Close Reduction and Percutaneous K-wire Fixation without Image Intensifier in Supracondylar Fracture of Humerus in Children.

Ruhullah Mohammad[1], Sanjay Kumar Ranjan Shah[1], H R Singh[1], KD Sinha[1], Dipan Barua[1], Mohammad Irshad[1], Sanjay Gupta[1].

[1]Department of Orthopaedics, National Medical College Teaching Hospital, Birgunj, Nepal.

ABSTRACT

Introduction: Extension Type III supracondyla fractures of the humerus is most common fractures around the elbow in children. Closed reduction and percutaneous pinning under image intensifier guide has been the gold standard method of treatment. However, image intensifier is not readily available in most part of our country. Closed reduction and percutaneous pinning is possible even without image intensifier. we report our case series of 51 cases who underwent closed reduction and percutaneous pinning without image intensifier.

Methods: Between November 2009 and April 2011 a total of 51 children with a displaced supracondylar fractures of the humerus were managed by close reduction and percuteneus k-wire fixation without using image intensifier. They were followed for a period of minimum 6 months up to one and a half years (average one year) and the final outcome was assessed using functional and cosmetic criteria used by Flynn and associates.

Results: Of these 51 patients, 46 (90%) patients showed an excellent results. Satisfactory results were achieved in 4 (8%) patients, poor in 1(2%) patients.

Conclusion: Close reduction and percutaneous K-wire fixation without using image intensifier is radiation free, cost effective and relatively safe method of management of displaced supracondylar fractures of humerus in children. It can be used in a remote hospital where the facilities of image intensifier or portable x-ray are not available.

KeyWords: image intensifier; percutaneous pinning; supracondylar humerus fracture.

INTRODUCTION

Elbow fractures treatment in children remained a great challenge for orthopaedic surgeons since Hippocrates. Proper training is needed to adopt recent advances by young surgeons to deal with these challenges[1]. Extension type III supracondylar fracture of the humerus is the most common fracture around the elbow in children[2]. Immobilisation in a posterior back slab is generally accepted as the standard treatment for non-displaced fractures but there is controversy as to the best treatment for displaced fractures. Close reduction and percutaneous k-wire fixation without using image intensifier of these troublesome fractures provided stability, vascular safety, simplified management, avoiding exposure of radiation, cost effective, time saving , shorter hospital stay and consistently satisfactory results. The increase in the utilization of fluoroscopy during surgical procedures carries with it an inherent increase in the exposure of both patients and surgical staff to ionizing radiation. This procedure can be easily and safely performed in remote hospitals by orthopaedic surgeon where the facilities of image intensifier or portable x-ray are not available.

We report the results of close reduction and percutaneous k-wire fixation in 51 patients of displaced supracondylar fracture of the humerus without using image intensifier during the one and half year and with a follow-up of more than one year.

METHODS

This study was conducted at Orthopaedic departmentt of National Medical College and Teaching Hospital, Birgunj, Nepal from November 2009 to April 2011 receiving 51 patients through casualty and OPD. The index procedure chosen for the study was closed reduction and percutaneous fixation without using image intensifier of Gartland III supracondylar humerus fractures (Figure 1). There were 31(61%) male and 20 (39%) female with a mean age at presentation of 4 years (range 3 to 8 yrs). The exclusion criteria in this study were Gartland Types I & II, compound fracture, associated long bone fractures, preoperative neurovascular deficits and pathological

Correspondance

Dr Ruhullah Mohammad

Department of Orthopaedics , National Medical College Teaching Hospital, Birgunj, Nepal

E-mail: drruhullah@yahoo.com

fractures or fracture with vascular compromise. They were followed for a period of minimum 6 months up to one and a half years (average one year).

Under local anesthesia (LA), Intravenous (IV) sedation with diazepam and in supine position the involved elbow was scrubbed. Fracture was closely reduced by gentle traction with counter traction by the assistant, in the following stepwise manner; disimpaction by traction, side to side correction of angulatory and rotatory deformities by thumb and fingers manipulation, pushing the distal fragment with opposite hand thumb and simultaneously flexing of the elbow and keeping the forearm in pronation to prevent displacement. Pronation derotates the distal fragment from its frequently medially rotated position and locks it in correct alignment[3]. The medial or lateral displacement was corrected by applying a varus or valgus force. The assessment of reduction was done clinically by assessing the extent of flexion and by assessing the carrying angle. Reduction can be also confirmed intra operatively by palpating three bony points relationship i.e. medial, lateral epicondyle and the tip of the olecranon. Prior to k-wire fixation reduction was maintained by applying sterile roll gauze to wrist and upper arm. The placement of the k-wires/pins was similar to that described by Swenson and others[4-6]. But we used only lateral k-wire fixation of supracondylar fractures to avoid iatrogenic ulna nerve injury. If the reduction was satisfactory, the fracture was pinned by obeying the principles of fracture reduction and k-wire fixation, the prominence of lateral epicondyle the entry point of pinning and resistant was felt in the medial cortex. If the landmarks were obliterated by swelling, a few moments of pressing with finger and thumb massaged away the edema and made the landmarks readily palpable. We used a hand drill and minimum 2 K-wires of 1.8 mm diameter (Figure 2). The pin was thrust through the skin on the lateral side without using a stab wound. The pin point was moved about gently under the skin until it was engaged against the lateral epicondyle keeping the elbow in hyperflexion. The pin was then directed upward and medially at an angle of 35 to 40 degrees to the sagittal plane of the humerus and 10 degrees posterior to the coronal plane of the humerus. The pin thus passed through the distal fragment and the medullary cavity of the proximal fragment to engage the medial cortex of the proximal fragment about three centimeters above the fracture line. Placements of the pins were inside and outside of cortex can be confirmed by manual palpation, so that the pin pierced the opposite cortex. Resistance of medial cortex can be missed due to soft bones in children. Some practice was necessary to acquire the skill needed to place the pins through the thin, flat supracondylar region across the fracture site into the opposite cortex of the proximal fragment. If the pins were inserted properly, the surgeon experienced resistance as the pin entered the opposite cortex of the proximal fragment. In general, an inadequately reduced fracture was more difficult to pin than the anatomically reduced fracture. To avoid this problem, load the approximate size of k-wire in T-Handle purchasing both cortexes. For the pin construct to be acceptable and biomechanically stable one pin had to be placed in lateral column and another in central column of lateral condyle. Pins were placed either in parallel or divergent configuration with the adequate separation at fracture site. In parallel fixation the Kirschner wires were separated by a distance of at least 10 mm so that they acted as separate Kirschner wires and to avoid pins crossing at the fracture site to maintain maximal construct strength[7]. If in doubt of stabillity, up to 3 K-wire can be inserted for assurity since it is a procedure without image intensifier. Now the stability and carrying angle was checked by gentle extending the elbow. The carrying angle of the elbow in extension should be identical to the opposite side. The wires are cut outside the skin and are bent to prevent their migration. Elbow was immobilized with posterior slab with elbow in 70 to 90 degree of flexion depending upon the swelling and neurovascular status. All patients were given single dose of broad spectrum antibiotics followed by oral antibiotics for three to five days. The patient was carefully observed for twelve to seventy-two hours (average 2.4 days) and then allowed to go home. Neurovascular examination was performed preoperatively and immediate post operatively and at one week follow up. The wires were removed without anaesthesia at three weeks follow up and active exercises are begun.

All the patients were evaluated clinically and radiografically at one week, two weeks, three weeks, six weeks, three months, six months and one and half year. Baumann angle and Humerocapitellar angle were calculated on the post op radiographs and after three months for any loss of Baumann angle and Humerocapitellar angle. In follow up patients were assessed according to Flynn criteria[14] (Table 1).

Figure 1 & 2. Preoperative and Post operative X-Rays

Picture 3a, 3b & 4. Callus at 3 weeks and at 6weeks follow up.

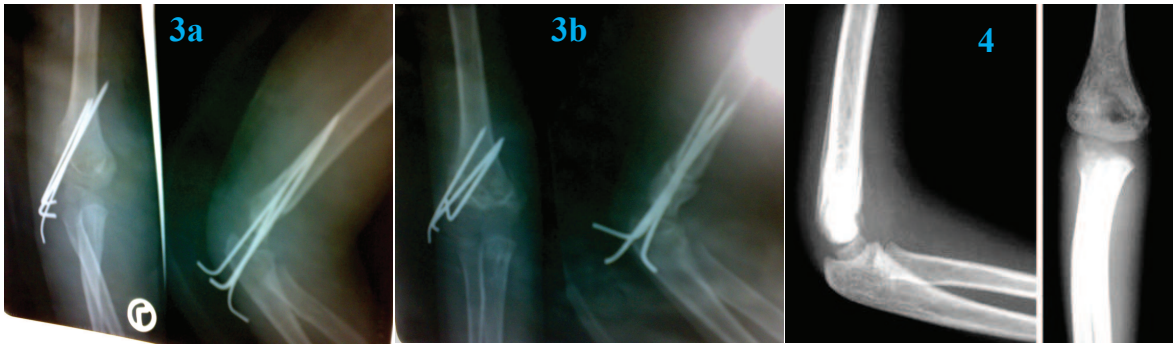

Table 1. Flynn Criteria for Reduction Assessment

RESULTS	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

RESULTS

Radiological callus was visible in all patients at 3 weeks post-operatively (Figure 3a & 3b). After removal of the splint and the wires at three weeks, the movements were regained at a very quick pace.

Union was achieved in all after 6 weeks of operation (Figure 4). Complications such as pin tract infections, myositis ossificans, compartment syndrome, deformity or nerve injuries in 46(90%) of cases did not occur. Range of motion of the elbow joint noted was 25 – 135 degrees in comparison to 0 – 140 degrees on the normal side after 6 weeks postoperatively. After three months of operation, elbow motion was equal to that of normal side (0 - 140 degrees). Carrying angle measured at follow-up 3 months after operation, was 8-10 degrees on the affected side except in 1(2%) patient where it was 0 degree. In one (2%) patient the end result was considered to be poor because of a poor cosmetic result with cubitus varus followed only in 6 weeks postoperatively with backed out all 2 K-wires. Among 3(6%) patients, in 1(2%) case where the K-wires were backed out at 3 weeks post op follow up and in 2(4%) cases had pin site infection on the 7th day postoperative on follow up and was given IV antibiotics and K-wires were removed on the same day and continue the application of posterior back slab, but the result was good on follow up without any deformity. The result was evaluated according to the criteria of Flynn et al, after a mean follow up of 6 months (range 6 to 12 months) (Table – 2).

Table 2. Results (According to Flynn criteria)

RESULTS	No of patients	Percentage
Excellent	46	90%
Good	3	6%
Fair	1	2%
Poor	1	2%

DISCUSSION

Extension type supracondylar fractures are the most common fractures around the elbow in children and adolescents. Fractures with Gartland type-I displacement are commonly treated by an above-elbow posterior slab without reduction. The treatment of more severely displaced (Gartland type II and type III) fractures remains controversial. But primary closed reduction and percutaneous pinning is the preferred treatment for the displaced fractures and gives the lowest rate of residual deformity and lowest rate of compartment syndromes of the forearm[8].

The aim of our procedure was to develop a simple algorithm of treatment to provide the best functional and cosmetic result even when undertaken by less experienced orthopaedic surgeons working in a remote hospital where the facilities of image intensifier or portable x-ray are not available. Utilization of fluoroscopy during surgical procedures carries with it an inherent increase in the exposure of both patients and surgical staff to ionizing radiation. The biologic effects of radiation have been shown to damage human DNA and the cellular structural matrix, potentially causing genetic alterations that could result in malignant changes[9]. In addition, skin burns, dermatitis, and cataract formation have been reported to occur as the result of radiation exposure[10]. The average radiation dose in micro-Sieverts received by the eye, thyroid gland and hands during orthopaedic trauma procedures like, K-wiring of supracondylar, distal radius, intramedullary nailing and putting an external fixator have been measured[11]. The technique of pinning is a matter of controversy and technical excellence. The choice is based

upon three basic points (i) stability of the construct, (ii) the avoidance of injury to the ulnar nerve and (iii) the avoidance of the radiation. Cross pinning is theoretically more stable biomechanically construct, but it adds to the risk of ulnar nerve injury especially when fracture is associated with swelling. Direct injury to ulnar nerve as well as delayed neuropathy possibly due to stretching of nerve over the medial pin is a known complication[12,13].

The technique of pinning has been popularized by Flynn [14] and others[4]. In a comparison of percutaneous crossed medial and lateral pinning with lateral pin fixation alone using two parallel pins, Topping et al[15] did not find any clinically significant biomechanical advantage of one pinning technique over the other.

We therefore choose lateral pinning by two parallel pins as the primary treatment for displaced supracondylar fractures. The technique has to be correctly applied. The K-wires must be strictly parallel and separated by a distance of more than 10 mm. If the wires are positioned too closely, the mechanical construct is equivalent to a single wire construct and allows rotation of the distal fragment around the axes of the wires. This was pointed out by Judet who initially used a single wire[16].

Any deviation and the stability are compromised. Hence, we chose 3 k-wire construct and modified this in a way that we do not have to introduce the wires from the medial side. Triple wire fixation also has the advantage of added stability. Bloom et al. reported that three lateral divergent pins were equivalent to cross pin fixation and both of these constructs were stronger than two lateral divergent pins[17]. If one wire for some reason or the other has a lesser hold, the third wire which is placed parallel to it makes up stability. Ends of the wires we leave outside the skin wound so that these can, later, be pulled out without anaesthesia. And a second operation for the removal of the wires were avoided. In our circumstances, it is significant as most of our patients are too poor to afford it.

CONCLUSION

Close reduction and percutaneous pining of displaced supracondylar fracture of the humerus in childrens can be performed without using image intensifier. This procedure can be easily performed in remote hospitals by orthopaedic surgeon where the facilities of image intensifier or portable x-ray are not available. Lateral pin fixation method for the treatment of type III supracondylar fracture is a reliably safe method to avoid iatrogenic ulnar nerve injury which also provides adequate stability if proper pin fixation principles are used.

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