).

Thereafter, active and passive exercises were al-

lowed. There was often very rapid and complete recovery of flexion. The maximal extension was often reached at a much later stage. In some cases, improvement continued up to one year after the trauma.

No complications occurred in the course of the treatment, and no child underwent surgical intervention.

Subdivision into groups was made on the basis of the criteria used by Gruber (14) and Mitchell (21) (table III).

The decision to perform a reduction was made depending on the degree of displacement (table IV). The patients were closely followed clinically and radiologically. The degree of reduction was classified as either partial or complete.

The carrying angle of both arms was measured by means of a goniometer, with the elbow in extension and the forearm in supination. Flexion, extension, pronation and supination were determined as well.

The patients were questioned about pain, functional limitation, and possible peculiarities of the outer appearance of the arm (table V). Striking was the fact that no patient complained about the outer aspect of the elbow.

The results were analyzed on the basis of the criteria determined by Flynn (11) and Mitchell (21) (table VI).

Each patient showing a reversed or cubitus varus carrying angle was automatically classified as having a bad result, even if the change in the carrying angle was less than 5°.

Some children presented a cubitus rectus (0° carrying angle) of only a few degrees, in the normal arm. In such cases, a slight change in the carrying angle may lead to a cubitus varus, and, by definition, to a poor result.

## RESULTS

Figures 3 and 4 show the initial radiographs on admission and the treatment results of a 7.5-year-old boy.

The treatment results, determined on the basis of the criteria defined according to Flynn (11) and Mitchell (21), are given in table VII.

Table III. — Classification of the fractures according to Gruber (14) and Mitchell (21)

Type	Definition
I	fractures without displacement
II	fractures with lateral displacement
III	fractures with rotation, with or without lateral displacement
IV	fractures with complete displacement, and without contact between the fragments

Table IV. — Radiologic classification and treatment by Dunlop traction with or without reduction (n = 33)

Type	Dunlop traction without reduction	Dunlop traction with reduction
I	0	0
II	0	0
III	11	9
IV	0	13

Table V. — Evaluation of the treatment result by the patient (n = 33)

Result	Description	Number of patients
Very good	no complaints	30
Good	slight complaints no deficit	3
Moderate	slight complaints slight deficit	0
Bad	serious complaints severe deficit	0

Table VI. — Evaluation of the results according to Flynn (11) and Mitchell (21)

Result	Function (loss of flexion-extension)	Change in the carrying angle
Excellent	0- 5°	0- 5°
Good	6-10°	6-10°
Moderate	11-15°	11-15°
Bad	> 15°	> 15°



Fig. 3 a



Fig. 3 b

Fig. 3. — A 7.5-year-old boy with a type IV fracture of the left elbow. An immediate reduction was performed and then Dunlop traction was applied. a. AP view ; b. Lateral view.

Table VII. — Treatment results according to Flynn (11) and Mitchell (21) (n = 33)

Result	Dunlop traction only	Reduction under anesthesia + Dunlop traction	Total
Excellent	4	18	22
Good	5	4	9
Moderate	1	—	1
Bad	1	—	1
Total	11	22	33
Cubitus varus	1 (9%)	0	1 (3%)



Fig. 4 a



Fig. 4 b

Fig. 4. — End result 2 years after treatment. There was normal function and carrying angle in comparison with the normal elbow. A. AP view ; b. Lateral view.

It is striking that there was only 1 patient with a slight cubitus varus deformity ( $4^\circ$  in comparison with the healthy arm, with a neutral axis of  $0^\circ$ ). In this study, this is the only patient in whom the result was judged to be bad. There was 1 moderate result, which arose from a change in the carrying angle of  $12^\circ$  and an increase in the physiologic cubitus valgus from  $6^\circ$  to  $18^\circ$ , while flexion and extension were normal. Both patients had type III fractures, which were both treated by means of Dunlop traction only.

In the nonaffected elbows, the mean carrying angle of the cubitus valgus was  $5.9^\circ$  (ranging from  $0^\circ$  to  $16^\circ$ ). The mean flexion was  $142^\circ$  (ranging from  $135^\circ$  to  $150^\circ$ ), while the mean extension was  $4^\circ$ . In the traumatic elbows, the mean carrying angle was increased by  $1.5^\circ$  to  $7.4^\circ$ . The range varied

considerably between a  $4^\circ$  cubitus varus and a  $20^\circ$  cubitus valgus.

The mean flexion was decreased to  $140^\circ$  (ranging from  $125^\circ$  to  $150^\circ$ ), while the extension was increased to  $5^\circ$  (ranging from  $-15^\circ$  to  $+5^\circ$ ).

## DISCUSSION

It is generally accepted that the conservative approach is the ideal ambulatory treatment method for nondisplaced and minimally displaced fractures (types I and II). Sometimes, it may even be used for displaced fractures, if the swelling is not severe and reduction can be obtained.

However, in case of a serious displacement with severe swelling and/or neurovascular deficiency, the conservative approach consisting of immobi-

lization by means of a plaster cast is not recommended. Moreover, although flexion stabilizes the fracture, it also increases the pressure in the cubital fossa (12, 13, 22, 28). This may reduce the perfusion and enhance a possible neurovascular deficiency. In such cases, it is recommended that the patient be treated with traction, so that he may be closely observed and measures may be taken immediately if necessary.

On the basis of these problems, widely varying treatment methods have been described in the literature. Some authors recommend performing open reduction and internal fixation (14, 16, 20, 31), which is rejected by advocates of a more conservative approach (4, 19, 21, 26). Closed reduction, combined with percutaneous pinning (2, 11, 16, 20, 30) avoids the risk of possible stiffness after an open reduction, but increases the risk of a lesion of the ulnar nerve. Tables I and II give comparison of different conservative and surgical treatment methods. As good results may be obtained with the conservative approach using traction, the surgical approach, with its associated risks, should clearly offer significant advantages over the conservative approach if it is to be considered.

In applying a treatment method, the measurement of the carrying angle, along with close observation of the affected limb is most important. It allows prompt recognition and treatment of possible complications. According to Smith (27), the medial tilt of the small distal fragment is the cause of a cubitus varus deformity. Medial rotation is often accompanied by medial tilt. Rotation predisposes to medial tilt, but does not always cause it and, therefore, does not necessarily lead to a cubitus varus deformity (1, 3, 4, 23, 32).

Clinical and radiological methods enabling evaluation of the alignment during traction, including measurement of Baumann's angle (2) and the method of direct observation (26), have been described. Both methods, however, are not practical. In all forms of treatment in flexion, the carrying angle often cannot be evaluated accurately until complete extension of the elbow is possible. This is achieved only weeks or months after the trauma.

In our follow-up of 33 patients with fractures of degree III and IV, who were treated by means of Dunlop traction in 90° flexion, only 1 case of cubitus varus deformity of 4° (with a neutral axis of 0° on the nonaffected side) was found. In one other patient a change in the carrying angle of 12° was observed (increase in the physiologic cubitus valgus from 6° to 18°).

Any remaining posterior displacement after treatment in traction is corrected by growth and remodeling (4, 19). Remodeling is maximal around and in the plane of motion of a joint. For the elbow, this means that a posterior displacement will be corrected, but that lateral or medial displacements will not.

A posterior displacement of the distal fragment may lead to a limitation in the anterior flexion, but this improves in the course of time by a combination of remodeling and growth. Attenborough (4) called attention to the fact that an obvious residual posterior displacement may be associated with good function. We made the same observation in our group.

Complete flexion is practically always achieved, although recovery may take one year or longer. Since treatment in traction relies in part on the process of remodeling, this treatment method is limited by age. A minimum of 2 years of growth and remodeling must remain in order to be able to correct any residual deformity. Fortunately, these fractures are rare above the age of 12 years.

## CONCLUSIONS

The treatment of severely displaced supracondylar elbow fractures of the extension type in children with Dunlop skin traction is simple, well tolerated, and safe.

It allows easy surveillance and assessment of possible complications, and gives good reproducible results.

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