ORIGINAL ARTICLE

Result of Open Reduction Kirschner Wire Fixation of Late Presentation of Lateral Condyle Fracture of Humerus in Children.

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Abstract

Background: Management of lateral condyle fracture of the humerus needs accurate reduction and stabilization because of rotational displacement. Neglected lateral condyle fractures of humerus are misdiagnosed or insufficiently treated fractures, presenting later than 3 weeks after injury. This study aimed at analyzing the morphological and functional outcomes with hospital-based prospective and descriptive clinical study design of the neglected lateral condyle fracture of humerus in children at the Yangon Children Hospital, Myanmar.
Methods: Sixty-two patients with unilateral neglected lateral condyle fractures of humerus were included in the study from January 2017 to January 2020. Seven patients had Milch's type I fracture and 55 patients had Milch's type II fractures. Open reduction with two smooth Kirschner wire fixation was done. Long arm plaster of Paris (POP) posterior slab was applied with the elbow at 90 degrees of flexion and forearm in a neutral position. Six weeks after the operation, the POP posterior slab and Kirschner wires were removed following a radiograph check. Thereafter, all patients were assessed both functionally and radiologically every month.
Results: The outcome of 12 months follow up data were calculated. For the radiological union time, the age group of less than 5 years and 5 years of age group achieved the bone union considerably faster than the age of 6 to 10 years of age group and above 10 years of age group. ($p<0.001$). According to the Hardacre Scoring System for the Clinical Evaluation, 96.7% of the patients had good and excellent outcome scores using the data of 12-month follow-up. Hardacre score of an excellent and good result was statistically significantly different from the mean age of the fair functional results with $p=0.018$ and $p=0.039$.
Conclusion: The study findings showed that open reduction and internal fixation in a majority of neglected lateral condyle fractures of the humerus in children gain good radiological and functional outcomes.

Keywords: Neglected lateral condyle fracture, smooth Kirschne

Introduction

Lateral condyle fracture of the humerus is the second most common fracture at the elbow in children. [1,2] The mechanism of the injury is falling onto the outstretched hand with valgus force and elbow extension. [1]

The detection of lateral condyle fracture is important because it tended to damage the growth plate and including the intra-articular surfaces. The lateral condyle of humerus epiphysis begins to ossify during the first year of life and fuses with the shaft at 16 years of age. These fractures involve the Salter Harris type II and type IV epiphyseal injuries in which the fracture line crosses the distal humeral growth plate. The fractures occur in the 3-14 year age group. [3]

The lateral condyle fracture is difficult to be diagnosed radiologically and clinically with loss of function due to fracture line extension into the articular surface and pull the extensor muscles to cause displacement. [4] The neglected lateral condyle fracture treatment may not be obvious until months or years after the initial injury. [3]

The Milch classification is commonly used and there are type I and type II due to whether the fracture exited through the capitular-trochlear groove. [5]

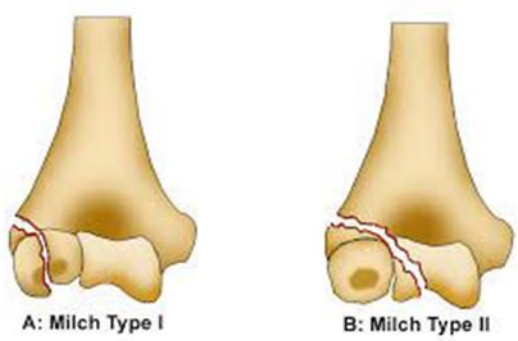

Figure 1. Milch classification of the lateral condylar fracture. Type I, the fracture line extends into the apex of the trochlea (A). Type II, the fracture line extends into the apex of the trochlea (B).

In developing countries, those patients with fractures of the lateral condyle of the humerus usually present late due to lack of parental awareness, especially in rural areas. Since the quality of the radiograph is poor, the extent of fracture involvement is often misinterpreted. [6]

The gold standard in treatment for an early displaced fracture is the open anatomical reduction and internal fixation with Kirschner wires or screws and then immobilized in a slab.[7]

There is a controversy about whether to treat neglected fractures by non-operative or operative methods. In the non-operative treatment, there are various complications such as non-union, malunion, instability of elbow joint, stiffness, cubitus valgus, and tardy ulnar nerve palsy. Alternatively, there could be problems of intraoperative reduction during operation. Furthermore, the hazardous blood supply to the small fractured fragment due to excessive stripping of soft tissue may result in avascular necrosis of the fragment. [8]

Despite the disappointing results and the general disapproval of surgery, there were several reports in the recent literature in favour of surgery. They reported good results by open reduction and internal fixation in those neglected cases with no avascular necrosis of the capitulum. [9]

Fracture stabilization with smooth Kirschner wires may cause bony callosity than using screws, and although the latter may provide a more rigid stabilization, it may result in a noticeable lateral prominence. [10]

Methods

All patients with late neglected lateral condyle fracture of the humerus were admitted to the children hospital. History taking and clinical examination with pre-operative radiologic assessment were done. Open reduction and internal fixation with two Kirchner wires were done by two senior orthopaedic surgeons.

Technique and operation

The operation was performed under general anesthesia in a bloodless field using a pneumatic

tourniquet. After thorough skin preparation and draping, a Kocher lateral J skin incision was done. In the interval between the brachioradialis and triceps muscle, the dissection was performed right down to the lateral humeral condyle. Limited soft tissue clearance was done to expose the bone fragment and elbow joint only. The fracture fragment was usually rotated as well as displaced and callus formation was usually encountered. The joint was exposed to reduce the articular surface accurately and the reduction was confirmed by observing the articular surface. When the reduction was being held by a small bone holder, two Kirschner wires (size of 1.5 / 1.8 mm) were inserted. The passive elbow movement was checked and the wound was irrigated with normal saline. The wound was closed back in layers and the ends of the wires were bent and buried under the skin. The elbow was immobilized in a plaster of Paris posterior slab with the elbow flexed at 90 degrees and forearm in the neutral position.

Post-operative Management

Active fingers movement was encouraged on the post-operative first day and a radiograph was done after the operation for checking the reduction. One week after surgery, the posterior slab was removed, another radiograph was taken again to check for fracture stability (Figure 2). If the wound healed well, the stitches were removed, and the slab reapplied. If there were no other complications, the patient was then discharged.

Follow up

The first follow-up was at one month post-surgery. The slab was removed and gentle active motion of the elbow was assessed. Callus formation was assessed with radiographs and the posterior slab was reapplied for another 3 weeks. At seven weeks post-operatively, the radiological union was assessed again, and if satisfied, K-wire was removed in the operation theatre.

The follow-up was done every month to assess the radiological union, range of motion, and to detect any complications following Kirschner wire removal. Twelve months post-operative, the data were collected for radiological assessment of union and functional outcomes such as residual range of motion and complications.

Figure 2. The radiographs of five-year old boy with a six-week-old fracture, preoperative (A) and postoperative (B)

Assessment

Clinical results were categorized as excellent, good, and fair according to the Hardacre score (Table 1). The excellent score implies a full range of motion, no alteration in the carrying angle, and is asymptomatic. The good score means a mobility deficit < 15° with slight minimal alteration in carrying angle and no residual pain. A fair score means a disabling loss of motion, conspicuous alteration of carrying angle, and arthritic symptoms. [11,12,13]

Results

The descriptive and inferential statistics were analyzed using IBM SPSS version 20.0.

Frequency, percentages, mean, and standard deviation were used to provide descriptive data.

Paired t-test, One-way ANOVA test with equal variances assumed with Tukey test, with equal variances not assumed with Tamhane post hoc test were employed for inferential statistics. The p-value was set at 0.05 to indicate a significant level. The p-value less than 0.05 was accepted as a statistically significant relationship between the two variables.

There were 62 unilateral neglected lateral condyle fractures of humerus cases in this study; the most common age range was 6 to 10 years (n= 53), and the male patients (n=51) were predominantly affected by the Milch type 2 pattern on their elbow (Table 1). The mean age was 7.77 years (between 2 years to 12 years) and the mean injury duration was 10.05 weeks (between 3 weeks to 18 weeks). The mean time of radiological union time was 6.05 (between 4 weeks to 7 weeks). The follow-up mean was 16.66 months. All patients came to follow up at least 12 months duration. Therefore we calculate the data at the 12 month follow-up time. For the radiological union time, the mean week of less than 5 and 5-year age group was 4.14 weeks, age 6 to 10-year group was 6.25 weeks, and age more than 10-years group was 7.50 weeks. There is a distinction between children less than 5 years and 5 year-age group achieved the radiological union substantially faster than the age group of 6 to 10-years group and more than 10-years group. (p=0.00) Hardacre score, the excellent result was 52 (83.8%) and the good result was 8 (12.9%). Only 2 (3.3%) patients had fair results. The mean age of the fair functional results is statistically significantly different from the mean age of good and excellent functional results with p=0.018 and p=0.039.

Discussion

Late presentation of displaced lateral humeral condyle fractures is not uncommon in developing countries and is considered as one of the problematic paediatric injuries due to the difficulty in surgical management. In developing countries, health care services are not widespread. Radiology and operation facilities are not available in rural areas. A neglected displaced lateral humeral condyle fracture patients have pain, instability of elbow joint, progressive cubitus valgus deformity, and condylar prominence. The bone ends become indistinct and soft tissue becomes contracted. The associated fibrosis and callus make this task further difficult. Moreover, an attempt to mobilize the fragment by stripping the soft tissues may lead to avascular necrosis. [13]

Ajay Pan et al reported that there was a mean age of 7 years and 3 months (range 4-14 years). [14] In the study conducted by Anil et al, the mean age of the patient at the time of presentation was 7 years (range, 3-12 years). [15] The sample population of study and procedure were quite similar to our study group. In our study, age distribution ranged from 2 to 12 years (mean age 7.77 years). In our study, the most frequent age group was 6 to 10 years. Most patients were of primary school-going age. In Myanmar, the school-going age starts from 6 years. This age group is prone to get an injury as they were active and playful.

Ajay Pan et al reported that there were 14 males and 4 females in the study.[14] Anil et al said that there were 19 boys and 3 girls were included with 9 Milch type I and 13 types II fracture. [14] Nineteen were boys and there were three girls in study by Anil et al. [15] Davod Jafar reported that there were 48 boys and 25 girls involved in the lateral condylar humerus fracture. [16] In our study, 51 boys and 11 girls with 7 Milch type I and 55 types II. These results pointed out that boys were more commonly affected according to their more active nature than girls.

Ajay Pan et al presented that among the nine (50%) patients who presented between 5 to 8 weeks after injury. [14] There were 5 to 8 weeks duration after injury in the study of Ki Cheor Bae. [17] In the study of Nguyen Ngoe Hung, among the patients studied, 21 presented after 3 weeks of injury. [18] In our study, the mean duration was 10.05±3.28 weeks (3 to 18 weeks). Myanmar being a developing country, many rural areas did not have the facility for orthopaedics. Parents were more inclined to treat with the traditional way. Therefore, most of the lateral condyle fracture humerus patients came late to seek medical treatment.

There are mutable results in clinical presentation following operative fixation of late presenting lateral condyle fractures in children and the method of result evaluation also varies significantly. The result by Anil et al showed 13

patients had excellent and good results among the18 patients. [15] Davod Jafar et al, in a case series, analyzed their results in 73 lateral condyle fracture cases, and clinical evaluation demonstrated excellent and good outcomes in 68 patients. [16] Ki Cheor Bae reported that all 8 cases had an excellent and good result. [17] Nguyen Ngoc Hung reported that 71.4% of 21 patients had excellent to good results in a retrospective study. [18] Khalid Mahmood studied 25 lateral condyle fracture children included 18 boys and 7 girls. Overall excellent results were achieved in the majority (73.9%) of these children. [19] Chhetri et al reported that 86.37% had excellent and good results among the 19 patients. [20] Andreas presented that 96% of the patients achieved an excellent final result and 4% was good result among 105 patients. [21] In our study, clinical outcomes using the Hardacre scoring system showed there were excellent and good in 96.7%, which demonstrated a higher rate of excellent scores in our patients. Our limitations of this study was the short-term follow-up.

Wen Chao Li studied the 62 patients (42 boys, 20 girls; mean age 6.93 years for an operation. There were five patients (16.7%) who presented with skin infection around K-wires. [21] In our study, skin infection around the wire occurred in 2 cases. Khalid Mahmood et al showed that five Kirschner wires in four fractures were found to be loose because the Kirschner wires did not pass through the cortex of the opposite side. [19] In our study, loose Kirschner wire losing was found in one case. Therefore the double cortex fixation of smooth Kirschner wires was necessary when Kirschner wire was used for fixation. No cases of avascular necrosis, fishtail deformity, cubitus varus, cubitus valgus deformity, non-union, or spur were seen up to 12 months follow-up time.

Conclusion

In our study, late presentation of displaced lateral condyle fracture could be treated successfully by anatomic reduction and internal fixation with smooth Kirschner wire. Our study confirmed that lateral condyle of fracture humerus in children yields excellent and good results in a majority of late presented cases. The long-term effects of osteosynthesis have not been studied in our study because all patients could not be followed up until bone maturity age.

Conflict of Interest

The authors declare no conflict of interest.

Table 1. Evaluation of treatment outcomes in lateral condylar fractures of children (Hardacre et al criteria)

Excellent	Full range of motion Normal carrying angle and appearance No symptoms Complete heling of the fracture
Good	Good Efficient range of motion Loss of extension less than 15 degrees Mild and subtle deformity No arthritic or neurological symptoms Complete healing of the fracture
Fair	Loss of motion to the extent of disability Alterations in carrying angle and prominent deformity Presence of arthritic or neurological symptoms Presence of nonunion or avascular necrosis

Table 2. Patient characteristics

Variable	Sub-variables	Frequency	Percentage
Age group in years	< 5 years to 5 years	7	11.3
	6 to 10 years	53	85.5
	more than 10 years	2	3.2
Gender	Female	11	17.7
	Male	51	82.3
Side	Left	40	64.5
	Right	22	35.5
Milch –Type	Type 1	7	11.3
	Type 2	55	88.7

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