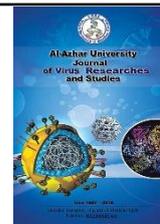




Al-Azhar University Journal for Virus Research and Studies



Safe Technique for Closed Reduction of Pediatric Supracondylar Humerus Fracture

Mohammed M. A. Ghazy *¹, Hany Z. Mohammed ² and Ashraf M. Abdelaziz^{1,2}

¹Clinical Pathology Department, Al-Khankah Central Hospital, Ministry of Health.

²Clinical Pathology Department. Faculty of Medicine for Girls, Al-Azhar University.

*E-mail: mohaalazab548@gmail.com

Abstract

Supracondylar fractures of the humerus are the most commonly diagnosed elbow fractures in children. Severely displaced supracondylar fractures of the humerus in children are challenging injuries to treat. Aim of work was to evaluate joystick technique for closed reduction of pediatric supracondylar humeral fracture and fixing it by k-wires according to clinical and radiological results during follow up. In this study, 20 patients (12 females, 8 males) aged from three to eight years who had supracondylar fractures and reduced by joystick technique and operated upon by closed reduction and pin fixation at Al-Zahraa university hospital, Cairo and Al Mahalla general hospital and followed up for an average 9 months. Among the 20 patients, four of them had superficial pin tract infection treated by course of antibiotics with dressing, one patient had mild loss of reduction, but it was stable, so it was left as it and another one had hyperextension of the elbow less than two degrees, so we delayed exercise of the elbow till complete healing. Supracondylar fractures of the humerus in children continue to possess treatment challenges for the surgeon. CRIF through joystick technique versus other techniques seems to be the hot topic of debate. This study concluded that treatment of supracondylar fractures of the humerus in children in age group 3- 8 years) by joystick technique for closed reduction and fixation with K- wires if placed with proper technique is a stable method of fixation.

Keywords: Supracondylar, Humerus, Fracture, Closed Reduction, Children.

1. Introduction

Supracondylar fractures of the humerus are the most commonly diagnosed elbow fractures in children and represents about 3% of all fractures. Severely displaced supracondylar fractures of the humerus in children are challenging injuries to treat [1]. There remains controversy in the literature with regard to the definitive management of these types of fractures.

The differences among authors relate mainly to the choice between treatment by closed versus open reduction with the suitable approach and percutaneous K-wire fixation [2]. Supercondylar humerus fractures occur proximal to the articular surface of the distal humerus and may be transverse, oblique, or jagged. Gartland described a rotatory and translational

deformity, with posterior displacement (extension) of the distal fragment occurring most often and described three types of extension injury based on degree of displacement. Type I nondisplaced, type II moderately displaced, and type III severely displaced injury and considered flexion-type injuries separately [3].

There is no clear evidence in the actual literature regarding which of the surgical approaches could bring about the best functional, cosmetic, and radiological outcomes, as well as fewer complications, when an open reduction and pinning of a severely displaced supracondylar humerus fracture is performed [4]. Four different surgical approaches have been described in displaced supracondylar humerus fractures requiring surgical treatment [5]. And also, there are many techniques used in reduction of this type of fracture as joystick technique (the most common type) and another technique by using a K-wire introduced percutaneously from the posterior aspect of the arm through the medullary canal of the humerus, similar to Kapandji's technique.

2. Patients and Methods

In this study, 20 patients (12 females, 8 males) aged from 3 to 8 years who had supracondylar fractures were reduced by joystick technique and operated upon by closed reduction and pin fixation at Al-Zahraa university hospital, Cairo and Al-Mahalla general hospital and followed up for an average 9 months.

2.1 Inclusion criteria:

Child patient with any type of closed unstable supracondylar humerus fracture and up to 8 years old.

2.2 Exclusion criteria:

Child above 8 years old, Neurovascular injury on presentation, old fracture or deformity and open fracture.

2.3 Personal data

Name, age, sex and address.

2.4 Complaints

Pain, swelling of the elbow and loss of function of the injured limb.

2.5 History

Time of injury affected side, mechanism of injury and medication and allergies.

2.6 Physical examination

Affected side, Deformity, swelling, Tenderness, Movement, Neurovascular condition, skin condition and other injuries.

2.7 Radiological evaluation

Standard AP and lateral plain X-ray views of the affected limb were done for all patients. CT scan was done in some cases.

2.8 First aid measures

All displaced supracondylar fractures were admitted, and injured elbow was immobilized in splint with elbow in 70 to 90 degrees of flexion. Analgesics were given.

2.9 Surgical technique

All patients were treated by closed reduction and fixation with Kirschner wires. The technique for reduction was joystick technique, the pin size (1.6mm-2mm).

2.10 Anesthesia

All patients underwent surgery under general anesthesia, and they received prophylactic antibiotics (50 mg/kg cephalosporin) half an hour before surgery.

2.11 Positioning

The injured elbow was placed on the plate of image intensifier which was adequate for the surgery due to the small size of the elbow (Fig.1).



Figure (1): Position of the elbow on the plate of the image

2.12 Technique of reduction

Closed reduction was done and confirmed by image intensifier. Reduction can be considered a “joystick” technique which involved a K- wire can be passed through the distal fragment from medial to lateral and used as a joystick to reduce the fracture and maintain reduction while pinning. During reduction by using joystick technique the fracture is first reduced in the coronal plane with the elbow in extension while gentle traction is applied. When skin puckering is present because the proximal fragment is transecting the brachialis muscle, the ‘milkman’s manoeuvre’ of the anterior part of the arm is useful to release the proximal fragment. Surgeons need to be aware of the higher risk of neurovascular injury associated with skin puckering. Later, pronating or supinating the forearm corrects rotation of the fragment. Finally, the elbow is flexed while pushing the olecranon to the correct extension. Maintaining the elbow in maximum flexion to stabilize the fracture until fixation with percutaneous pinning is performed under c-arm evaluation. Sometimes, maintaining the elbow flexed

does not stabilize fractures while pinning. In those cases, a K-wire can be passed through the distal fragment from medial to lateral and used as a joystick to reduce the fracture and maintain reduction while pinning as shown in Figure .2.



Figure (2): Position of the elbow on the plate of the image

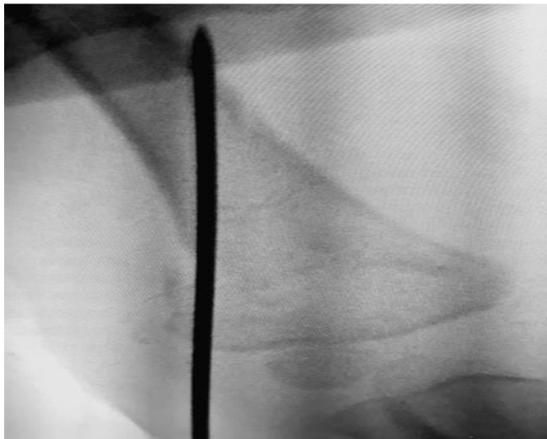
2.13 Fixation

After acceptable reduction two or Three K-wires (1.6-2mm) were inserted. The first k-wire was inserted within the lateral column and achieved strong purchase in the medial cortex of the proximal fragment. The position of the first k-wire is confirmed on both AP and lateral views. The second and third k-wires were inserted from the lateral

or medial side according to the surgeon. as shown in Figure .3, 4. The wires were then bent and cut outside the skin. Elbow was immobilized with posterior slab with elbow in 70 to 90 degrees of flexion depending upon the swelling and neurovascular status as shown in Figure. 5.



(a)



(b)



(c)



(d)

Figure (3): (a), (b), (c) & (d) anatomical reduction and inserting guidewires under fluoroscopy.



Figure (4): Fixation instruments 1: Electric drill 2: Bender & cutter 3: K-wire 1.6 mm 4: Key.

2.14 Postoperative care

Vital signs were recorded routinely, Neurovascular assessment was done at the affected limb, an intravenous antibiotic (50 mg/kg individual dose) was given two times daily for two days, appropriate analgesia was given when required, check X-rays were done in the first postoperative

day to check the position of the wires and patient was discharged from the hospital after 2-3 days.



Figure (5): Wires bent and cut outside the skin followed by above elbow slap.

2.15 Follow up

Regular follow up visits were weekly, till 6 weeks then monthly and radiographic evaluation was performed in every visit. Splint and K-wires were removed after 3 to 4 weeks. Physiotherapy is very important after k-wires removal. Clinical evaluation was graded according to carrying angle and elbow range of motion using the criteria of Flynn et.al.

2.16 Ethical Considerations

Oral and written informed consent will be signed by one of the patient's parents in the study. Ethical issues and anonymity of

patient's names will be taken in consideration.

2.17 Statistical analysis

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 23. The quantitative data were presented as mean, standard deviations and ranges when parametric and median, inter-quartile range (IQR) when data found non-parametric. Also, qualitative variables were presented as number and percentages. The comparison between groups regarding qualitative data was done by using Chi-square test and/or Fisher exact test when the expected count in any cell found less than 5.

3. Results

The In this study, the mean age was five years seven months ranged from (3-8) years, 12 patients were females (60%) and eight patients were males (40%) as shown in Table .1. The final results according to Flynn's criteria were, ten patients had excellent results (50%), seven patients had good results (35%), two patients had fair results (10%) and one patient had poor result (5%) as shown in Table .2. Regarding carrying angle, results were ten patients excellent (50%), seven were good (35%), two were fair (10%), one was poor (5%) as shown in Table .3. According to extension loss, there were ten excellent (50%), six were good (30%), two were fair (10%), one was poor (5%), and one case had hyperextension of the elbow as shown in Table .4. Among the 20 patients, four of them had superficial pin tract infection treated by course of antibiotics with dressing, one patient had mild loss of reduction, but it was stable, so it was left as it and another one had hyperextension of the elbow less than two degrees, so we delayed exercise of the elbow till complete healing as shown in Table .5.

Table (1): Demographic characteristics of the studied cases

Age/years/Sex	n=20	%
Mean	5.65	
Median (Min-Max)	5	(3.0-8.0)
<5	9	45
≥5	11	55
Female	12	60.0
Male	8	40.0

Table (2): Flynn's criteria among studied cases

Flynn's criteria	n=20	%
Excellent	10	50%
Good	7	35%
Fair	2	10%
Poor	1	5%

Table (3): Carrying angle degree among studied cases.

Carrying angle	n=20	%
0-4	10	50%
5-9	7	35%
10-14	2	10%
>15	1	5%

Table (4): Extension loss degree among studied cases.

Extension loss	n=20	%
0-4	10	50%
5-9	6	35%
10-14	2	10%
>15	1	5%
Hyperextension	1	5%

Table (5): Extension loss degree among studied cases.

Complications	n=20	%
No complication	14	70%
Mild Loss of reduction	1	5%
Pin tract infection	4	20%
Hyperextension	1	5%

4. Discussion

Supracondylar fracture is one of the most common elbow injuries in children [8]. Currently, closed reduction and percutaneous pinning of Gartland's types II and III supracondylar fractures of the humerus in children have become the standard method of treatment [9]. However, controversy exists about the different techniques used in reduction of this type of fracture. This study included 20

patients treated by closed joystick technique for reduction and fixation with K- wires. The mean age was five years seven months ranged from (3 to 8) years, 12 patients were females (60%) and eight patients were males (40%), 17 patients had their fracture as a result of falling on outstretched hand (85%) and three patients had their fractures as a result of falling from height (15%), the time from injury to

surgery range between (5-48) hours. According to Gartland classification all cases were extension type 15 of them were type II (75%), five cases were type III (25%), operative time range was (30 -90) minutes. According to Flynn's criteria, ten patients had excellent results, seven patients had good results, two patients had fair results and one patient had poor results due to mild loss of reduction. Patients were early mobilized after pin removal (3 to 4 weeks average); the follow up period was six months average. There was one patient with a carrying-angle loss of ten degree or more compared to the opposite elbow. More than ten-degree loss in carrying angle may lead to development of cubitus varus deformity. The cubitus varus may need to be corrected -not only for cosmetic appearance - but also to avoid tardy posterolateral rotatory instability of the elbow in future. We found no iatrogenic neurovascular injuries during the study in patients treated with this technique. Several studies showed comparable results to the result of this study as follows; Lee et al [10] reported 61 Gartland type II or III supracondylar fracture in children (mean age, 5 years 6 months) treated between 2001 and 2004 according to the following protocol: close reduction by joystick technique and percutaneous pinning using K- wires. Minimum 2 years follow-up was done in all 61 patients, of whom 24 (39%) presented with Gartland type II fractures, and the remaining 37 (61%) presented with a type III fracture. A comparison of perioperative and final radiographs shows no loss of reduction of any fracture.

There was also not clinically evident cubitus varus, hyperextension, or loss of motion. Eight patients had preoperative nerve palsy. Five of these nerve injuries resolved immediately after surgery, and the other 3 resolved completely within 12 weeks of surgery. After an average of 28

months post operation, 56 (91.8%) patients had achieved an excellent clinical result, and 5 (8.2%) achieved a good result. There were no iatrogenic nerve palsies, and no patient required additional surgery. One patient had a minor pin-track infection. Sahu RL [11] reported 85 displaced supracondylar fractures of humerus, aged between one and half year and eight years, were treated using joystick technique for closed reduction and percutaneous K- wire fixation. Above elbow plaster of paris back slab was applied in all cases for at least 3-4 weeks.

The slab and K-wires were removed after 4 weeks, and elbow range of motion exercise was started. 68.23% had excellent, 29.40% good, 1.17% fair and 1.17% had poor results at eight weeks, which was improved to 91.75% excellent, 7.05% good, 1.17% fair and no poor result at final follow-up. There was no iatrogenic neurological injury either for the ulnar or for the radial nerves. Five patients developed superficial pin tract infection post-operatively and were treated conservatively with good healing and no long-term sequelae. They concluded that joystick technique for closed reduction and percutaneous pinning proved an efficient, reliable, and safe method in the reduction and treatment of displaced supracondylar fractures of the humerus in children.

5. Conclusion

Supracondylar fractures of the humerus in children continue to possess treatment challenges for the surgeon; CRIF through joystick technique versus other techniques seems to be the hot topic of debate. This study concluded that treatment of supracondylar fractures of the humerus in children in age group (3- 8 years) by joystick technique for closed reduction and fixation with K- wires if placed with proper technique is a stable method of fixation

References

1. Ozkoc G, Gonc U, Kayaalp A, Teker K, Peker TT. Displaced supracondylar humeral fractures in children: open reduction vs. closed reduction and pinning. *Arch Orthop Trauma Surg.* 2004; 124: 547–551.
2. Koval, KJ, Zuckerman, JD. Atlas of Orthopaedic Surgery - A Multimedia Reference, 1st Ed, Chapter 12, Supracondylar Humerus Fractures. Lippincott Williams & Wilkins, Philadelphia. 2003; 125-132.
3. Kaewpornawan K. Comparison between closed reduction with percutaneous pinning and open reduction with pinning in children with closed totally displaced supracondylar humeral fractures: a randomized controlled trial. *J Pediatr Orthop B.* 2001; 10:131–137.
4. Cheng JC, Ng BK, Ying SY, Lam PK. A 10-year study of the changes in the pattern and treatment of 6,493 fractures. *J Pediatr Orthop.* 1999; 19:344–350.
5. Skaggs DL, Flynn JM. Supracondylar fractures of the distal humerus. In: Rockwood and Wilkins Fractures in Children, 7th ed, Beaty JH, Kasser JR, Lippincott Williams & Wilkins. 2010; 487-532.
6. Minkowitz B, Busch MT. Supracondylar humerus fractures. Current trends and controversies. *Orthop Clin North Am.* 1994; 25:581–594.
7. Spencer HT, Dorey FJ, Zionts LE. Type II supracondylar humerus fractures: can some be treated nonoperatively? *J Pediatr Orthop.* 2012; 32:675–681.
8. Skaggs DL, Hale JM, Bassett J. Operative treatment of supracondylar fractures of the humerus in children. The consequence of pin placement. *J Bone Joint Surg Am.* 2001; 83 (5): 735-740.
9. Simanovsky N, Lamdan R, Mosheiff R. Underreduced supracondylar fracture of the humerus in children: clinical significance at skeletal maturity. *J Pediatr Orthop.* 2007; 27(7):733-738.
10. Lee YH, Lee SK, Kim BS. Three lateral divergent or parallel pin fixations for the treatment of displaced supracondylar humerus fractures in children. *J Pediatr Orthop* 2008; 28:417–22.
11. Sahu RL. Percutaneous K-wire fixation in paediatric supracondylar fractures of humerus: A retrospective study. *Niger Med J.* 2013; 54(5): 329–334.