



Comparative study of surgical treatment of supracondylar humerus fractures Gartland's extension type III in children by closed reduction and pinning versus open reduction and pinning methods

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Abstract

Background: Supracondylar fracture of humerus is the commonest injury about the elbow in children. Anatomical reduction and stability of fixation are required to prevent complications and improve cosmetic appearance.

Objective: To evaluate the safety and efficacy of the results of the closed reduction with K. wires fixation and open reduction with K. wires fixation of displaced supra-condylar humeral fracture in children.

Patients and Methods: The study was done for displaced supracondylar humeral fractures in children of 2-12 years of age who admitted to orthopedic department in Baquba teaching hospital and they were divided in 2 groups; group I patients were treated by closed reduction and K. wires fixation, and group II children were treated with open reduction K. wires fixation. All cases had been operated within the first 24 hours of injury, both groups were followed up for 4-6 months and evaluated clinically and radiologically.

Result: Fractures were more in boys than girls in both groups, most of the fractures were seen on left side. All the fractures were found to be united clinically and radiologically when X-rays were taken at 4 weeks in group I and at 6 -7 weeks in group II. Overall result according to Flynn's criteria was 96% satisfactory result in group I as compared to 92% in group II. Cubitus varus occurred in one patient in group I and in two patients in group II, the angles were 10°, 15°, and 25° respectively. No neurovascular complication had been noted in all cases in both groups.

Conclusion: closed reduction and K. wires fixation of displaced supracondylar humeral fracture in children is a safe, effective with rapid method of fixation with less complications.

Keywords: supracondylar humeral fracture in children, closed reduction, open reduction.

Introduction

Supracondylar humeral fracture is the most common fracture in children it accounts for 60% of fractures around the elbow^{1, 2, 5}. This superimposed on the frequency of falls in small children while playing on ground, cycling or falling from household objects such as bed, chair and other furniture, which are the factors responsible for the common occurrence of this type of fracture in children^{2,8,13}. In addition to that the metaphysis being the weakest area around the elbow^{1, 7}. Most of these fractures occur between 5-7 years of age, more frequent in boys^{1,11} and predominately involves non-dominant hand in almost all studies^{1,6,8}.

There are two types of supracondylar humeral fractures according to the mechanism of injury, extension type which accounts for about 97% of the cases and are due to a fall onto outstretched hand with the elbow in full extension^{4, 11} and flexion type which is rare and occur in 3% of the cases and is due to a fall on a flexed elbow^{1,5,15}. The Gartland classification is the most commonly accepted and applied system of classification of the supracondylar humeral fracture⁷. During clinical evaluation of children with supracondylar humeral fracture, the whole limb should be examined for associated fracture of forearm as this fracture increase the risk of compartment syndrome^{5, 9, 11, 20}. Neurological examination as radial nerve which occur in association with the fracture and ulnar nerve injury which mainly iatrogenic injury^{12,19}.

The management of displaced supracondylar humeral fracture is one of the most difficult of the many fractures seen in children, it should be considered as a surgical urgency^{5, 7, 16}.

Various treatment modalities available which includes close reduction and POP (plaster of Paris) cast, slab application, skin traction, overhead skeletal traction, open reduction and internal fixation and close reduction and percutaneous pinning^{1,3,19}.

This variation may be owing to individual surgeons skill or owing to differences in surgical facilities, each method has its own advantages and disadvantages.

The main objectives of treatment for supracondylar humeral fracture in children are accurate anatomical reduction for restoration of normal elbow function and prevention of complications such as Volkmann's ischemic contracture, neurovascular injury, myositis ossificans, stiffness of elbow, and malunion^{3,9,16}.

The purpose of the study was to evaluate the anatomical and functional results of treatment of supracondylar humeral fracture with closed reduction and percutaneous K. wire fixation versus open reduction and percutaneous K. wire fixation.

Patient and Methods

The study was done in Baaquba teaching hospital, orthopedic department from 1st of January 2017 to 30th of June 2018, of the total cases (fifty patients) of closed displaced extension type of supracondylar humeral fractures (Gartland's type III, 2-12 years of age, of both genders were included in this study with 25 patients were treated by closed reduction and percutaneous K. wires fixation and 25 patients treated by open reduction and K. wires fixation.

All the patients selected for this study had been treated within the 24 hours of accident and followed up at 2 weeks, 4-6 weeks and 3, 4, 6 months.

Open fractures, fractures with neurovascular complications, patients unfit for general anesthesia and children younger than 2 years and older than 12 years were excluded from this study.

Surgical technique

Closed reduction and K. wires fixation:

Under general anesthesia and under C arm fluoroscopy with patient in supine position with affected limb on side arm support table, closed reduction is done, both anteroposterior and lateral images must confirm good reduction which is very important for a good outcome, K. wires used for fixation are of 1.5- 2mm diameter. The lateral condyles were identified under image intensifier and fixed by 2 crossed or parallel K. wires on the lateral condyle, medial K. wire fixation carries the risk of ulnar nerve compression or injury, the direction, length of K. wire and the stability of the fracture was checked under C-arm image intensifier, radial pulsation should be checked.

After fixation, the elbow are moved through its full range of movement.

Above-elbow POP slab is applied after properly padding the arm and forearm.

Full range of movements at metacarpo-phalangeal and inter phalangeal joints are advised.

Open reduction and K. wires fixation

Under general anesthesia with patient in supine position with affected limb on side arm support table, sometime lateral position used and affected elbow supported on a sand bag and it was left free on the side of the table, tourniquet was applied. Then the elbow with distal arm painted and draped, open reduction using a posterior approach with midline triceps split was performed. Cleaning and anatomic reduction of fracture fragments was performed and stabilized with crossed K. wires through medial and lateral condyles, in some patient 3rd K. wire was inserted laterally for better stability. K. wires were buried under the skin, which reduces the chance of infection and lowers the risk of early removal of an infected K. wire and subsequent displacement of fracture fragments^{11, 18}.

Postoperatively

Group I: All patients discharged within the 24 hours of surgery after checking of X-ray then re- X-rayed at the end of 2 weeks. The elbow movement is started after the POP slab was removed at the end of 4 weeks, X rays were taken anteroposterior and lateral views to see the callus formation. Physiotherapy was continued and followed for any swelling, or pin track infection. Elbow range of movements and the carrying angle were observed and evaluated.

Group II: All patients were discharged 48 hours after the surgery, skin sutures were removed at the end of 2nd week and checked by X-ray, and the back slab was removed after 5-6 weeks, mobilization of the elbow start when it is pain-free. The buried K. wires were

removed at 6 weeks (after checking fracture consolidation by X-ray).

At 4 months for both groups, the range of motion and carrying angle were measured with a goniometer and graded according to Flynn's criteria. The Baumann angle was measured for radiological assessment¹². The patients were also evaluated for functional range of motion of the injured elbow, which is established as 75–120 degrees of flexion with an arc of motion of 45 degrees necessary for feeding and toilet purposes^{13,18}.

Clinical union with callus formation was seen in all the patients at the end of 4 weeks post operatively in group I and at the end of 6 weeks in group II.

All patients were followed at the end of 2nd, 4th and 6th months.

The subjective satisfaction of the outcome, in group I it was excellent in 15 patients, good in 7 patients, fair in 2 patients and poor in 1 patient (due to mild displacement of distal fragment and cubitus varus), while in group II it was excellent in 13 patients, 6 good in patients, fair in 2 patients and poor in 4 patients. In both groups the four fair cosmetic results were associated with inadequate reduction and residual medial angulation, and the five poor results also due to inadequate reduction and residual medial angulation and calcification or obliteration of olecranon fossa.

Evaluation of Outcomes

A total of 50 patients were included in the study, fractures were more in boys (66%) compared to girls (34%) in both groups (Table 1). Most of the fractures in both groups were seen on left side (66%) and (34%) in right side (Table 2).

Table 1: Distribution of patients according to gender.

Parameter	Group I	Group II	Total
No. of patients	25	25	
Sex (%)			
Boy	16 (64%)	17(68%)	33(66%)
Girl	9 (36%)	8 (32%)	17(34%)

Table 2: Distribution of patients according to the side injured.

Side	Group I	Group II	Total
Right	10 (40%)	7(28%)	17(34%)
Left	15(60%)	18(72%)	33(66%)

Mean time for fracture healing was 4 weeks in group I while 6 weeks in group II. Postoperative functional outcomes were assessed using Flynn's criteria (Table 3).

Table 3: Results according to Flynn's criteria among the study groups.

Flynn's criteria results after 6 months total

Loss of Carrying angle in degrees >15 poor 10–15 fair 5–10 good < 5 Excellent
 Loss of ROM (flex-ext) in degrees >15 poor 10–15 fair 5–10 good < 5 Excellent

Results	Poor	Fair	Good	Excellent	
Group I	4.0%	8.0%	28.0%	60.0%	100.0%
Group II	16.0%	8.0%	24.0%	52.0%	100.0%
Total	10.0%	8.0%	26.0%	56.0%	100.0%

There is significant difference in comparison of duration of surgery among both study groups, closed reduction required less duration of surgery (Table 4)

while X-ray exposure is more in group I than group II which can be decreased by surgeon experience.

Table 4: Duration of surgery and duration of healing:

Duration of surgery (in minutes)	
Group I	20
Group II	40
Duration of healing (weeks)	
Group I	3-4
Group II	5-6

According to Flynn's criteria, the range loss of motion, and carrying angle was less than 10 degrees in 22 patients in group I and 19 patients in group II, one patient has loss of motion more than 15 degrees in group I and 4 patients in group II.

Six patients from group I and 3 patients from group II developed pin tract infections which resolved with oral antibiotics and did not require premature K. wires removal. K. wires were removed at 4 weeks for group I and 5-6 weeks for group II after surgery.

None of the patients in both groups had developed post-operative complications such as iatrogenic nerve injury, compartment syndrome or myositis ossificans. One patient from group I and 2 patients from group II developed lack of full extension and cubitus varus.

Discussion

Supracondylar humeral fractures are the most common fracture seen in children, the management of severely displaced forms is controversial and has given rise to different methods of surgery. The important goals of the treatment are full recovery of elbow movements, achieving good cosmetic view of elbow and protecting the patient from developing any neurovascular complications.

Supracondylar humeral fractures are more common in boys than girls. In our study 66% were boys and 34% were girls. These results are coinciding with other literatures^{12,14,16}. In our study, the fractures are more common on left side 66% and 34% on the right side, these results were also coinciding with other studies^{14,16,17}.

Closed reduction and K. wire fixation of supracondylar fracture in children is a sound, rapid, and effective technique especially for type 3 fractures, advantages of percutaneous pinning include rapidity, no soft tissue dissection and minimal disturbance of fracture hematoma which result in a minimal risk of infection and rapid healing.

Drawbacks are more X-ray exposure and risk of iatrogenic ulnar nerve injury which is avoidable by putting 2 or 3 wires laterally.

The open technique allows accurate fracture reduction, and avoidance of ulnar nerve injury, but is associated with increasing risks of infection, motion range limitation and unsightly or painful scars.

There is a statistically significant difference of healing time between two groups, this is because of evacuation of fracture hematoma and stripping of periosteum during open reduction method to achieve anatomical reduction.

In total 25 patients in group I excellent results in 15 patients, good results in 7 patients, 2 fair results 1 patient with poor result were obtained.

Deep pin tract infection was detected in 1 patient in which K. wires were removed after 3 weeks.

In total 25 patients in group II excellent results in 13 patients, good results in 6 patients, fair results in 2 patients and poor result in 4 patients (cubitus varus and limitation of elbow movements)^{5,7}.

Percutaneous pinning after closed reduction has got superiority over other techniques, as this technique provides anatomic and stable fixation with good function and less morbidity with minimizes the risk of compartment syndrome^{1,2}.

Conclusion

Early closed reduction and percutaneous K. wires fixation is a gold standard treatment for extension (Gartland's type III) supracondylar humeral fracture in children.

Because of a higher satisfaction score with better cosmetic outcome, less surgical trauma to the soft tissues, minimal hospital stay, less postoperative stiffness and cost effective compared to open reduction and K. wires fixation. The use of two K. wires laterally was preferred to reduce the risk of ulnar nerve palsy. According to Skaggs et al, the use of lateral-entry K. wires alone was effective for even the most unstable supracondylar humeral fracture, they recommended using three diverging lateral K. wires which provides the same degree of biomechanical stability as the cross K. wires technique.

Open reduction and K. wire fixation have greater risks of excessive callus formation and deep infection of the wound which may result in delay in starting the physiotherapy and getting a good range of movements. From our study we concluded that closed reduction and percutaneous fixation is a sound, rapid and effective technique for treatment of displaced supracondylar humeral fractures in children.

We believe these results support the first-line use of percutaneous pinning, which is simpler and less aggressive than open reduction and cross K. wiring.

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