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DOI- 10.13107/ijpo.2022.v08i01.131 | www.ijpoonline.com

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Fixation of Displaced Paediatric Humeral Lateral Condyle Fractures with 3 K-Wires

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Abstract

Background: Management of paediatric humeral lateral condyle fractures by 2 Kirschner wire (K-wire) or screw fixation in parallel or divergent manner remains the treatment of choice and has long remained unchallenged. In this study, we are recommending using a third K wire for fracture fixation in children younger than 10 years which enhances stability and ensures better outcomes without any significant disadvantages.

Materials & methods: We present a series of 20 pediatric lateral condyle fractures of Stage 3 and above, according to the Song Classification. Of the 20 patients treated, 12 were boys and 8 girls. All fractures were fixed using 3 lateral Kirschner wires of size 1.2 or 1.5mm. Out of the 20 fractures, 12 required open reduction and 8 were stabilized percutaneously.

Results: All patients demonstrated union at 6 weeks. K-wires were removed at 6 weeks. Good radiological and clinical outcomes were noted during periodical check-up. Hardacre score was used to assess clinical outcomes. None of the patients had loss of reduction, non-union, or implant-related failure except for pin tract infections in a few patients.

Conclusion: We recommend adding a third wire to the construct for fixation for lateral condyle humerus fractures in patients younger than 10 years. With this method, there was no loss of reduction, early union, and the opportunity for early mobilization with good restoration of movements

Keywords: Pediatric fractures, Elbow fractures, Lateral condyle fractures, K-Wires

Introduction

Lateral condyle fractures of the humerus account for 10-15% of the pediatric elbow fractures, and are the second most common pediatric elbow fractures, after supracondylar fractures [1]. Closed reduction and percutaneous pinning (CRPP) is preferred over open reduction and pinning to decrease tissue injury, decrease surgical time and for faster functional recovery [5-7]. Management of lateral condyle fractures by 2 Kirschner's wire or screw fixation in a parallel or divergent manner remains the treatment of choice.

The possibility of passing three K-wires arose when fixation using two K-Wires (in a non-recommended trajectory) lead to various complications such as distraction at the fracture site, delayed union and nonunion.

This study was conducted to assess the effect of using a 3rd K-wire during operative management of lateral condyle fractures of the humerus in children.

Submitted: 13/01/2021; Reviewed: 27/01/2022; Accepted: 15/02/2022; Published: 10/04/2022



Figure 1: (a) AP and lateral radiographs taken on presentation, showing displaced & rotated lateral humeral condyle fracture. (b) Post-operative AP and lateral radiograph showing anatomical reduction and fixation with three lateral K-wires.

Materials & Methods

A retrospective study was conducted at two tertiary referral trauma centers over a period of 5 years. Paediatric humeral lateral condyle fractures (PHLCF) presenting within the first 7 days of injury with Song Stage 3 and above were included in this study.

Inclusion Criteria:

1. Patients younger than 10 years
2. No associated fractures of the ipsilateral upper limb
3. Fractures stabilized using three K-wires.
4. Patients with a minimum follow up of 6 months.

Exclusion Criteria:

1. Fractures fixed with 2 Kirschner wires or screws.
2. Patients who lost to follow up.

Informed consent was obtained after a clear explanation of the surgical procedure and post-operative protocol. Patients were clinically evaluated for elbow swelling, neurovascular status and elbow stability. Clinical data included the age and sex of the patient, type of trauma, the time from injury and the initial management in delayed presentation.

Radiological assessment was performed using four standard radiographic views (anteroposterior, lateral, and oblique views). Fractures were classified preoperatively according to the degree of displacement and the fracture pattern using the classification by Song et al [5]. They classified these fractures into five stages. Internal oblique view radiographs help in determining the size of the metaphyseal fragment and fracture stability based on the extension of the fracture line to the joint surface.

Under appropriate anesthesia, either CRPP or ORPP (open reduction and percutaneous pinning) was performed. In cases where open reduction required, direct lateral approach was employed to expose the distal humerus through the interval between brachioradialis and the common extensor origin. Fixation was performed using three K-wires. An intra-operative assessment of the quality of reduction was carried out using c-arm in four views (anteroposterior, lateral, and two oblique



Figure 2: (a) AP and lateral radiographs taken on three-month follow-up showing good consolidation (union) at the fracture site. (b) Clinical Picture showing the full range of motion at three-month follow-up.

views) and an arthrogram of the elbow.

Postoperatively, a long arm splint was applied for 6 weeks. K wires were removed once reliable healing was detected clinically and on x-rays and active range of motion exercises were commenced.

Results

Twenty cases of PHLCFs (12 boys and 8 girls) were included in this study, with a mean age of 6.5 years (4 – 8 years). The right side was affected in 14 cases whereas the left side in 6 cases. The mean duration of injury/surgery interval was 3 ± 2 days. Duration of follow-up was 6 to 12 months (mean 9.2 months).

According to the classification by Song et al, eight cases were stage 3 fractures, seven were stage 4, five cases were stage 5 fractures. CRPP was successful in 8 (40%) of the 20 cases with displaced and/or rotated fractures, with satisfactory radiological results and no late displacement or surgery related complications. ORPP was performed in 12 cases (60%).

The success of closed reduction depended upon the fracture stage, time elapsed from injury to presentation and the size of the metaphyseal fragment. Regarding the quality of the achieved reduction, an anatomical reduction was achieved in all the cases requiring open reduction. Of the 8 cases with successful closed reduction, acceptable reduction (excellent and good) was achieved in 7 (87.5%) cases and one case had a fair reduction with a step of <2mm.

Union occurred in all cases. The mean radiological union time in cases treated by CRPP was 32.4 days (28 to 42 days) and for ORPP was 37.8 days (35 – 42 days). The mean time required for the restoration of elbow movements in the cases treated by CRPP was 8.2 weeks (8 – 10 weeks) whereas the meantime in the cases treated by ORIF was 10.4 weeks (10 – 12 weeks) ($P < 0.001$).

At the latest follow-up, 19 cases (95%) had excellent function and 1 child demonstrated good function (Hardacre) [15]. There was 1 instance of superficial pin tract infection after ORPP which was managed by a short course of oral broad-spectrum antibiotics and pin site care. There were no cases of

frank nonunion with a gap, premature fusion of the epiphysis, avascular necrosis of the trochlea, progressive deformity, or stiffness.

Discussion

PHLCFs are an epiphyseal injury of the distal humerus; associated with the risk of growth arrest, premature physal closure, stiffness, and deformity [5]. These fractures exhibit a higher propensity for nonunion owing to their intraarticular location and secondary displacement through the action of the common extensors.

The two most popular techniques of fixation of paediatric humeral lateral condyle fractures are fixation by divergent k wires and cannulated screw fixation. Advantages of divergent k-wire fixation are that it is technically easy, provides adequate stability with a lower probability of growth disturbance and avoids repeat intervention for implant removal. Proponents of divergent k-wire fixation found good to excellent results in their case series [9-14]. The reported complications include wire loosening, pin tract infection and non-union in a few cases. Addition of a third K-wire provides additional stability and may help prevent such complications. The wires were bent and kept outside the skin to avoid irritation and obviated the need for implant removal under anaesthesia.

Fixation of lateral condyle fractures with a screw provides compression at the fracture site leading to early union with lower infection rates and the opportunity for early postoperative elbow mobilization. Disadvantages include the need for greater technical skill to place the screw accurately, possibility of growth disturbance, screw loosening, loss of elbow extension and the necessity for a separate procedure for screw removal [16-20].

Li and Xu [21] compared K-wires with cannulated screw fixation retrospectively in 62 patients with fractures which were displaced by > 2 mm. There was no significant difference in

clinical outcomes in the two groups and no patient had nonunion or avascular necrosis of the ossific nucleus. However, a loss of extension of the elbow of 10 degrees was seen in nine (30%) in the Kwire group and two (6.3%) of the screw fixation group. Gilbert et al [22] assessed 84 patients with a follow-up of between six and eight months and found a much higher rate of complications, of 31% in the K-wire group compared with 7.5% in the screw fixation group. Nonunion occurred in three patients in the K-wire group more than six months postoperatively and none in the screw fixation group.

There are some limitations in this study- 1. Small Sample size 2. No control group 3. No biomechanical evidence to prove that an additional k-wire provide equal stability to a screw. We recommend further studies with a larger sample size comparing two versus three k-wires.

Conclusion

We recommend adding a third k-wire to the construct for improved fixation of lateral condyle humerus fractures in all patients less than 10 years. We found that this method provided good outcomes without any significant disadvantages.

Declaration of patient consent : The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/her images and other clinical information to be reported in the journal. The patient understands that his/her names and initials will not be published and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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How to Cite this Article

Jain D, Agrawal T, Raut SJ, Malviya P | Fixation of Displaced Paediatric Humeral Lateral Condyle Fractures with 3 K-Wires | *International Journal of Paediatric Orthopaedics* | January-April 2022; 8(1): 31-34.