

A COMPARATIVE STUDY OF LATERAL APPROACH VERSUS POSTERIOR APPROACH FOR THE SURGICAL TREATMENT OF SUPRACONDYLAR FRACTURES OF THE HUMERUS IN CHILDREN

A. ENSAFDARAN, M.D., M.J. EMAMI, M.D.,
AND M. BORGHEI, M.D.

From the Department of Orthopedic Surgery, Shiraz University of Medical Sciences, Shiraz, I.R. Iran.

ABSTRACT

Background: Supracondylar fracture of the humerus is the second most common fracture in children. For most cases closed reduction and percutaneous crossed pinning is recommended. Those patients who had previously undergone an unsuccessful closed reduction trial need open reduction and pin fixation, but the best surgical approach is questionable. Most surgeons apply the technique of posterior or lateral approach.

Methods: To compare the results of these two classical techniques, in a prospective study, 40 pure closed noncomplicated supracondylar fractures of the humerus (under 10 years old), after failure of closed reduction, were randomized into 2 groups, 20 cases in each series, and operated by a single surgeon. The first group was operated by posterior approach. There were 12 boys and 8 girls, with average age of 5 years (range 3-10). Their fractures were reduced and fixed by two crossed pins. The second group was operated by lateral approach. There were 14 boys and 6 girls, with average age of 6 years (range 4-10), whose fractures were reduced and fixed by two lateral pins. Both groups were immobilized in a long arm posterior slab in 80 degrees of elbow flexion. The sutures were removed after 2 weeks, and the pins were removed after 3 weeks and active motion begun. Then after 6 months follow up, the results were determined according to Lagrange – Rigault range of motion.

Results: In group 1: 70% (14 patients) were excellent, 20% (4 patients) good, 10% (2 patients) poor results. In group 2: 85% (17 patients) were excellent, 15% (3 patients) good, and no poor or bad results. There was a significant difference between groups 1 and 2 ($p < 0.05$) for post-operation range of motion. There was no deep infection, myositis ossificans or compartment syndrome.

Conclusion: The lateral approach appears to provide good long-term functional results.

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Correspondence: A. Ensafdaran, Department of Orthopedic Surgery, Shahid Chamran Hospital, Tel: +98-711-6246093, Fax: +98-711-6231409, ensaf@yahoo.com

INTRODUCTION

Supracondylar fracture of the humerus is the second

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most common fracture in children.¹ Gartland has classified these fractures into three types. Type I is a nondisplaced fracture. In type II there is an obvious fracture line with displacement of the distal fragment but there is still an intact posterior cortex and type III has a circumferential break in the cortex with complete displacement of the fracture fragments.² In the extension type, the distal fragment has displaced posteriorly and in the flexion type it has displaced anteriorly. The most frequent complications are limitation of motion of the elbow joint and cubitus varus.^{3,4}

Insufficient reduction of type III fractures may lead to varus deformity and inappropriate surgical technique also may lead to limitation in the range of motion.^{5,6}

The purpose of this study was to consider the surgical treatment of type III fractures and to compare the posterior approach with the lateral approach of surgery in two homogenous groups of 20 cases in each series.

MATERIAL AND METHODS

40 closed, pure, noncomplicated supracondylar fractures of the humerus in children under 10 years, after failure of closed reduction, were randomly operated by two different surgical approaches, (20 cases in each group). The two series were operated by a single surgeon.

Group 1: Posterior approach

The average age of cases in this group was 5.5 years (3-10 years). There were 12 boys and 8 girls, projecting a male predominance. The fractures involved 11 left and 9 right elbows. The patients with other injuries were not included in this study, so all of the cases were isolated fractures. The mechanism of injury was falling down in 18 and motor vehicle accident in 2.

Group 2: Lateral approach

The average age of the patients was 6 years (4-10 years). There were 14 boys and 6 girls representing a clear male predominance. The fractures involved 13 left and 7 right elbows. The mechanism of the trauma in this group was falling down in 17 and sport injury and motor vehicle accident in 3 patients.

Operative technique in group 1

Under general anesthesia, in decubitus position, by a midline posterior skin incision, the triceps muscle was split longitudinally and after exposure of the fracture site it was reduced and fixed by crossed pins, one in each column. The ulnar nerve was sometimes explored and retracted medially. The muscle and fascia were closed

by interrupted vicryl sutures. The subcutaneous tissue was also closed by vicryl and the skin by interrupted nylon sutures.

A posterior long arm splint in 80° of elbow flexion and neutral rotation of forearm was applied. Roentgenograms were made intra-operatively. After 2 weeks the sutures were removed and three weeks later the pins were removed and active motion of the elbow begun.

Operative technique in group 2

The patients in this group were operated in supine position. An incision was made over the lateral epicondyle to 5-6cm proximally and 4-5cm distally. After dissection between the triceps muscle and the origin of the brachioradialis, the fracture site was exposed, and open reduction was performed and fixed by two parallel K wires in the lateral column. Wound closure and post-operative care was similar to the first group.

The patients had 5 postoperative follow ups:

A- 2 weeks after surgery for removal of sutures.

B- 3 weeks after surgery for removal of the pins and beginning of active motion.

C- 6 weeks after surgery

D- 12 weeks after surgery.

E- 6 months after surgery for determination of elbow mobility

RESULTS

There was no major postoperative complication like compartment syndrome, neurovascular injury, deep wound infection or myositis ossificans. Three patients experienced pin site infection that resolved by oral antibiotics and after removal (two in group 1, one in group 2). The results were evaluated after 6 months according to Lagrange-Rigault's range of motion scale: Excellent result= normal elbow; Good result=a slight deficiency in mobility < 10 degrees in flexion and extension, 20 degrees in all; Poor result= a mobility deficiency of > 20 degrees; and Bad result=a mobility deficiency of > 50 degrees.

Group 1

There was no delayed union or non-union, or secondary displacement. Patients had an average hospital stay of 4 days. The results are summarized in Table I.

14 patients enjoyed excellent results, 4 experienced good results and 2 exhibited cubitus varus of less than 10°. Poor results were observed in two patients, who experienced limitation of motion more than 20°.

Group 2

No delayed union or non-union was seen. The pa-

Table I. Mean range of motion of elbow in group 1.

| Mean range of motion | 6 weeks | 12 weeks | 6 months |
|----------------------|------------------|------------------|------------------|
| Flexion | 118 ⁰ | 125 ⁰ | 136 ⁰ |
| Arc of motion | 88 ⁰ | 110 ⁰ | 131 ⁰ |
| Flexion contracture | 30 ⁰ | 15 ⁰ | 5 ⁰ |

Table II. Mean range of motion of the elbow in group 2.

| Mean range of motion | 6 weeks | 12 weeks | 6 months |
|----------------------|------------------|------------------|------------------|
| Flexion | 125 ⁰ | 133 ⁰ | 140 ⁰ |
| Arc of motion | 100 ⁰ | 123 ⁰ | 136 ⁰ |
| Flexion contracture | 25 ⁰ | 10 ⁰ | 4 ⁰ |

Table III. Late results in the two groups.

| | Group 1: Post. approach | Group 2: Lat. approach |
|-----------|--------------------------------|-------------------------------|
| Excellent | 14 (70%) | 17 (85%) |
| Good | 4 (2 cubitus varus <100) (20%) | 3 (1 cubitus varus <100)(15%) |
| Poor | 2 (10%) | 0 |
| Bad | 0 | 0 |

tients had an average hospital stay of 4 days. The results are summarized in Table II.

17 patients enjoyed excellent results, 3 experienced good results, and no poor or bad results were seen. So as mentioned above and shown in Tables (I, II and III), the appearance of the extremity was normal in 18 patients in group 1 with 2 cubitus varus of less than 10 degrees and 19 patients in group 2 with 1 cubitus varus of less than 10 degrees.

DISCUSSION

The standard method of treatment for supracondylar fracture of the humerus in children is closed reduction and percutaneous pinning.⁸ When the reduction is not acceptable, open reduction is required and controversy exists about which approach to apply. The most commonly used techniques are the posterior and lateral approach. Some surgeons use the anterior or medial approach. Reitman and Waters indicate that highly satisfactory results can be obtained with the posterior approach.⁹ Gennari et al. had 87% excellent results with the anterior approach.⁷

Comparison of the two groups in this study shows that although exposure of the fracture site is more difficult in the lateral approach, the results are more accept-

able than the posterior approach (Table III), as in the posterior approach the intact posterior structures will be damaged and lead to decreased range of motion, additional trauma and poor results. We had 70% excellent, 20% good, and 10% poor or bad results with the posterior approach. The advocates of the lateral approach operate through the site in which the periosteal hinge is torn.^{11,28,29} We had 85% excellent, 15% good, and no poor or bad results with the lateral approach. There were significant differences between group 1 and 2 ($p < 0.05$) for postoperative range of motion. A higher number of cubitus varus was observed with the posterior compared to the lateral approach.

Advocates of the posterior approach are more numerous.¹² However for more than 20 years, the percentage of excellent and good results with the posterior approach has not increased.¹¹ Because this approach injures the extension apparatus unnecessarily, it commonly results in an important limitation of extension. The rate of iatrogenic ulnar nerve injury in the posterior approach has been reported differently.^{12,13} Rose and Phillips revealed 10 ulnar nerve palsies in 141 supracondylar fractures postoperatively by the posterior approach. In a study by Srivastava,¹⁵ a total of 42 cases with displaced supracondylar fracture were treated by the posterior approach. An excellent outcome was seen

in 81% and a good outcome in 17%. The incidence of complications such as pin tract infection (14%), and nerve injury (2%) was very low. None of the patients had vascular complications or myositis ossificans. In a study by Ogunlade,²⁵ a total of 28 children with severely displaced supracondylar fractures of the humerus were operated using the posterior approach. 71.4% could flex the elbow joint beyond the 120° angle and only 10.7% had 15 degrees of extension lag at the elbow joint after six months. In this study we had no neurovascular complication after surgery. We had 70% excellent, 20% good and 10% poor results. In a study by Kumar¹ 44 children with type three supracondylar fracture were treated with primary open reduction and cross pinning. After treatment the range of motion of the elbow was restricted in eight patients (19%). Cubitus varus was not seen. There was no deep infection or myositis ossificans. Five children had temporary ulnar nerve palsy (11%). With the posterior approach we did not have any nerve palsy, and restriction of motion was only 10%. As reported by Davis¹⁷ retrospective analysis was performed on 87 children treated operatively for type two and three supracondylar humeral fracture by 18 different surgeons during a 6-year period. Long-term results were excellent in 56%, good in 21%, fair in 3%, and poor in 21% of patients. They had 13% cubitus varus deformity of more than 10 degrees. Our results are much better than those of the above-mentioned study. Their poor results could be due to a large number of surgeons.

Those who do not use the lateral approach claim that the lateral pin does not provide good stability. Studies by Skaggs,^{18,22} Solak,¹⁹ Onwuanyi,²⁰ and Gordon²¹ showed that the lateral pin gave good stability of the fracture site. In a study by Skaggs,²² 124 displaced supracondylar humeral fractures were fixed by closed reduction and lateral pin. There was no loss of reduction, no cubitus varus or loss of motion. In our study we did open reduction and lateral pin fixation, but our results are close to those of this report. In a study by Mazda²³ 116 displaced extension supracondylar fractures were treated by closed reduction and two lateral pins. The clinical result was considered to be excellent in 91.6%, good in 4.6% and poor in 3.7%. Our result with open reduction was excellent in 85%, and good in 15%, with no poor or bad results. A retrospective review of 115 children treated for displaced supracondylar humeral fracture was conducted by Mehlman.²⁴ Sixty percent were treated with a cross K-wire after closed reduction, another 30% received two lateral pins. The remaining 10% were treated with a variety of other pin configurations. Eighty-three percent had good or excellent results. 14% had fair results, and 3% had poor results. In our cases with open reduction, the results were better than those

of this study. As stated by Scola²⁶ 22 children were treated by dorsolateral approach, showing 72.2% excellent, 18% good, and 4.4% fair results. Our results are more favourable than those of this study. In a study by Siemers²⁷ in an 11 year period, from 01/08/1987 to 31/08/1998, a total of 72 children with displaced supracondylar humeral fractures were reduced openly via a single lateral approach. They had excellent and good results with no poor or bad results in their cases. Our study showed similar results. The non-dominant side was involved more and had male predominancy like the literature.³

After comparison of the results from the two series in this study, we propose the lateral approach as a good alternative to the posterior approach with lesser complications and better long term functional results.

REFERENCES

1. Kumar R, Kiran EK, Malhotra R, Bhan S: Surgical management of the severely displaced supracondylar fracture of the humerus in children. *Injury* Jul 33(6): 517-22, 2002.
2. Barton KL, Kaminky CK, Green DW, Shean CJ, Kautz SM, Skaggs DL: Reliability of modified Gartland classification of supracondylar humerus fracture. *J Pediatr Orthop* Jan-Feb 21 (1): 27-30, 2001.
3. James HB, James RK: Supracondylar fractures of humerus (Chapter 14). In: Rockwood's Fractures in Children. 5th ed, Lippincot-Raven, 2001.
4. Charles TP, Dennis PD: Management of fractures. In: Lovell and Winter's Pediatric Orthopaedics. 5th ed, Williams and Wilkins, 2000.
5. Labelle H, Bunnell WP, Duhaime M, Poitras B: Cubitus varus deformity following supracondylar fractures of the humerus in children. *J Pediatr Orthop* 2(5): 539-46, 1982.
6. Devain AS: Lateral closing wedge supracondylar osteotomy of humerus for post-traumatic cubitus varus deformity in children. *Injury* Nov-Dec, 28(9-10): 643-7, 1997.
7. Gennari JM, Merrot T, Piclet B, Bergoin M: Anterior approach versus posterior approach to surgical treatment of children's supracondylar fractures: comparative study of thirty cases in each series. *J Pediatr Orthop B* Oct 7(4): 307-13, 1998.
8. Kaewpornawan K: Comparison between closed reduction with percutaneous pinning and open reduction with pinning in children with closed totally displaced supracondylar humeral fractures *J- Pediatr Orthop- B*. Apr 10(2):131-7, 2001.
9. Reitman RD, Waters P, Millis M: Open reduction and internal fixation for supracondylar humerus fractures in children. *J-Pediatr Orthop* Mar-Apr; 21 (2): 157-61, 2001.
10. Srivastava S: The results of open reduction and pin fixation in displaced supracondylar fractures of the humerus in children. *Med J Malaysia* Sep 55 Suppl C: 44-8, 2000.

11. Weiland AJ, Meyer S, Tolo VT, Berg HL, Mueller J: Surgical treatment of displaced supracondylar fracture of the humerus in children. *J Bone Joint Surg Am* Jul 60(5): 657-61, 1978 .
12. Ristic S, Strauch RJ; Rosenwasser MP: The assessment and treatment of nerve dysfunction after trauma around the elbow. *Clin-Orthop* Jan (370): 138-53, 2000.
13. Lyons ST, Quinn M, Stanitski CL: Neurovascular injuries in type III humeral supracondylar fractures in children. *Clin- Orthop* Jul (376): 62-7, 2000.
14. Rose RE, Phillips W: Iatrogenic ulnar nerve injury post pinning of displaced supracondylar fractures of the humerus. *West Indian Med J* Mar 51(1): 17-20, 2002.
15. Srivastava S: The results of open reduction and pin fixation in displaced supracondylar fractures of the humerus in children. *Med J Malaysia* Sep 55 Suppl C: 44-8, 2000 .
16. Aronson DC, van Vollenhoven E, Meeuwis JD: K-wire fixation of supracondylar humeral fractures in children: results of open reduction via a ventral approach in comparison with closed treatment. *Injury* Mar 24 (3): 179-81, 1993.
17. Davis RT, Gorczyca JT, Pugh K: Supracondylar humerus fractures in children. Comparison of operative treatment methods. *Clin Ortho* Jul (376): 49-55, 2000.
- 18-Skaggs DL, Hale JM, Bassett J, Kaminsky C, Kay RM, Tolo VT: Operative treatment of supracondylar fractures of the humerus in children. The consequences of pin placement. *J Bone Joint Surg Am* May 83-A(5): 735-40, 2001.
19. Solak S, Aydin E: Comparison of two percutaneous pinning methods for the treatment of the pediatric type III supracondylar humerus fractures. *J Pediatr Ortho B* Sep 12(5): 346-9, 2003 .
20. Onwuanyi ON, Nwobi DG: Evaluation of the stability of pin configuration in K-wire fixation of displaced supracondylar fracture in children. *Int Surg* Jul-Sep 83(3): 271-4, 1998.
21. Gordon JE, Patton CM, Luhmann SJ, Bassett GS, Schoenecker PL: Fracture stability after pinning of displaced supracondylar humerus fracture in children. *J Pediatr Orthop* Sep-Oct 22(5): 697-8, 2002.
22. Skaggs DL, Cluck MW, Mostofi A, Flynn JM, Kay RM: Lateral pin entry fixation in the management of supracondylar fractures in children. *J Bone Joint Surg Am* Apr 86-A(4): 702-7, 2004.
23. Mazda K, Boggione C, Fitoussi F, Pennecot GF: 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* Aug 83(6): 888-93, 2001 .
24. Mehlman CT, Crawford AH, McMillion TL, Roy DR: Operative treatment of supracondylar fractures of the humerus in children: the Cincinnati experience. *Acta Ortho Belg* 62 Suppl 1: 41-50, 1996.
25. Ogunlade SO, Alonge TO, Omololu AB, Salawu SA: The surgical management of severely displaced supracondylar fracture of humerus in childhood. *Niger Postgrad Med J* Dec 11(4): 258-61, 2004.
26. Scola E, Jezussek D, Kerling HP, Yedibela S: Dislocated supracondylar humerus fracture in the child. Surgical technique and outcome with dorsolateral approach. *Unfallchirurg* Feb 105(2): 95-8, 2002.
27. Siemers F, Obertacke U, Fernandez ED, Olivier LC, Neudeck F: Combination of ipsilateral supracondylar humeral and forearm fractures in children. *Zentralbl-chir* Mar 127(3): 212-7, 2002.
28. Ozkoc G, Gonc U, Kayaalp A, Teker K, Peker TT: Displaced supracondylar humeral fractures in children: open reduction vs. closed reduction and pinning. *Arch Orthop Trauma Surg* Oct 124(8): 547-51, 2004.
29. Fleoriau-Chateau P, McIntyre W, Letts M: An analysis of open reduction of irreducible supracondylar fracture of the humerus in children. *Can J Surg* 41: 112-118, 1998.

