

The Outcome of Percutaneous Lateral Pinning of Displaced Supracondylar Fracture of the Humerus in Children

Yasin Thamer Hussein (MBCChB, FICMS)¹ and Abdulrahman Saeed Ahmed (MBCChB, FICMS)²

Abstract

Background: Supracondylar humeral fracture in children is the most frequent one in the first decade of life. Closed reduction and percutaneous pinning has been adopted as the treatment of choice, and the outcome has relied mainly upon the perfection of reduction and the stability of fixation. Many configurations of pinning has been used.

Objective: To evaluate the efficacy and safety of the closed reduction and lateral pinning in treating displaced supracondylar humeral fracture.

Patients and Methods: Thirty-eight patients of extension type Gartland class III displaced SCHF in children aged (1.5-13) years had been included in this study in the period from April 2014 to July 2016 all of them had been treated by closed reduction and lateral percutaneous pinning. They were (26) males (68.4%) and (12) females (31.6%) and the mean age was (5.8) years. The left side was injured in (25) patients (65.8%) and the right side was involved in (13) patients (34.2%). All cases had been operated within the first 24 hours of injury.

Results: Stable and satisfactory reduction had been obtained in all cases except one, in whom failure of reduction occurred postoperatively. All cases regained full-range of extension and flexion of elbow movement after about 3-4 months. Baumann's angle was (76 ± 2.5) and (74 ± 0.5) on the injured and normal sides respectively. In all cases the carrying angle of elbow was within normal limit. No neurovascular complication had been noted in the all cases.

Conclusion: Percutaneous pinning using the lateral configuration technique found to be stable and safe method.

Key words: Supracondylar Humeral fracture, Closed reduction, Lateral pinning.

Corresponding Author: dr-saeed8688@hotmail.com

Received: 25th December 2016

Accepted: 4th June 2017

<https://doi.org/10.26505/DJM.13023071225>

^{1,2} Baquba Teaching Hospital -Diyala - Iraq .

Introduction

Supracondylar humeral fracture (SCHF) is the most common fracture of the elbow in children [1][2][3]. Most of these fractures occur between 5-7 years of age, more frequent in boys [2][4]. And predominantly involves the non-dominant

side in almost all studies [1][5][6]. Supracondylar humeral fractures are classified according to the mechanism of injury into two main types: extension type, which accounts for about 95-98% of the cases and are due to a fall onto the

outstretched hand with the elbow in full extension [7][8]. And flexion type: Is rare and due to a fall on a flexed elbow, and this type occurs in about 2-5 % of the cases [7]. The modified Gartland classification is the most commonly accepted and applied system for classification of the extension type of supracondylar humeral fracture .according to that classification we have four types; type 1: Is non or minimally displaced, type 2: Is displaced but the posterior cortex is intact and radiologically the anterior humeral line does not go through the middle of the capitellum, Type 3 : Is displaced fracture with no significant cortical contact and type 4: Is multidirectionally unstable, and it may occur iatrogenically during attempts for reduction [7] .

During the clinical evaluation of the child with supracondylar humeral fracture ,the whole limb must be examined as forearm fracture can occur in association with this fracture and this can significantly increase the risk of compartment syndrome[7,8,9,10,11].The neurological examination must be performed carefully because of the high incidence of nerve injury which is considered to be the most common complication of supracondylar humeral fracture[1].

The anterior interosseous nerve is the most commonly involved contributing to about 34% [11][14][15][16]. The ulnar nerve has the highest incidence of iatrogenic injury , [4,9,10].In the radiographic diagnosis, in the AP view the Baumann's angle which is subtended between a line perpendicular to the longitudinal axis of the humerus and the line passing along the physis of the lateral condyle and normally is (9° - 26°) ,a decrease in this angle indicates that the fracture is in varus angulation (8),and this represents the original Baumann's angle and called angle (b). Angle (a) is currently

more commonly used and it is subtended between the longitudinal axis of the humerus and a line passing along the physis of the lateral condyle and normally is less than (80°) [2][7].

The definitive treatment of the supracondylar humeral fracture relies upon the type of the Gartland's classification. type 3, is usually treated by closed reduction and percutaneous pinning, open reduction is used if the fracture is irreducible by closed reduction, in cases of open fracture or in fractures associated with vascular injury [9][10][11]. Many pinning techniques have been used, crossed medial and lateral pinning has been presumed to be more stable but has a higher risk of iatrogenic ulnar nerve injury, two parallel lateral pins if placed properly can provide the same stability and avoid the ulnar nerve injury and some prefer to add a third lateral pin to augment stability on need [12].

The present study design to evaluate the efficacy and safety of the closed reduction and lateral pinning in treating displaced SCHF.

Patients and Methods

In the period from April 2014 to July 2016, (38) children with displaced supracondylar humeral fracture were included in our study in the Orthopedic Department in Ba'quba Teaching Hospital, 26 were males and 12 were females, their age ranged 1.5- 13 years.

All cases were with extension Gartland's type III supracondylar humeral fracture.In (25) patients the injured limb was the left side (65.8%), while the right side was involved in (13) patients (34.2%) .They had been submitted to closed reduction and lateral percutaneous pinning .

The exclusion criteria, were open fractures, supracondylar humeral fractures associated with ipsilateral forearm bone fracture and patients with failure of an

attempt to achieve closed reduction. All cases were operated in the first (24) hours of the injury. In the theatre while the patient is anesthetized closed reduction of the fracture with the aid of the image intensifier and the perfection of the reduction is verified by evaluating the Baumann’s angle in the AP view, it must be less than (80°) and the anterior humeral line in the lateral view which has to intersect the middle of the capitellum, after that the fracture is fixed by two parallel K-wires inserted from the lateral aspect of the elbow.

The size of the wires is (1.5-2 mm), after that the stability of the fracture fixation is checked. The limb is splinted by a back-slab in (60-90°) elbow flexion. Antibiotic prophylaxis is given in two doses of third generation cephalosporin. The patient is discharged from the hospital on the same day after recovery from anesthesia or on the next

day. The patient is evaluated clinically and radiologically after one week , and other periodic evaluations are recommended to be done at the 2nd , 3rd , 6th ,12th and 24th weeks. The wires and the cast are removed after (3-4) weeks postoperatively. The grade of perfection was assessed according to the carrying angle and elbow range of motion using the criteria of Flynn et al. Radiographic evaluation was done by checking the elbow by AP and lateral view x-ray , and Baumann’s angle and anterior humeral line were assessed to check for any loss of reduction .

Results

The result of present study show that minimum age was 1.5 years and maximum age was 13 years with mean age 5.8 years, 26 were males (68.4%) and 12(1.6 %) were females. Statistical analysis show significant differences .

Table (1): Distribution of the patients according to gender.

Gender	Frequency	Percentage (%)
Male	26	68.5
Female	12	31.5
Total	38	100

Supracondylar humeral fracture found to affect more commonly the left side .

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

Side injured	Frequency	Percentage(%)
Left	25	65.7
Right	13	34.3
Total	No.=38	100

Table (3): Flynn criteria for grading results.

Result	Cosmetic factor (degrees of loss of carrying angle)	Functional factor (degrees of loss of extension / flexion motion)
Excellent	0-5	0-5
Good	6-10	6-10
Fair	11-15	11-15
poor	>15	>15

This study included (38) cases of supracondylar humeral fracture in children all of them were extension Gartland type III ,all of these cases were submitted to closed reduction and lateral percutaneous pinning .Stable and satisfactory reduction of the fracture had been maintained in all the cases except one case (2.6 %) in whom open reduction was used to correct the failed closed reduction. One patient had median nerve injury which had resolved spontaneously after about (6) weeks .Three patients had vascular compromise, the hand was pulseless but well-perfused limb and the pulse returned to its normal volume after the fracture reduction .Superficial pin tract infection had been faced in (8) patients

(21%) which responded well to local cleansing and systemic antibiotics .The noted range of motion of the elbow joint was (25 °- 135°) compared to (0°-140°) on the normal side after (6) weeks post- operatively and the range of the motion was gradually improved to reach that of the normal sides after (3-4) months post –operatively. Carrying angle was measured on the last periodic clinical examination comparing the injured and the healthy elbow and the loss in the angle found to be (0°-5°) in (29) patients (76.3%) and (6°-10°) in (9) patients (23.7%) .Baumann’s angle was found to be (76°±2.5°) and (74°±0.5°) on the injured and healthy elbow respectively .

Table (4): Evaluation of the results according to Flynn criteria (cosmetic factor).

Result	Number of cases	Percent of the cases
Excellent	29	76.3
Good	9	23.7
Fair	0	0
Poor	0	0

Table (5): Evaluation of the results according to Flynn criteria (functional factor).

Result	Number of cases	Percent of the cases
Excellent	38	100
Total No.	38	

Discussion

The optimum goal of treating displaced supracondylar humeral fracture in children is to get satisfactory functional and cosmetic results with the least complication rate [8][18]. Nowadays closed reduction and percutaneous pinning is the standard procedure for Gartland type II and III [13], and open reduction is primarily used for those with failure of closed reduction, fracture with vascular injury, extensive swelling of the limb and in case of lack of functioning image intensifier in the operative theatre [8,17,18,19].

Regarding the manner of fixation, the closed reduction and lateral pinning in our study found to achieve satisfactory and stable reduction in all but one case (2.6%). And it was found safe as it wasn't complicated by injury of the vital neurovascular structures specially the Ulnar nerve which is at a special risk when the cross-pinning method is used. This result coincides with that study by David L., Skagg MD, who found that lateral pinning alone provides adequate fixation of unstable supracondylar humeral fracture [20] and avoid an iatrogenic injury to the Ulnar nerve.

Our results also matched with that study by Sudeeb Man Vaidya who found no significant clinical difference in the stability offered by the two methods and he found that the best method to avoid Ulnar nerve injury is not to insert a medial pin [21].

The effectiveness of lateral pinning also proved in the study done in 2014 in Arizona medical center USA and it was found that there is no significant statistical difference between lateral pinning and cross-pinning [22]. The same fact was proved by Ucar and Demertas in Turkey in 2012. And by Foad and Penafort in Kuala Lumpur in 2004 [23]. A last systematic review of (35) articles comparing medial and lateral pin fixation with lateral pin fixation only revealed that

iatrogenic Ulnar nerve injury took place in (40) of (1171) cases. (3.4%) in which cross pinning was used for fixation of supracondylar humeral fracture, while (5) of (738) cases (0.7%) in which only lateral pinning is used. Iatrogenic Ulnar nerve injury often resolves but there have been many reports of permanent damage [7].

Conclusion: Closed reduction and two parallel lateral pins fixation offers a satisfactory stability in both coronal and sagittal planes and is safe with no iatrogenic ulnar nerve injury.

References

- [1] Babal JC, Mehlman CT, Klein G, Nerve injuries with pediatric supracondylar humeral fracture; A meta-analysis. *J. pediatric orthopedics* 2010; 30: 253-263.
- [2] White L, Mehlman CT, Crawford AH. A systemic review of vascular injuries in pediatric supracondylar humeral fracture, results of Posna questionnaire. *J pediatric orthopedics* 2010; 30: 328-335.
- [3] Cheng JCY, Lam TP, Shen WY. Closed reduction and percutaneous pinning for type III displaced supracondylar humeral fracture in children. *J orthopedic trauma*. 1995; 9: 511-515.
- [4] Flynn JC, Matthews JG, Benoit RI. Blind pinning of supracondylar humeral fracture in children, 16 years' experience with long term follow up. *J Bone joint surgery Am*. 1974; 56-A: 263-272.
- [5] Slobogean BL, Jackman H, Tennant, Malpurik. Iatrogenic nerve injury after the surgical treatment of displaced supracondylar humeral fracture in children. *J pediatric orthopedic*. 2010; 30:430-4.
- [6] Griffin KJ, Walsh SR, Tang TY, Boyle JR, Hayes PD. The pink pulseless hand: A review of the literature regarding management of vascular complication of supracondylar humeral fracture in children.

Eur J Endovascular Surgery. 2008; 36: 697-702 .

[7] Omid R, Paul DC, David LS. Current concepts review of supracondylar humeral fracture in children.j. Bone Joint Surgery Am. 2008, 90A ,No.5 p:1121-1132 .

[8] Miller MD, Stephen R. Review of orthopedics 6th edition 2012 P:791-794.

[9] Subharwal S , Tredwell SJ ,Beauchamp RD ,Mackenzie WG ,Jakubec DM ,Cairns R Management of pulseless pink hand; Pediatric supracondylar humeral fracture: J pediatric orthopedic. 1997; 17 : 303-310 .

[10] Skagges DL, Clack MW, Mostofi A, Flynn JM, Kay RM. Lateral entry pin fixation ,management of supracondylar humeral fracture in children. J Bone Joint surgery Am. 2004; 86 :702-707.

[11] Shraden MW. Pediatric supracondylar humeral fracture. Orthopedic Clin N Am. 2008, 39: 163 -171 .

[12] Spinner M, Shreiber S. Anterior interosseous nerve palsy in supracondylar humeral fracture in children. J Bone joint surgery Am .1969 ; 51-A : 1584 -90.

[13] Dormans JP, Squillante R, Sharf H. Acute neurovascular complication with supracondylar humeral fracture in children J . Hand surgery Am .1995; 20 : P:1-4 .

[14] Campbell C ,Waters PM ,Neurovascular injury and displacement in type III supracondylar humeral fracture. J pediatric. 1995; 15 : 47-52.

[15] Louis S , David W. Apley's system of orthopedics and fractures 9th edition.2010 P:758-761.

[16] Ozan F, Kaan G. Type III supracondylar humeral fracture in children: Open reduction and pinning. J of clinical and analytical medicine department of orthopedics and traumatology Kayseri Training and Research Hospital. Turkey 2015 P: 1-4 .

[17] David L, Skagg MD, Julia M, Hale MHS, Jeffrey Basset BA. (Open reduction of supracondylar humeral fracture in children)

Published in J of Bone and Joint surgery JBJS. ORG.2001; 83A No.5 P: 735-740 .

[18] Sudeep Man Vaidy. Percutaneous fixation of displaced supracondylar humeral fracture in children comparing lateral and medial pinning; A thesis submitted to university of Seychelles American institute of medicine . 2009 ;16 , P: 24-27 .

[19] Demirtas DE. Treatment approaches and outcomes in childhood supracondylar humeral fracture by Ucar. European Review for medical and pharmacological sciences. 2012; 16: 936 -941 .

[20] Foad A, Penafort R, Saw A. Comparison of two methods of percutaneous pin fixation in displaced supracondylar humeral fracture in children. J of Orthopedic Surgery. 2004; 12: 76-82.