DISPLACED SUPRACONDYLAR FRACTURES OF HUMERUS IN CHILDREN TREATED WITH OPEN REDUCTION AND CROSS K-WIRE FIXATION

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ABSTRACT

Objective: *To describe the outcome of open reduction and cross K-wire fixation through a triceps non disturbing posterior approach used in the treatment of type III supracondylar fractures of humerus in children.*

Methodology: *This descriptive study was conducted at Orthopaedics Unit District Headquarter Hospital Timergara Dir Lower from December 2005 to September 2008. Fifty children with type III supracondylar fractures, who presented within one week of injury, and in whom satisfactory reduction was not possible by closed means, were evaluated clinically and with radiographs before surgery and at follow up. All these patients underwent open reduction and crossed K-wire fixation through a triceps non disturbing posterior approach. Anatomical reduction of the fracture was achieved and fixation was carried out by two cross K-wires. The patients were regularly followed up and at one the results were measured according to the criteria of Flynn.*

Results: *The mean age was 10+6 years. In 3(6%) patients the fracture was flexion and in 47(94%) the fracture was of extension variety. Traditional bone setters were the initial treatment provider for 54% of the patients. The average delay in presentation was 31 hours. Four patients have ipsilateral fractures of the distal radial epiphysis. Postoperatively 9(18%) patients developed pin track infection, and only 2(4%) had transient neuroprexia of the ulnar nerve.*

Conclusion: *Open reduction and cross K-wire fixation through a posterior triceps non disturbing approach can be satisfactorily used in the treatment of type III supracondylar fractures that could not be reduced satisfactorily by closed methods.*

Key Words: *Type III supracondylar fracture, Open reduction, Posterior approach.*

INTRODUCTION

Supracondylar fracture is one of the most common fracture in children[1,2], and can be associated with disabling complications as arterial occlusion, compartment syndrome, Volkmann's ischemic contractures, nerve injuries, myosits ossificans and severe deformities, if not treated appropriately[1-3]. The most common mechanism of injury is fall on out stretched hand[4]. The aim of treatment is to gain a functional and cosmetically acceptable limb with a normal range of movement. Various treatment methods have been used, as close reduction and plaster immobilization, skin or skeletal traction, close reduction percutaneous k-wire fixation and open reduction and k-wire fixation[1,2]. Every method has its advantages and drawbacks. Close reduction and percutaeneous pinning is the most favoured procedure, but the image intensifier needed for this procedure is not available in district hospitals. Close reduction and plaster cast immobilisation is associated with higher rates of cubitus varus due to suboptimal reduction or loss of reduction in the cast[3,5-9]. Treatment with traction needs prolonged hospitalization and has produced variable results[6, 9]. Type III supracondylar fractures can be effectively treated with open reduction and k-wire fixation, especially in regions where image intensifiers are not available in the orthopaedics units, provided soft tissue trauma is minimised by avoiding

repeated attempts at close reduction, by sparing the extensor mechanism and by obtaining and maintaining accurate reduction[4].

This study was thus planned to describe the outcome of open reduction and cross K-wire fixation through a triceps non disturbing posterior approach used in the treatment of type III supracondylar fractures of humerus in children.

METHODOLOGY

This descriptive study was conducted in District Headquarter Hospital Timergara from December 2005 to September 2008.This study included 50 patients with Type III supracondylar fractures of distal humerus who presented within one week of injury and needed open reduction due to unsatisfactory close reduction. Patients with open fractures, with Gartland's type I, type II closed fractures and fractures with gross swelling, blisters or compartment syndrome were excluded from the study. On arrival the patients were evaluated for other associated injuries, and distal neurovascular status of the limb was checked. Anteroposterior and lateral radiographs were taken, fracture geometry was defined. Under general anesthesia an attempt of closed reduction was made, and a posterior plaster splint was applied in maximum possible and safe, flexion and pronation. Post reduction lateral view and Jones view radiographs were made immediately after immobilisation, and the quality of reduction was assessed. The criteria for satisfactory reduction was Baumann's angle of 5-8 degrees and humero-capitallar angle within 10 degrees of the contralateral side. Patients with satisfactory reduction were continued with conservative treatment and were excluded from the study. With prior consent taken, if the reduction was found unsatisfactory on the check radiographs, open reduction was carried out in the same anesthesia.

Posterior mid line incision was used, starting two centimetres distal to the tip of olecranon extending it proximally for about 8 centimetres. Deep skin flaps were elevated, ulnar nerve was identified, isolated and secured with a sling. Triceps aponeurosis and muscle was not disturbed. From the exposed medial and lateral epicondyles small incisions were given and extended proximally 2-3 centimetres along the supracondylar ridges. The fragments alignment and reduction was confirmed in the exposed field, by the appropriate restoration of the medial and lateral supracondylar pillars. Once the reduction was achieved, cross k-wires were passed from the medial and lateral epicondyles into the opposite cortices in the metaphysealdiaphyseal regions. Radiographs were made and the patients were discharged on the second post operative day.

After three weeks the stitches were removed, back slab was discarded, intermittent range of motion exercises were started, and commercially available polysling was applied.

At six weeks radiographs were made to asses the fracture healing, k-wires were removed, but polysling was continued for another 3 weeks, during this time the parents were strictly advised about regular exercises of the elbow. These patients were regularly followed up monthly for 6 months in order to know the improvement in the range of motion of the elbow, and fracture union. They were then followed up at 9 months and one year, and the elbow status was assessed according to the criteria of Flynn which is given below[10].

RESULTS

Fifty children with displaced type III supracondylar fractures of humerus were included in this study. Three (6%) patients have flexion type, while rest of them (94%) have extension type fratures. Forty (80%) of them were male and 10 (20%) female with a male to female ratio of 4:1. the age range in them was 4 years to sixteen years, with mean age of 10.00$\pm$6.00 years. Thirty five (70%) patients presented within 24 hours of injury while 10(20%) presented with in72 hours and 5(10%) of them presented within one week. Four (8%) patients have ipsilateral distal radial epiphyseal injury, the mechanism of injury in these patients was fall from height as tree or roof top. Twenty six (52%) patients had received their initial

Table:1 Flynn Criteria for Reduction Assessment

	Cosmetic factor – loss of carying angle (degree)	Functional factor – loss of motion (degree)
Excellent	0 –5	0 –5
Good	6 – 10	6 – 10
Fair	11 –15	11 –15
Poor	> 15	> 15

treatment in the form of bandages and wooden splints etc, from the traditional bone setters, which indicates the prevailing practices of these traditional bone setters in the region. Patients who developed complications as gross swelling in the elbow, forearm, and hand, with or without blisters formation, compartment syndrome or vascular gangrene, due to their intervention were excluded from the study. Only those patients initially treated by the bone setters, who did not develop the above mentioned complications, were included in the study.

In all patients the posterior midline extensor mechanism sparing approach was used. Reduction was achieved and the quality of reduction assesed through medial and lateral windows created along the supracondylar ridges. Medial and lateral cross k-wires were passed in all of them.

Nine (18%) patients developed pin tract infection, which resolved on oral antibiotics. In none of them the wire removal was needed for the control of infection before the due time of six weeks. No deep wound infection was noted in any of them.

Neuroprexia of ulnar nerve was noted in 2(4%) patients, which resolved in three months time and none of them required exploration of the nerve (Table 2).

By six weeks time reasonable callus was formed in all of the patients, and the fracture was united.

Postoperatively the outcome of treatment was measured at one year according to the Flynn criteria. In 37(74%) patients the outcome of treatment was excellent, in six (12%) patients it was good with only 6 to 10 degrees of flexion deformity, and 6-l0 degrees decrease in carrying angle.

Seven (14%) of the patients with fair results have an extension lag of 15 degrees, but carrying angle was normal in them. The decrease in carrying angle was noted in patients who had comminution at the medial supracondylar pillars, and the extension lag was present in patients who had poor compliance to rehabilitation (Table 3).

Majority of the patients (74%) achieved almost normal range of motion and normal carrying angle. In 6(12%) patients there was extension lag of 6-10 degrees which did not affect the function of the limb and the carrying angle was reduced only about 6-10 degrees. In 14% patients the extension lag was 15 degrees that affected the symmetry of the elbows to certain degrees but did not compromise the function.

DISCUSSION

Supracondylar fracture is the most common fracture around the elbow in children especially more common in the second half of the first decade of life[1-3]. These fractures involve a transformation zone between tubular and flat bone, and the fracture line crosses through the thin and weak part of bone between the olecranon and coranoid fossae, just proximal to the articular surfaces. These anatomic factors make this fracture difficult to reduce and even more difficult is to maintain its reduction[3].

The mean age of the patients with type III supracondylar fractures in our study is almost

Table 2: Postoperative Complications

Complication	No. of patients	Percentage
Pin track infection	09/50	18
Ulnar Neuroprexia	02/50	04
Elbow Stiffness >15 degrees extension loss	03/50	06
Cubitus varus >10 degrees change in carrying angle	03/50	06

Table 3: Results at One Year Follow up Using Flynn Criteria

Flynn Group	No. of Patients	Percentage
Excellent	37/50	74
Good	06/50	12
Fair	07/50	14

comparable with other studies on the same topic[9,11,12].

Because most of the children who sustained these fractures were between five to eleven years, which is the time period when the bones are relatively weak as compared to adolescents and the level of activity in this age group is higher than the preschool children, thus the average age remained around 6 to 8 years in most of the studies.

The male to female ratio in our study was 4:1, and this male predominance was noted in other studies[8,11,13]. A possible explanation may be the involvement of boys in more vigorous sports and physical activities which makes them more prone to these fractures.

Considerable proportion i.e., (52%) of our patients was attended by traditional bone setters initially, that indicates the prevailing practices of bone setters in the periphery of our province, that's why they presented late in the hospital. A smaller proportion was observed in another study conducted in Lahore[14]. This difference can be attributed to the difference in the social make up and better health facilities of the two regions.

The average delay in presentation of these patients was 31 hours, and this delay was 34 hours in the series of Kumar[12]. The main reason for this delay in our series was the time spent in getting their initial treatment from the traditional bone setters.

Traditional bone setters are the practitioners of joint manipulation. In the area of the study these are people known in the community for their art of reducing the fractures and dislocations. They inherit this art from their elders or teachers, who used be educated or uneducated, but none have any medical/ paramedical education. They apply multilayered tight bandages, augmented by multiple wooden splints placed longitudinally across the fracture site for immobilisation of the fractures after attempting reduction by manipulation without any sedation or anesthesia. In the supracondylar fractures after manipulation they immobilise the elbow in full extension by the help of wooden splints and bandages.

In three (6%) patients the fracture was flexion type, in rest of them it was extension type. The incidence of flexion type fractures noted in other studies was 2%, 13%, 4% and 3% respectively[1,3,6,15.]

Comminution of the medial or lateral pillars was found in 7/50(14%) of our patients, while this cominnution was noted in 57% cases in another study[12]. Comminution of the supracondylar pillars is associated either with the initial magnitude of trauma or with the repeated, aggressive attempts of close manipulations, and we did not manipulated the fractures repeatedly.

Ulnar nerve neuroprexia was noted in 2(4%) patients, and they all recovered completely within three months and exploration was not needed in any of them. Similar incidence of ulnar nerve neuroprexia was found by Boparai R et al[3]. The incidence of iatrogenic ulnar nerve injury ranged from 2 - 8% to 16.5% in other studies[16,17]. Our lower incidence of the ulnar nerve damage is attributed to the proper identification, isolation and protection of the nerve.

Pin tract infection was the most common complication, found in 9 (18%) patients and in all of them the infection subsided on oral antibiotics. This infection was noted in 40%, 18%, 8.6% and 1-21% by other authors' respectively[3,5,18,19]. We left the K-wires off the skin for easier removal in the outpatient clinic at the due time, this exposed placement of the K-wires make it more vulnerable to pin track infection in our patients.

Deep wound infection did not develop in any patient and similar lower rates of infection was noted by other authors, as it was found in 4%, 2.5% and 0% in their studies[1,3,12]. Measures as appropriate preoperative preparation of the limb, adequate antibiotics and meticulous tissue handling can avoid infections.

A minor degree of cubitus varus was noticed in only three (6%) patients. Similar lower rates of this complication were observed by Boparia R et al[3] who used open reduction for the treatment of these fractures.

This lower rate of deformities can be explained on the basis of following factors that are characteristic of open reduction through our approach. First, only one meticulous attempt was made to achieve closed reduction and repeated manipulations were avoided, thus comminution or further damage at the fracture site was avoided. Second, a reasonably wide exposure especially the medial and lateral windows, made the reduction quite easier, thus further soft tissue damage and bony comminution was prevented. Third the quality of reduction of the supracondylar pillars was easy to monitor under vision, thus horizontal rotation, coronal tilting and displacement of the distal fragments, that are the main causes of cubitus varus were avoided. Fourth, medial and lateral cross k-wires were passed instead of two lateral k-wires and thus a stable construct was provided which reduced the chances of displacement after fixation, and the stability of fixation was confirmed during operation.

Stiffness, producing an extension lag of 15 degrees was noted in three patients. While decreased range of motion was noted in 4% patients in another study[20].

Stiffness in the joint results from soft tissue damage due to the initial trauma, repeated manipulations or surgical trauma. Earlier posterior approach was found to be associated with elbow stiffness, but in the past decade or two the use of posterior approach did not show any significant increase in elbow stiffness[1]. We noted elbow stiffness in fewer patients with less severity, because we avoided further trauma to the tissues by, first, avoiding multiple attempts at close reduction, second, using the extensor mechanism sparing posterior approach that provided wide exposure of the fracture site through medial and lateral windows that made an accurate reduction easy and thus rough handling of the tissue was minimised, and neither the triceps nor the brachialis were disturbed.

The overall results obtained in one study are eighty two percent excellent or good, 12% fair, and 6% poor, while in another study, they were observed to be 85% excellent and good, 5.7% fair and poor in 8.5%. In a study conducted by Kumar R et al[12], showed excellent and good results in 84%, fair and poor in 16% of the patients. The results in our patients are compatible with all these studies.

In summary, open reduction and cross K-wire fixation through a posterior triceps non disturbing approach can be used safely in the treatment of type III supracondylar fractures that could not be reduced by closed methods. This approach ensures the safety of ulnar nerve, avoids trauma to the unaffected posterior soft tissues, and reduces further trauma to the affected anterior structures, as in this approach mainly the medial and lateral subcutaneous windows along the supracondylar ridges are used to make under vision precise anatomical reduction of the fracture feasible. This minimised soft tissue trauma reduces the postoperative stiffness of the elbow, and the anatomical reduction of the fracture prevents elbow deformities. Stable cross K-wires placement is possible without endangering the ulnar nerve, and this stable fixation makes early rehabilitation and range of motion exercises easier.

CONCLUSION

Triceps non disturbing posterior approach can be used safely and effectively for open reduction and cross K-wire fixation of type III supracondylar fractures, which are irreducible by closed methods especially in centres where the facilities of image intensifier are not available.

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