

Retrospective Review of Kirschner Wire Fixation and Casting for Displaced Lateral Condylar Fracture of the Humerus in Children

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ABSTRACT

This study was conducted to assess the optimum period for Kirschner wire fixation and cast immobilization for displaced lateral condylar fracture of the humerus in children. We retrospectively reviewed 12 patients with displaced lateral condyle humerus fracture, ranging in age from 3-9 y, with injuries that occurred between Jan 2005 and Dec 2006. All patients were treated with two Kirschner wire fixation and elbow immobilization. In all except 2 patients, the Kirschner wires were maintained for 3 to 4 weeks. Mean time for union was 3.78 weeks and mean humeroulnar arch motion at last review was 138.7 degrees. Only one patient had a 5 degree increased carrying angle in valgus as compared to the non-injured side, and 50% had prominent scars > 4mm. We conclude that fracture union can be expected within three to four weeks for most children after open reduction and fixation with 2 Kirschner wires.

Key Words:

Lateral condyle, humerus, pediatric fracture healing

INTRODUCTION

Fractures of the lateral condyle of the humerus account for 10%-15% of all elbow fractures in children^{1,2}. These include Salter Harris type 2 and type 4 growth plate injuries in which the fracture crosses the distal humeral growth plate and enter the elbow joint³. Several different modalities of treatment have been described for the treatment of this problem. For undisplaced or minimally displaced fracture of less than 2mm^{4,5}, cast immobilization with weekly radiographic follow up has been the recommendation of choice. However, the risk for subsequent displacement of the fracture has been reported to range from 11% to 42%.

A well accepted option for displaced elbow fractures is open reduction with 3-8 weeks of Kirschner wire fixation and elbow immobilization⁶. Nonunion is a common problem in fractures of the lateral humeral condyle^{7,8}. Some clinicians recommend that the implants should not be removed until

fracture healing can be demonstrated in anteroposterior, lateral and oblique radiographs, meaning an average of six or more weeks⁷. When deciding on timing for implant removal, stability of the fracture site must be weighed against the risks pin tract complications such as infections. In our centre (Seberang Jaya Hospital), the usual treatment for displaced lateral condyle fractures of the humerus in children is open reduction, 2 Kirschner wire fixation and elbow immobilization for approximately 3 to 4 weeks. This duration of treatment is similar to the treatment period for pediatric fractures of the distal humerus⁹.

This study was undertaken to analyze the clinical and radiological outcomes of shorter immobilization periods for children with displaced fractures of the lateral condyle of the humerus at Seberang Jaya Hospital in Malaysia.

MATERIALS AND METHODS

This was a retrospective study of 12 children who were admitted with displaced fracture of the lateral condyle of the humerus between 2005 to 2006 at Seberang Jaya Hospital in Penang, Malaysia. Fractures were classified using the Milch classification system: Type I (n = 9) in which the fracture line traversed the ossific nucleus of the lateral condyle or Type II (n = 3) where fractures exited through the trochlea¹⁰. Fractures were also classified according to the degree of displacement based on Stanley's classification, a modification of the classification developed by Jacob *et al*¹¹. Stage I displacement (CRACK) is one in which the injury is a stable fracture that can be treated with a cast alone (less than 2mm displacement). Stage II displacement (GAP) is a fracture with a significant lateral gap indicating the fragment has undergone some rotation and is unstable. Stage III displacement (FLIP) is a fracture with complete rotation of the condylar fragment.

Surgery for patients were scheduled on an emergency basis. A lateral approach to the distal humerus using the interval between the brachioradialis and the extensor carpi radialis

Table I: Demographic information and fracture descriptions of 12 pediatric patients with lateral humeral condylar fracture

| Case | Classification | | Duration of K wire maintenance | Range of motion | | Carrying angle | |
|------|----------------|---------|--------------------------------|------------------|--------------|------------------|--------------|
| | Milch | Stanley | | Non-injured Side | Injured Side | Non-injured Side | Injured Side |
| A | I | III | 27d | 0 – 140 | 0 – 140 | 7 | 7 |
| B | I | II | 21d | 0 – 145 | 0 – 145 | 7 | 8 |
| C | II | III | 23d | 0 – 145 | 5 – 135 | 7 | 12 |
| D | I | III | 42d | 0 – 145 | 0 – 145 | 7 | 8 |
| E | II | III | 27d | 0 – 145 | 0 – 145 | 8 | 9 |
| F | II | III | 40d | 0 – 140 | 0 – 140 | 8 | 8 |
| G | I | III | 21d | 0 – 140 | 0 – 130 | 7 | 7 |
| H | I | III | 28d | 0 – 140 | 0 – 140 | 7 | 8 |
| I | I | III | 22d | 0 – 145 | 0 – 145 | 8 | 9 |
| J | I | II | 25d | 0 – 140 | 0 – 140 | 7 | 7 |
| K | I | III | 21d | 0 – 140 | 5 - 135 | 7 | 6 |
| L | I | III | 23d | 0 -145 | 0 – 135 | 8 | 8 |

longus anteriorly and the triceps posteriorly was performed under general anaesthesia and tourniquet. Considering the blood supply to this area, minimal posterior dissection of the soft tissue from the distal fragment was used to reduce the risk of avascular necrosis of the capitellum. The joint surface was accurately reduced under direct vision and 2 convergent Kirschner wires were inserted. After wound closure, the elbow was supported in plaster backslab. Kirschner wires were not buried under the skin.

Patient status was reviewed at 3 weeks after surgery, initial cast was removed and radiographs were evaluated for presence of bone healing. Radiographic criteria for a healed fracture consisted of callus across the fracture site in antero-posterior and lateral radiographic views of the elbow. If callus formation was visible radiographically, Kirschner wires were removed and active mobilization of the elbow without a cast was allowed. The cast was reapplied in those patients who failed to fulfil the radiographic criteria. Such patients were then regularly re-examined for radiographic evidence of union.

Demographic data, the mechanism of injury, duration of Kirschner wire fixation, fracture healing and post-operative complications were recorded from medical records and radiographs. Outcomes and complications were also evaluated, including carrying angles measurements, range of motion of both elbows and radiographic evidence of bone healing, avascular necrosis, overgrowth, malunion and non-union. The width of the scars was also determined.

RESULTS

The study included 12 children (10 boys and 2 girls) with a mean age of 5.8 y (range from 3 -9 y). Mechanism of injury included falls from bicycle (33%), falls from slide (33%), falls from tree (16%) and falls from monkey bar (16%). The average follow up for these patients was over 29.5 months (range from 21 m to 36 m). Analysis of initial radiographs

revealed 3 Milch type I fractures and 9 Milch type II fractures. Salter Harris type 2 fractures (ie Milch type II) were more common than Salter Harris type 4 fractures. Degree of displacement based on Stanley’s classification revealed two stage II (GAP) and ten stage III displacements (FLIP) (Table I).

All fractures achieved union by the end of 6 weeks. K-wires were removed after the fracture was clinically and radiologically healed; this was at 3-4 weeks during first clinic follow-up in clinic for 10 patients (83.3%). For the other 2 children (16.7%) the fracture did not show radiographic union at 3 weeks and the K-wires were therefore continued for another 3 weeks (Table I). These two children had Milch type I and Milch type II fractures respectively. At 6 weeks after surgery, both cases showed radiographic union and the K-wires were removed. The average time for implant removal based on clinical and radiographic union was 26.5 days/ 3.78 weeks after surgery. At the last follow-up visit, the mean carrying angle in the previously injured arm was 8 degrees valgus and did not differ significantly from that of the uninjured arm (7 degrees). Only one patient had an increased carrying angle with a cubitus valgus of 12 degrees while the uninjured side was only 5 degrees. Review of the radiographs of this child did not provide an explanation for this mild increase in the carrying angle. There was no evidence of slippage and no varus deformity in any of the patients after removal of the K-wires. The mean arc of humeroulnar motion was 138.7 degrees in the injured elbow. Eight children (67%) showed same range of motion of the elbow joint in both injured and uninjured elbow. Three children (25%) had 10 degrees loss of motion in the previously injured arm, and one a 15 degrees loss of motion.

Six patients (50%) had prominent scars (more than 4mm in width), but the parents of only one patient expressed dissatisfaction due to the scar. There were no reported complications such as pin tract infection, osteomyelitis,

avascular necrosis, overgrowth malunion, varus deformity, gun stock deformity, fishtail deformity or lateral bowing. Union (by clinical and radiographic examination) was achieved at three to four weeks after surgery for 83.3% of the patients.

DISCUSSION

In displaced fractures of the lateral humeral condylar physis, improper reduction can result in both cosmetic deformities and functional loss of motion. Hence, open reduction has become the standard treatment^{6, 11, 12}. Maintenance of reduction by 2 K-wires is standard practise for most clinicians^{6, 12}, but there is lack on consensus Regarding the actual duration of fixation and casting that is appropriate for this type of fracture. Many clinicians depend on radiological findings to guide their decision on when to remove fixation and splint but with such assessment is complicated by overlying plaster if the cast is not removed for examination. Pin tract infection is a known complication of percutaneous K-wire fixation^{13-15, 17}, and the risk is higher with prolonged period of fixation. Infection may result joint stiffness thus contributing towards possible poor functional outcome. Superficial pin tract infection usually resolves with antibiotic treatment, but deep infection however may be complicated with osteomyelitis and/or septic arthritis if the wires are not removed in a timely fashion¹⁸. There was no incidence of pin tract complication in this series.

We believe that earlier removal of K-wire and cast also allows for early initiation of range of motion exercises that are important for good outcomes. In this small series of patients, we demonstrated that in most children, fixation of 3 to 4 weeks is adequate and mobilization of the joint can then be initiated, however in some situations prolonged immobilization may be necessary. The degree of displacement at the time of injury may indicate inherent instability of the fracture and require longer period of immobilization. Both children who had delayed wire removal had Stanley Type III fractures. Older children may also require more prolonged fixation but this variable was not present in the current study.

CONCLUSION

Our findings demonstrate that 3-4 weeks of fixation with 2 K-wires and immobilization with casting is sufficient for most fractures of the lateral condyle of the humerus. However, radiological evaluation is still necessary because in some cases the fracture may not have united in this time period. Other factors including degree of fracture displacement or type of fractures may offer additional information for the decision making but further evaluation will be necessary.

REFERENCES

1. Bast SC, Hoffer MM, Aval S. Nonoperative treatment for minimally and nondisplaced lateral humeral condyle fractures in children. *J Pediatr Orthop*. 1998 Jul-Aug; 18(4): 448-50.
2. Fontanetta P, Mackenzie DA, Rosman M. Missed, maluniting, and malunited fractures of the lateral humeral condyle in children. *J Trauma*. 1978 May; 18(5): 329-35.
3. Salter R, Harris W. Injuries Involving the Epiphyseal Plate. *The Journal of Bone and Joint Surgery (American)* 2001; 83: 1753.
4. Badelon O, Vie P, Mazda K, Bensahel H. Fracture of the external condyle of the humerus in children. Apropos of a series of 46 cases. *Rev Chir Orthop Reparatrice Appar Mot*. 1986; 72 Suppl 2: 66-9.
5. Badelon O, Bensahel H, Mazda K, Vie P. Lateral humeral condylar fractures in children: a report of 47 cases. *J Pediatr Orthop*. 1988 Jan-Feb; 8(1): 31-4.
6. Foster DE, Sullivan JA, Gross RH. Lateral humeral condylar fractures in children. *J Pediatr Orthop*. 1985 Jan-Feb;5(1): 16-22.
7. Cardona JI, Riddle E, Kumar SJ. Displaced fractures of the lateral humeral condyle: criteria for implant removal. *J Pediatr Orthop*. 2002 Mar-Apr; 22(2): 194-7.
8. Thomas DP, Howard AW, Cole WG, Hedden DM. Three weeks of Kirschner wire fixation for displaced lateral condylar fractures of the humerus in children. *J Pediatr Orthop*. 2001 Sep-Oct; 21(5): 565-9.
9. Pirone AM, Graham HK, Krajbich JI. Management of displaced extension-type supracondylar fractures of the humerus in children. *J Bone Joint Surg Am*. 1988 Jun; 70(5): 641-50.
10. Milch H. Fractures and Fracture Dislocations of the Humeral Condyles. *J Trauma*. 1964 Sep; 4: 592-607.
11. Jakob R, Fowles JV, Rang M, Kassab MT. Observations concerning fractures of the lateral humeral condyle in children. *J Bone Joint Surg Br*. 1975 Nov; 57(4): 430-6.
12. Rutherford A. Fractures of the lateral humeral condyle in children. *J Bone Joint Surg Am*. 1985 Jul; 67(6): 851-6.
13. Hargreaves DG, Drew SJ, Eckersley R. Kirschner wire pin tract infection rates: a randomized controlled trial between percutaneous and buried wires. *J Hand Surg [Br]*. 2004 Aug; 29(4): 374-6.
14. Schalamon J, Petnehazy T, Ainoedhofer H, Zwick EB, Singer G, Hoellwarth ME. Pin tract infection with external fixation of pediatric fractures. *J Pediatr Surg*. 2007 Sep; 42(9): 1584-7.
15. Sharma H, Taylor GR, Clarke NM. A review of K-wire related complications in the emergency management of paediatric upper extremity trauma. *Ann R Coll Surg Engl*. 2007 Apr; 89(3): 252-8.
16. Velazquez RJ, Bell DF, Armstrong PF, Babyn P, Tibshirani R. Complications of use of the Ilizarov technique in the correction of limb deformities in children. *J Bone Joint Surg Am*. 1993 Aug; 75(8): 1148-56.
17. Board TN, Bale RS. K-wire fixation of displaced physal injuries. *Orthopedics*. 2003 May; 26(5): 475-6.
18. Stavlas P, Polyzois D. Septic arthritis of the major joints of the lower limb after periarticular external fixation application: are conventional safe corridors enough to prevent it? *Injury*. 2005 Feb ;36(2): 239-47.
19. Rockwood CA, Wilkins KE, King RE. Fractures in children. 3rd ed. Philadelphia: Lippincott; 1991.