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RESEARCH ARTICLE

A PROSPECTIVE CASE STUDY OF SURGICAL TREATMENT OF SUPRACONDYLAR FRACTURES OF THE HUMERUS IN CHIDREN BY CLOSED CLOSED REDUCTION AND PERCUTANEOUS FIXATION WITH KIRSCHNER WIRES

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ABSTRACT

OBJECTIVE: To assess the ability of closed reduction and percutaneous K-wire fixation, to obtain and maintain an adequate reduction, and thereby achieve satisfactory end results.

METHODS: A prospective study conducted on forty displaced extension type Gartland type-III of supracondylar fractures of the humerus in childrens treated by closed reduction and percutaneous cross-fixation with kirschner wires under image intensifier control between august 2012 to july 2014 at Vijayanagara Institute of Medical Sciences, Bellary.

RESULTS: There was no problem in union. Patients were graded by Flynn's criteria with excellent results in 60%, good in 20%, and fair in 15%, and poor in 5% cases. Only two patient had developed cubitus varus deformity and four had Iatrogenic Ulnar nerve palsy from medial pin, which recovered subsequently. The Baumann's angle was well with in the normal range of 66-84 degrees.

CONCLUSION: Percutaneous K-wire fixation is a safe and effective method for the management of Gartland type-III supracondylar fractures with minimal hospital stay and without risking vascular compromise.

Key words: Supracondylar fractures, closed reduction, Crossed-pin fixation

INTRODUCTION:

Supracondylar fractures of the humerus represent 60% of all elbow fracture in children in the first decade of life.[1] The rate of occurrence increases steadily in the first five years of life to peak at 5-7 years of age. Current method of treatment of this fracture is based on Gartland classification. Flynn et al., reported the incidence of cubitus varus deformity after treatment was 5%, whereas Arino et al., reported that it was almost 21%, ulnar nerve deficit was found in 15% of patients who were treated with medial and lateral pin as per the report of chai.[2,3,4] Many different methods are described such as close reduction and long arm cast or slab, Dunlop skin traction, olecranon traction, but all of these methods had large complication rate.[1,2,5,6,7,8] The current preferred method of treatment for displaced Supracondylar fracture has been close reduction and percutaneous pin fixation. This method has given excellent results reported by various authors.[6,7,8,9]

MATERIALS AND METHODS:

This retrospective study was carried out between August 2012 to July 2014 at Vijayanagara Institute of Medical Sciences, Bellary. Institutional medical ethics committee approved it. A written informed consent was obtained from all the patients (by their parents). In this study, 40 children with Grade III close Supracondylar fractures of humerus were included. The mean age of the patients in our study was 8.8 years and maximum number of patient (60%) were between 4-9 years of age. 28 (70%) of patients were males and 12 (30%) were females. Fracture occurred on the left side in 30 (75%) patients. Fall while playing was the main cause of fracture amounting to 55%. 26 fractures were posteromedial displacement and 14 (35%) had posterolateral displacement. 10% of the patient had associated fractures. The average interval between fracture and surgery was 2.35 days and the average hospital stay was 3.35 days.

Under general anesthesia, using c-arm fluoroscopy closed reductions were done. When satisfactory reduction had been achieved, then fixations were done by K-wires of 1.5 or 2.0 mm size and well-padded above-elbow posterior back-slabs were applied. The patients were carefully observed for 12-72 hours and then discharged. The above-elbow plaster of paris back slabs were kept for two to three weeks and the pins and slab were removed in the

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outpatient clinic. Elbow Range of motion was started after removing the back slab. The follow-ups were arranged as follows: The first follow-up on the 7th day to inspect the wound; the second follow-up on the second week for wound inspection or suture removal and to see the pin configuration. Within 2-3 weeks, x-rays were taken to see the callus formation; if callus is formed, then we remove the pop and pins and to start physiotherapy; the third follow-up on the 4th week and the fourth follow-up on the 8th week post-operatively to see the range of motion and carrying angle of the elbow, and the final follow-up on the 6 months post-operatively to see the final result of the study.

In our study all fractures were united around 4 weeks. One patient had developed superficial pin tract infection which healed completely with appropriate antibiotics. Two patient had developed cubitus varus deformity, one of which was later treated by corrective osteotomy. Four had Iatrogenic Ulnar nerve palsy resulting from the medial pin, which recovered subsequently within four months. Patients were graded by Flynn's criteria[2] with excellent results in 60%, good in 20%, and fair in 15%, and poor in 5% cases.

CASE-1

Figure 1: Pre-operative A-P and Lateral radiographs showing Supracondylar fracture of humerus of 12-year-old child- Case 1

Figure 2: Immediate Post-operative anteroposterior and lateral radiographs of Supracondylar fracture of humerus showing with Crossed K-wire fixation- Case 1

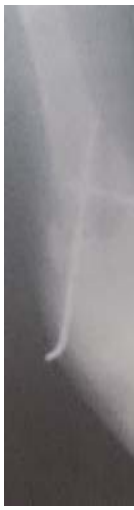

Figure 3: Four weeks Post operatively- Case 1

Figure 4: Follow-up at 8 weeks- Case 1

CASE-2

Figure 5: Pre-operative Antero-posterior and lateral radiograph showing Supracondylar fracture of humerus of 15-year-old child- Case 2

Figure 6: Immediate Post-operative anteroposterior and lateral radiographs of Supracondylar fracture of humerus showing with Crossed K-wire fixation- Case 2

Figure 7: Four weeks follow-up- Case 2

Figure 8: Eight weeks post-op- Case 2

RESULTS:

There were 40 children in this study, 28 children were male and 12 children were females. The children were aged 4-9 years. There were 30 left-sided and 10 right-sided fractures. Among 40 children, 22 children had injury during playing, 14 children had met with a road traffic accident and 4 had a fall from a height. All were closed fractures. All were extension type fractures and were treated by cross pinning by two K-wires. 2 patients (5%) had associated fracture both bones right forearm and 2 patients (5%) had associated distal radius fracture. Preoperatively, there were no cases of neuro-vascular injuries. Post-operatively, One patient had developed superficial pin tract infection which healed completely with appropriate antibiotics. Two patient had developed cubitus varus deformity, one of which was later treated by corrective osteotomy. Four had Iatrogenic Ulnar nerve palsy resulting from the medial pin, which recovered subsequently within four months. Callus formations were seen in all patients at the 3-4 weeks post-operatively before removing the K-wires. The fractures united in all cases at the 4^{th} week post-operatively. Results were analysed using Flynn's criteria[2] with excellent results in 24 patients (60%), good in eight patients (20%), and fair in 6 patients (15%), and poor in two cases (5%). All patients were followed at 8^{th} week, 16^{th} week and the 24^{th} week, postoperatively. All patients achieved complete radiographic healing at a mean of 4 weeks (range: 3-6 weeks). At final follow-up, all patients went on to osseous union, loss of range of motions more than 15^{o} were seen in two patients, mean loss of carrying angle was 5.65^{o} with maximum being 15^{o}. During this study, complications like vascular injury, compartment syndrome, myositis ossifications and non-union were not noted.

Table 1**: Results of the evaluation of the 40 patients according to the Flynn criteria**

Result	Rating	No. of patients	Percentage
Satisfactory	Excellent	24	60
	Good	8	20
	Fair	6	15
Unsatisfactory	Poor	2	5
Total		40	100

DISCUSSION:

Management of displaced extension type III Supracondylar fracture of humerus treated by close reduction and percutaneous pin fixation has consistently given satisfactory result compared to other method of treatment. However, controversy persists regarding the adequate pin fixation technique comparing medio-lateral and lateral pin fixation. The medio-lateral pin fixation method supposed to have the advantage of better fracture stability, although iatrogenic ulnar injury can occur with this technique. Pin fixation from lateral side has the advantage of avoiding ulnar nerve injury but this construct has been thought to be biomechanically less stable. Lee SS *et al*., and Ziouts *et al*., reported that medial and lateral entry provides greater torsional rigidity than lateral entry pin fixation does.[10,11] There are some authors who advocated the use of the third wire to prevent the displacement of the distal fragment.[12] The use of a third pin requires the medial pin to enter the joint and thus increases the risk of joint penetration and infection. The use of two pins was preferred to decrease the risk of infection. In an other study of Skaggset al.,[9] of 204 children who had a Gartland type-3 fracture, 51 were treated with lateral pins only and 153 were treated with crossed pins. The configuration of the pins did not affect the Baumann's angle in Gartland type 3 fractures. Reynolds and Jackson[13] found no differences in results between the two different methods. The most common complication in the treatment of closed reduction and percutaneous pinning of displaced Supracondylar fractures of the humerus is iatrogenic ulnar nerve palsy with the use of medial pin.[14,15,16] The rate of ulnar nerve injuries varies in different studies. Lyons et al.,[16] have reported this number as 6%, Royce et al.,[14] as 3%, Agus et al.,[15] as 58%. It is found that postoperative nerve palsies after percutaneous pinning was with direct injury to the nerve, not after manipulation of closed reduction.[7,14] Skaggs et al.,[9] noted the incidence of ulnar nerve injury as 4% in patients whom the pins were applied without hyper flexion of the elbow and as 15% in whom the medial pin was applied with the elbow hyperflexed. Different techniques are performed to decrease the rate of ulnar nerve injury. It is also showed that lateral-pins decrease the rate of ulnar nerve injury when compared with medial-pins. In the present study, iatrogenic nerve injury was seen in four patients (10%). Although most cases of the ulnar nerve injuries recover spontaneously between 4 months and 6 months, permanent damage has been reported in the literature.[14,17] Lyons et al.,[16] observed spontaneous functional recovery after the removal of medial pin. However, Rasool[17] advocated the early exploration of the nerve. Clawing of the fingers may occur rarely after ulnar nerve injuries. Pathological electromyographic measurements can be detected in most of ulnar nerve injuries during the early postoperative period.

Cubitus varus deformity is the most common problem seen after the treatment of Supracondylar fractures. The cause of the deformity is coronal rotation, or tilting of the distal fragment.[18] Some investigators believed that varus deformity is due to epiphyseal growth disturbance or rotation of the distal fragment.[19] Smith suggested that residual medial tilt after reduction is the most important factor in varus angulations, with isolated rotational deformities being corrected by compensatory rotation at the shoulder.[20] This concept has become popular in understanding the sequel of alteration in carrying angle. We had two cases (5%) of cubitus varus deformity, one of which was treated by corrective osteotomy.

We had mean loss of range of motion at 6.05^{o} with two patients having >15^{o} loss of motion.

In the present study, at the final follow-up 0-5^{o} carrying angle loss of the affected extremity was noted in 24 (70%). More than 15^{o} loss of carrying angle was noted in two (5%) patients and mean loss of carrying angle was 5.65^{o}. In a study by Flynn et al mean loss of carrying angle was 6.2^{o}.[2]

In my study, two (5%) patients developed pin-tract infections, which were superficial and healed after removing pins and administration of oral antibiotics. No deep infection or septic arthritis was found. Pirone found superficial pin-tract infection in 2% of cases with no deep infection and septic arthritis.[21]

At the final follow-up, excellent results were seen in 60% of the cases. In post-operative period, physiotherapy plays a significant role in increasing the range of motion of the elbow joint. Those patients who had good or fair results were having severe soft tissue injuries or repeated closed reduction. Flynn had excellent results in 80% cases[2] while Pirone had achived excellent results in 78% of his cases.[21]

Dua et al.,[22] proposed that closed reduction and crossed pinning of displaced Supracondylar fractures of humerus in children is a safe and effective method even with delayed presentation. The main goal of the treatment of displaced paediatric Supracondylar humerus fractures is to achieve an anatomic reduction. This reduction should be supported by a fixation with a good stability and less morbidity. When all these are taken into consideration, we believe that

closed reduction and percutaneous pinning is an efficient, reliable and safe method.

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