

Supracondylar Fractures of the Humerus in Children

(Comparative study of the conservative and operative treatment)

Mohammad Arshad, FRCS*

Firoz A Khan, FRCS**

Salem Al-Zahrani, FRCS***

Mamoon Kremli, FRCS***

ABSTRACT

One hundred and five children with displaced extension-type supracondylar fractures of the humerus treated by conservative and operative method were reviewed in this study. Forty nine patients were treated by manipulative reduction and immobilisation in a plaster cast and forty patients had closed reduction and Kirschner wire fixation. The other sixteen patients were treated by open reduction and internal fixation. The results of treatment by these three methods were assessed clinically and compared. After a mean period of 4.6 years (ranged two to eight years) follow up; according to Flynn's clinical grading there were highest percentage (75%) of excellent result achieved by closed reduction and percutaneous K-wire fixation followed by open reduction and internal fixation (61%) and closed reduction and plaster cast (52%). In the light of our experience and of the good results we recommend that percutaneous Kirschner wire fixation is the method of choice in the management of displaced supracondylar fractures of the humerus in children.

Supracondylar fractures of the humerus is the most common injury in children^{1,2}. The extension type accounts for 95% of the fractures^{3,4}. The incidence of deformities in the elbow and the potential neurovascular complications that results from this fracture makes it a serious injury⁴.

The management of severely displaced supracondylar fractures of the humerus is continued to be controversial⁵.

Although the extensive literature on this fracture describe many methods of the treatment, both conservative and operative, it would appear that none of these methods are suitable for all fractures and has gained universal acceptance.

Closed reduction and application of cast is one of the oldest method of treatment⁶. There is concern about the danger and difficulties of this method, specially the risk of Volkmann ischemia⁷ and high incidence of cubitus varus⁸. Closed reduction and fixation with percutaneous Kirschner wires was first described by Swenson⁹, but others also described as a method of choice^{3,10,11}. Open reduction and internal fixation has specific indications mainly for complicated fractures or irreducible fractures¹², but some reports suggested that it may cause permanent loss of movements at elbow^{13,14}.

METHODS

A retrospective study was conducted to evaluate the results of treatment of displaced extension type of supracondylar fractures of the humerus in one hundred and five children admitted to King Khalid University Hospital between January 1982 to December 1990. The patient's

* Orthopaedic Surgeon

** Associate professor and
Consultant Orthopaedic Surgeon

*** Assistant Professor

Division of Orthopaedics (49)
King Khalid University Hospital
Riyadh, Saudi Arabia

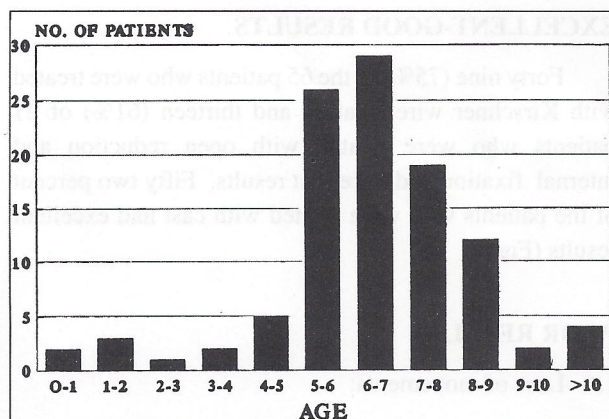


Figure 1: Age Distribution

age range one to fourteen years (mean age 6.2) (Fig 1). There were 73 boys and 32 girls. Eighty three of the injuries were in the left while twenty two were in the right elbow. The severity of the fractures was graded according to the classification of Pirone, et al³. Type I is undisplaced, type IIA is angulated but not displaced, type IIB is partially displaced and type III is completely displaced.

METHODS OF TREATMENT

There are three treatment groups as outlined below.

Group 1: Forty nine children in this group were treated by manipulated reduction under anaesthesia and immobilisation in a plaster cast for three to four weeks. Forty patients had type II (30 type IIA and 10 IIB) while nine had type III fractures. The forearm was placed in pronation regardless of displacement in anteroposterior projection. In twenty patients the position of reduction was lost in an average one week time; subsequently fifteen of these patients had closed reduction and K-wire fixation, while the others five underwent open reduction.

Group 2: In this group forty patients were treated by closed reduction and percutaneous Kirschner wire fixation. Out of these 15 patients had insertion of two K-wires from lateral side but in five patients the position was lost, then the operation was revised and cross wires were passed. The remaining 25 patients had insertion of crossed medial lateral K-wires. Thirty one patients were classified to have type II (5 type IIA and 26 type IIB fractures while 9 had type III fractures). The arm was protected in a posterior slab for three weeks postoperatively. The wires were left

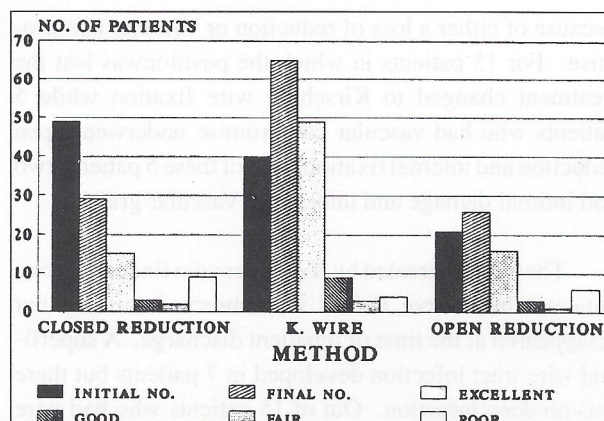


Figure 2: No. of patients and results

under the skin and removed as an outpatient in three weeks time.

Group 3: There were 16 patients in this group who had open reduction and internal fixation. This treatment was reserved for type III fractures or in type II fracture where adequate reduction could not maintain in a cast. The surgical approach was lateral in all cases. The fracture was reduced under direct vision and fixed with percutaneous crossed K-wires.

VASCULAR INJURIES

There was concern about circulation in thirty one patients (28%). In twenty nine patients the pulse returned after reduction of the fracture but in two cases immediate exploration of the brachial artery was done. The intima was found to be damaged and primary vascular graft was applied.

FOLLOW-UP

The range of follow up was from two to eight years (mean 4.6 years). At the follow up all the patients were assessed clinically; for the restriction of motion, appearance of elbow, carrying angle and the arc of flexion-extension of both the injured and uninjured elbow, and radiologically for myositis ossificans.

RESULTS

EARLY COMPLICATIONS

There were few complications specific to each method of treatment. Of the 49 patients who were in treatment group 1, 20 required change in the management

because of either a loss of reduction or vascular compromise. For 15 patients in which the position was lost the treatment changed to Kirschner wire fixation while 5 patients who had vascular compromise underwent open reduction and internal fixation. Out of these 5 patients two had intimal damage and underwent vascular graft.

The patients treated by Kirschner wire fixation, in one patient Ulnar nerve deficit was observed initially but disappeared at the time of inpatient discharge. A superficial wire tract infection developed in 7 patients but there was no deep infection. Out of 15 patients who had wire inserted from lateral side, 5 showed loss of position and the procedure was revised and changed to cross wires.

The patients treated by open reduction and internal fixation initially had no problems such as wound healing or infection but one patient had temporary paraesthesia in the distribution of radial nerve.

LATE OUTCOME

Table 1
Criteria for grading results (15)

Result	Loss of carrying angle	Loss of motion
Excellent	0 - 5	0 - 5
Good	6 - 10	6 - 10
Fair	11 - 15	11 - 15
Poor	> 15	> 15

The results of treatment were assessed using the criteria of Flynn, et al¹⁵ (Table 1). Flynn clinical gradings of the 105 children reviewed are shown in Table 2.

Table 2
Review of Flynn clinical grading

Method of treatment	Initial numbers	Final numbers	Excellent (%)	Good (%)	Fair (%)	Poor (%)
Closed reduction and cast	49	29	15(51)	3(10)	2(3)	9(31)
K-wire fixation	40	65	49(75)	9(13)	3(4)	4(6)
Open red and internal fixation	16	21	13(61)	3(14)	1(4)	4(19)

EXCELLENT-GOOD RESULTS

Forty nine (75%) of the 65 patients who were treated with Kirschner wire fixation and thirteen (61%) of 21 patients who were treated with open reduction and internal fixation had excellent results. Fifty two percent of the patients who were treated with cast had excellent results (Fig 2).

POOR RESULTS

1. Loss of movements:

Five patients treated by cast were graded as poor because of restriction of their flexion-extension arc more than 15 degrees.

Three patients who had Kirschner wire fixation presented with a restriction of Flexion-Extension arc by 16 degrees. These patients had revision of procedure because of loss of initial position.

Five patients treated by open reduction and internal fixation had a poor result because of restriction of Flexion-Extension arc by 16 degrees. These patients initially treated by plaster cast and later had open reduction.

2. Cubitus Varus

Four patients treated by cast had poor results attributable to Cubitus varus of 8,10,10 and 15 degrees. One patient treated by Kirschner wire had Cubitus varus of 12 degrees. This patient had revised surgery. In a group treated by internal fixation one patient developed Cubitus varus of 14 degrees.

DISCUSSION

The management of displaced supracondylar fractures of the humerus remain controversial⁵. The avoidance of complications and achievement of excellent functional and cosmetic results are the goals of treatment. Any management of displaced supracondylar fracture of the humerus should achieve these aims.

Pirone, et al³ showed 51% of excellent results achieved by closed reduction which are similar to our results (52%). Out of forty nine, twenty (40%) patients lost the reduction in first week because of the swelling of elbow within the cast.

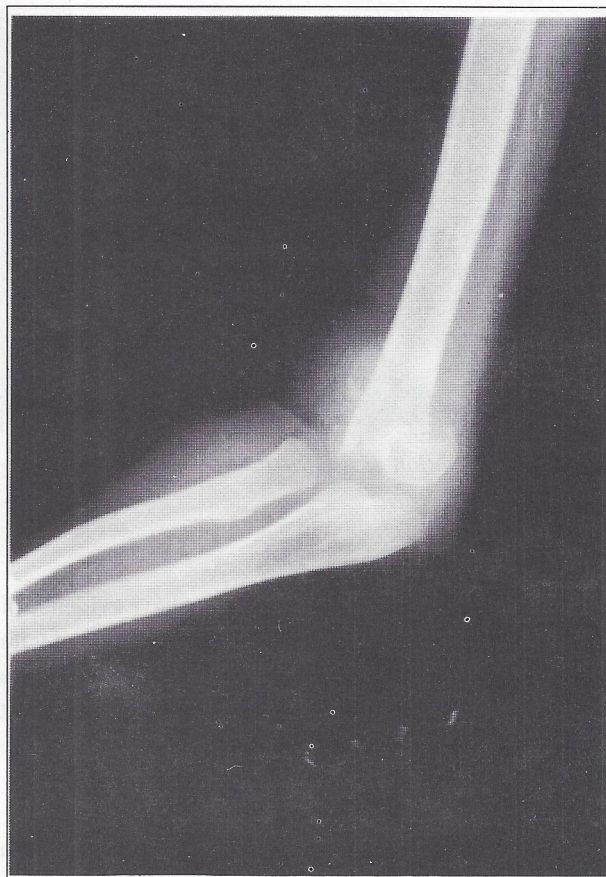


Figure 3 (A & B): Anterio-posterior and lateral view of supracondylar fracture of humerus

In elbow plaster, it is difficult to get true lateral view and any movement of the arm might displace the fracture. It is advisable to move the C arm of X ray machine for lateral view rather than moving the elbow.

The main force stabilising the fracture are flexion and full pronation¹⁷. If the amount of flexion is not enough because of fear of impairment of the circulation the reduction will be lost. This is the "Supracondylar dilemma", flexion stabilises the fracture but compromises the circulation⁷. The poorest functional and cosmetic results in our series were in patients who had treatment by cast (31%). Four patients (13%) developed cubitus varus. Piggot, et al⁸ reported incidence of 25 percent of cubitus varus in patients treated by closed reduction and cast, while in other series it ranged from 4% to 58% with an average of 30 percent¹⁷⁻²⁰. The average carrying angle in boys is 5.4 (range 0 to 11) and in girls 6.1 (range 0 to 12)¹⁹.

Initially it was thought that the residual medial displacement of the distal fragment, or epiphyseal disturbance or failure to correct medial rotation of the distal fragment was responsible for producing the cubitus varus²¹ but the,

latest and the most accepted view is that varus tilt of the distal fragment produces the cubitus varus deformity^{19,20}. Varus tilt is difficult to assess on X ray and error of alignment of 5 to 10 degree is sufficient to cause cubitus varus. The incidence of cubitus varus in our series is minimum in group of patients treated by percutaneous wires (1.5%). This support the evidence that fracture required to be stabilised by some means to avoid any minimal tilt of the distal fragment. This could successfully be achieved by Kirschner wires after anatomical reduction.

In this study 65 patients (59%) had percutaneous fixation and excellent results achieved in 75%, which is similar to other reports^{3,10,11,15,21}. Fifteen patients had insertion of wires through lateral condyle while rest of the patients had crisscross wires through lateral and medial epicondyle respectively. Four patients who had insertion of wires from lateral side lost the position and underwent revised surgery in the form of percutaneous crisscross Kirschner wires. In these cases the fractures were of grade III and fixed with two wires which were not long enough to engage the opposite cortex and also they were not parallel to the lateral condyle. In 50 patients who had

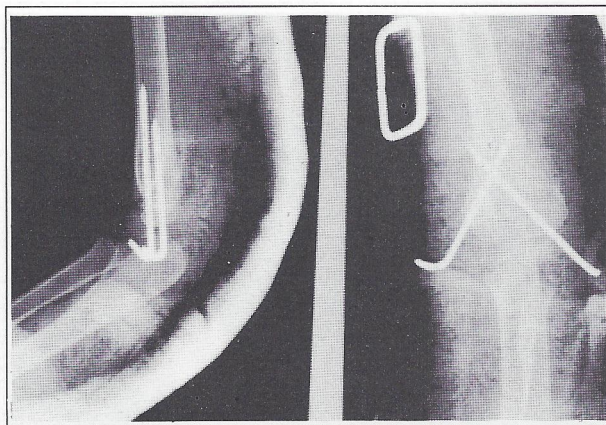


Figure 4: Fixation of the fracture by percutaneous K-wire

percutaneous cross wire fixation did not have evidence of loss of position of fracture. Two patients presented with neuropraxia along the distribution of ulnar nerve which disappeared within a week. This method of treatment allows to keep the elbow in optimal flexion without any risk of displacement.

The open reduction and internal fixation has been recommended by some authors^{8,16} but is blamed to cause severe stiffness¹. However this is mainly caused by posterior approach⁷. Archibald, et al⁵ showed 79% excellent results by open reduction through medial incision and transarticular pinning; Sibly, et al¹⁴ reported loss of movement in 60% of the open reduction groups and 42% of the closed reduction group. In our series 17% of the patients developed loss of movement treated by closed reduction and 19% treated by open reduction. The high proportion of children in the open reduction group suffering loss of movement may be due to the severity of the initial soft tissue injury and period of immobilisation. These patients usually had attempts of closed reduction before open reduction. There was no case of myositis ossificans in our patients.

CONCLUSION

In the light of our experience and the results of this study, we recommend that all displaced fractures (type II and III) in children may be better managed by closed reduction and percutaneous Kirschner wire fixation; preferably crossed medial and lateral wires. If two lateral wires are used; they should be parallel and engaged the opposite cortex.

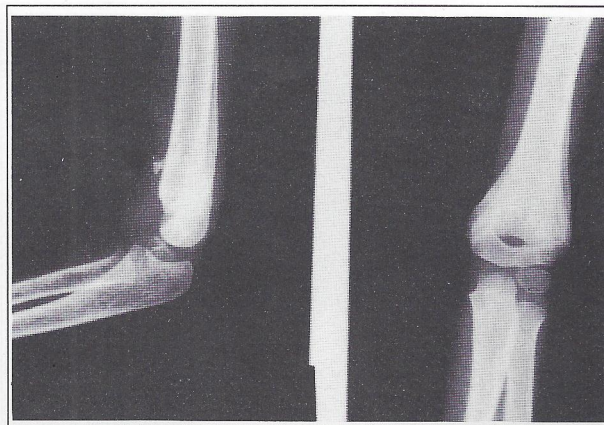


Figure 5: Six months post operative showing excellent results

REFERENCES

1. Blount WP. Fractures in Children. Baltimore: Williams and Wilkins, 1955.
2. Wilkins KE. Fractures and dislocation of elbow region. In: Rockwood CA Jr, Wilkins KE, King RE, eds. Fractures in Children. Vol. 3. Philadelphia: JB Lippincott, 1984:363-575.
3. Pirone AM, Graham HK, Krajchich JJ. Management of Displaced Extension-Type Supracondylar Fractures of the Humerus in children. J Bone Joint Surg 1988;70A:641-50.
4. Tachdjian MO. Paediatric Orthopaedics. Vol 3. Philadelphia: WB Saunders, 1990:3085.
5. Archibald DAA, Roberts JA, Smith MG. Transarticular Fixation for Severely Displaced Supracondylar fractures in Children. J Bone Joint Surg 1991;73B:147-9.
6. Charnley J. The Closed Treatment of Common Fractures. 3rd ed. Edinburgh: E & S Livingstone, 1961.
7. Mercer R. Children Fractures. 2nd ed. Philadelphia: JB Lippincott, 1983.
8. Piggot J, Graham HK, McCoy GF. Supracondylar Fractures of the Humerus in Children. Treatment by straight lateral Traction in children. J Bone Joint Surg 1978;60A:653-6.
9. Swenson AL. The treatment of Supracondylar fracture of the Humerus by Kirschner Wire Transfixation. J Bone Joint Surg 1948;30A:993-7.
10. Jones KG. Percutaneous Pin Fixation of fractures of the Lower End of Humerus. Clin Orthop 1967;50:53-69.
11. Fowles JV, Kassab MT. Displaced Supracondylar Fractures of the Elbow in Children. A Report on the Fixation of Extension and Flexion Fractures by Two Lateral Percutaneous Pins. J Bone Joint Surg 1974;56B:490-500.
12. Walloe A, Egund N, Ekelund L. Supracondylar Fracture of Humerus in Children. Review of Closed and Open Reduction leading to a proposal for treatment. Injury 1985;16:296-9.

13. Gruber MA, Hudson OC. Supracondylar Fractures of the Humerus in childhood. *J Bone Joint Surg* 1964;46A:1245-455.
14. Sibly TF, Briggs PJ, Gibson MJ. Supracondylar fractures of the humerus in childhood: range of movement following the posterior approach to open reduction. *Injury* 1991;22:456-8.
15. Flynn JC, Mathews JG, Benoit RL. Blind pinning of displaced Supracondylar Fractures of the Humerus in Children. *J Bone Joint Surg* 1974;56A:263-72.
16. Furrer M, Mark G, Ruedi T. Management of displaced Supracondylar fractures of the humerus in children. *Injury* 1991;22:259-62.
17. Khare GN, Gautam VL, Kochhar VL, Anand C. Prevention of cubitus varus deformity in supracondylar fractures of the humerus. *Injury* 1991;22:202-6.
18. Hoyer A. Treatment of Supracondylar Fractures of the Humerus by skeletal traction in abduction splint. *J Bone Joint Surg* 1952;34A:623-7.
19. Smith KL. Deformity following Supracondylar Fractures of the Humerus. *J Bone Joint Surg* 1960;42A:235-52.
20. Louvelle H, Bunnell WP, Duhaime M, et al. Cubitus Varus deformity following Supracondylar Fractures of the Humerus in Children. *J Pediatr Orthop* 1962;2:539.
21. Madsen F. Supracondylar Fractures of the Humerus in Children. *J Bone Joint Surg* 1955;37B:241-5.