



Lateral pinning versus others procedures in the treatment of supracondylar humerus fractures in children

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We compared results of lateral pinning procedure with crossed pinning, closed reduction, and open reduction in a retrospective review of 184 patients with displaced supracondylar humeral fractures. All patients had a minimum of 2 years follow-up (range 36-90 months). Patients were separated into 4 groups. Success was estimated by Flynn's criteria. We compared success of the lateral pinning to others procedures. Incidence of nerve palsy was recorded and compared. Esthetic effect of lateral pinning is significantly better than closed reduction ($p=0.0007$), but no significant difference was found comparing with cross pinning and open reduction. Elbow function was similar. Cross pinning procedure was followed with ulnar nerve palsy in ten patients (20.8%). There was 1 case (5%) of combined nerve palsy including ulnar, median and radial nerve after open reduction procedure. Lateral pinning is safe and effective method of therapy for Gartland type II and III supracondylar humeral fractures.

INTRODUCTION

Supracondylar fractures of the humerus are the most common fractures of the elbow in children: 8% of all upper extremity fractures involve the elbow and 65% are supracondylar fractures of the humerus (21). There are different classifications of supracondylar humeral fractures, and the most common is Gartland classification which includes :

Type I – undisplaced fracture; Type II – displaced with posterior cortex intact and Type III – completely displaced with no cortical contact (21). There is no consent in literature about the treatment of displaced supracondylar humeral fractures in children. There are several different treatment approaches including closed reduction and cast splinting, closed reduction and cross or lateral pinning, open reduction, olecranon skeletal traction etc (21,5,8,15-16). Elbow injuries including supracondylar fractures account almost 2/3 hospitalizations and they may be associated with different complications, such as deformities of the elbow, neurovascular complications and compartment syndrome (16,8,15,3,12,14).

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Currently, preferred method of the treatment is closed reduction and lateral pinning because it minimizes the risk of the ulnar nerve lesion (8). The aim of this study was to compare outcome of the lateral pinning procedure with following procedures : cross pinning, closed reduction and open reduction to evaluate safety and efficiency.

PATIENTS AND METHODS

From January 2008 to December 2012, 184 patients (median age 7.8 years \pm 2.1, range 2.5-13 years) with Gartland II and III displaced supracondylar humeral fractures of extension type, were treated at the pediatric surgery clinic. The study was retrospective and controlled. According to therapeutic procedure, patients were separated into 4 groups: Group I, lateral pinning with parallel wires (90, 48.9%) (Figure 1) ; Group II, closed reduction only and cast splinting (26, 14.1%); Group III, cross pinning procedure (48, 26.1%) and Group IV, open reduction (20, 10.9%). In all patients firstly we performed closed reduction in general anesthesia. The indication for additional treatment was made by attending surgeon.

Only in patients with unsuccessful closed reduction, we performed open reduction.

After fracture healing, and removing of the cast and K- wires, patients were included in physical therapy program. After treatment, all patients were followed up at 3 weeks, 1 and 6 months after the procedure and annually for growth thereafter. The follow-up was 52 ± 8 months (range 36-90 months).



Fig. 1. — Lateral pinning with parallel wires.

There was no loss of patients in follow-up. Success of therapy procedures was judged by Flynn's criteria (changing of the elbow carrying angle and limitation of the elbow motion after treatment) (Table I). Anteroposterior (AP) radiography was used for measuring of the elbow carrying angle (humeral – ulna angle). We used clinical examination for measuring elbow extension – flexion amplitude. Both measurements were compared to angles measured on the patient's opposite side. Study protocol included lateral pinning comparing to each of other procedures using Flynn's criteria with chi-square test with Yates correction. According to Flynn, marks "excellent" and "good" were estimated as "positive"; marks "fair" and "poor" were estimated as "negative". To compare results of Group I with others (Group II, III and IV) we used cross matching (Table II).

Incidence of ulnar, median, and radial nerve palsy was recorded in each of procedures and then compared using chi-square test. Individual differences were considered to be statistically significant for $p < 0.05$. SPSS version 17.0 (SPSS Inc, Chicago, Ill) was used for all statistical calculations. It is a general policy at our institution that on admission, parents must sign an informed consent that allows the use of their data for retrospective analysis. Also, approval from the local Ethical Committee for the particular study was obtained.

RESULTS

The study included charts of 184 patients. Patients were aged 2.5 to 13 years (average 7.8 yrs). There were 105 boys and 79 girls. Most of the fractures were closed with 5 (2.7%) Gustillo type I open fractures.

Most of the patients were treated by lateral pinning (90 patients, 48.9%), followed by cross pinning (48 patients, 26.1%), closed reduction (26 patients, 14.1%) and open reduction (20 patients, 10.9%). The follow-up was 52 ± 8 months (range 36-90 months).

There were no statistically significant differences between groups compared in base line characteristics of the patients (age, gender, time between injury and treatment). There were no statistically significant

Table I. — Therapy procedure success judged by Flynn's criteria. Elbow carrying angle from cross section of humeral and ulnar axis on the AP radiography. Extension – flexion and pronation – supination angles were measured directly on the patient's elbow. Both kinds of angle values were compared with opposite side of the same patient (7).

Rating	Elbow esthetics: Changing of the elbow carrying angle (angle degrees)	Elbow function: Limitation of the elbow motion amplitude extension – flexion / pronation – supination (angle degrees)
EXCELLENT	0 to 5	0 to 5
GOOD	5 to 10	5 to 10
FAIR	10 to 15	10 to 15
POOR	>15	>15

Table II. — Absolute frequencies distribution of the patients into group intervals, judging elbow esthetics and function, comparing four therapy procedures of the extension type dislocated supracondylar humeral fractures by Flynn (7).

THERAPY PROCEDURE	SUCCESS OF THE THERAPY PROCEDURE JUDGED BY FLYNN'S CRITERIA	ELBOW ESTETICS – Absolute frequencies of patients into group intervals of the marcs. Elbow carrying angle change	ELBOW FUNCTION – Absolute frequencies of patients into group intervals of the marcs. Elbow extension – flexion amplitude limitation	Σ
I procedure: LATERAL PINNING	EXCELLENT	85	87	90
	GOOD	3	2	
	FAIR	1	1	
	POOR	1	0	
II procedure: CLOSED REDUCTION	EXCELLENT	16	25	29
	GOOD	6	3	
	FAIR	5	1	
	POOR	2	0	
III procedure: CROSS PINNING	EXCELLENT	42	40	48
	GOOD	4	4	
	FAIR	1	3	
	POOR	1	1	
IV procedure: OPEN REDUCTION	EXCELLENT	17	11	20
	GOOD	2	7	
	FAIR	1	1	
	POOR	0	1	
				184

difference between Gartland type of fractures in group treated by cross and lateral pinning. All patients treated with closed reduction had only Gartland type II fractures and all patients treated with open reduction had Gartland type III fractures.

Esthetic effect of lateral pinning procedure is significantly better than closed reduction ($p=0.0007$). There is no significant difference of the elbow esthetics after lateral pinning procedure

comparing with each of other procedures (compared with group III $p=0.93$; group IV $p=0.51$). There is no statistically significant difference in elbow function after lateral pinning compared to other procedures (group II $p=0.41$; group III $p=0.10$; group IV $p=0.15$)

Lateral pinning procedure was the most successful comparing the proportions of positive and negative result (percents, see the chart 1 and 2).

In lateral pinning group there was no ulnar, median and radial nerve palsy comparing with 10 cases of ulnar nerve palsy in cross pinning group ($p < 0,001$). All ulnar nerve injuries were grade I nerve injuries (neuropraxia). All patients were treated only with physical therapy and they recovered in 1.5 to 4 months. In open reduction group there was 1 case of combined ulnar nerve palsy with median and radial nerve (ulnar nerve palsy was solved by neurosurgeon two months after injury). In this series none of the children had fracture displacement after the treatment. Also, no pin tract infections were noted. All the fractures healed in 3 to 5 weeks, depending on patient's age.

DISCUSSION

The purpose of this study was to compare different type of treatment of pediatric supracondylar humerus fractures in terms of safety, esthetics and functional outcome.

Our study shows that lateral pinning is safe procedure in terms of nerve injuries. Also, esthetic effect of lateral pinning is significantly better than closed reduction but no significant difference was found comparing with cross pinning and open reduction by Flynn. Elbow function after all procedures was similar.

In our study all Gartland type III fractures were managed by closed reduction with pinning or open reduction. Gartland type II fractures were treated by closed reduction but in some cases with closed reduction and pinning depending of surgeon preference.

Study by Padneyet al. (17) shows similar results based on the assessment of elbow esthetics. In study by Pironeet al. (18) percutaneous K-wire fixation is advocated as the method of choice for the majority of displaced fractures. Closed reduction without pinning excludes the possibility of pin tract and subsequent bone infection. With adequate wound care and prophylactic antibiotics (Ceftriaxone, 50 mg/kg daily) three days after procedure, we had no K-wire or bone infection in our series. Bearing in mind that the most of patients after healing have the unsatisfactory esthetic result we advised to use closed reduction without pinning only in a small number of patients with minimally displaced fractures.

There were no differences in the result of cross and lateral pinning in our study. Karimet al. (9) had instability in 6 patients (10%) after lateral entry pin fixation. Similar was found in study of Zamzam et al. (23) with loss of reduction in nine children (8.33%) who underwent fixation by two lateral pins. In addition, in a similar study done by Chakraborty

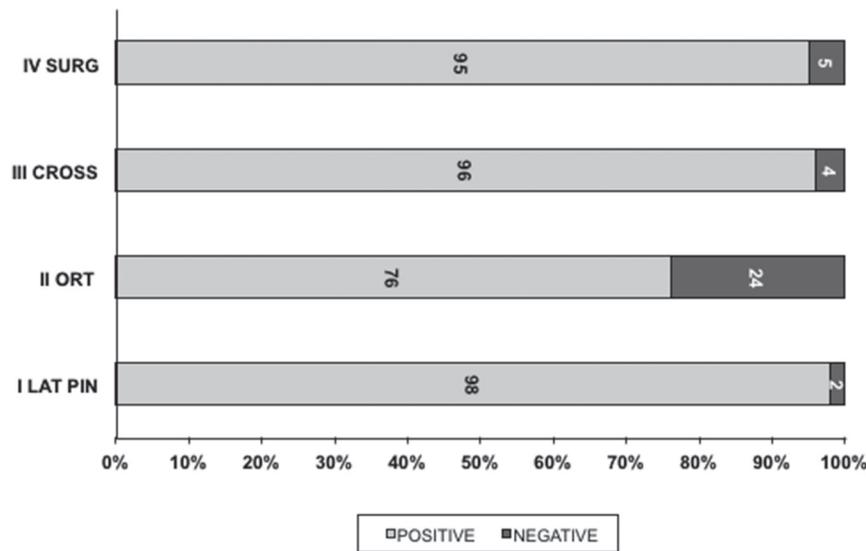


Chart 1. — Percentage of the marc “POSITIVE” and “NEGATIVE” related to the applied therapy procedure, judging ELBOW ESTHETICS by Flynn.

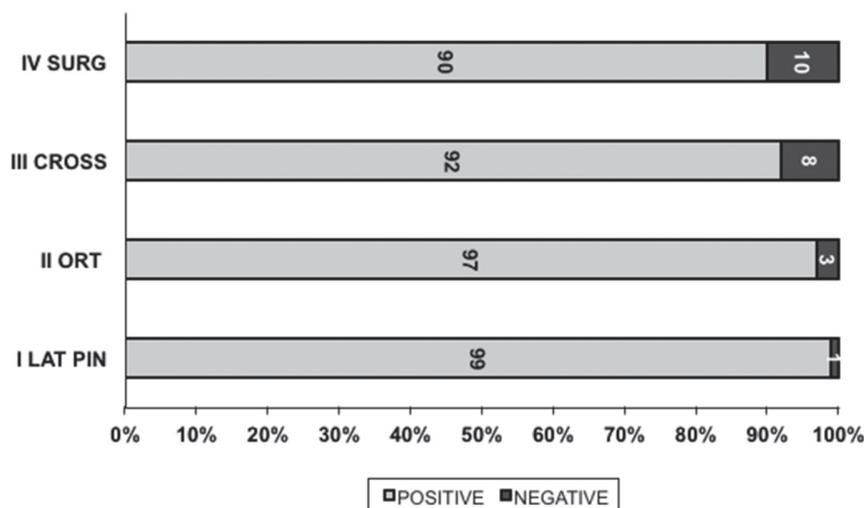


Chart 2. — Percentage of the marc "POSITIVE" and "NEGATIVE" related to the applied therapy procedure, judging ELBOW FUNCTION by Flynn.

et al. (4) instability after pinning, lateral and crossed was observed in 16 patients (17.39%), ten after lateral and six after crossed pinning. In a prospective randomized controlled study done by Kocher et al. (10) there were no patients in either group that had a major loss of reduction after crossed and lateral entry pin fixation. Same was found in our study, there were no fracture dislocations after lateral and crossed pinning and we concluded that, with adequately placed pins loss of reduction can be avoided.

The majority of cases (n=90, 48.9%) in our study were solved successfully by lateral pinning procedure. In this procedure positive outcome of elbow esthetics and function was present in almost all of patients except in two patients probably due to insufficient physical therapy. There are several review papers with similar number of patients and study design like ours, trying to establish therapy protocol (1,2,14,15,16,18,19,20). Some authors favor cross pinning procedure over lateral pinning, because of mechanic stability of fracture fragments (23). The other performed one single therapy procedure (crossed pinning) and found that it is an effective method (11). A serious prospective randomized controlled clinical trial comparing cross pinning and lateral pinning procedure was done by Maity et al (13). The authors concluded if a uniform standardized opera-

tive technique is followed in each method, both of procedures are the same in terms of safety and efficacy.

Iatrogenic ulnar nerve lesion is the most important drawback of the cross pinning procedure. In our series it occurred in ten patients (20.8%) but only in cross pinning group. In open reduction group there was no iatrogenic ulnar nerve injuries because of surgical procedure which include ulnar nerve identification. Woratanarat et al. (22) in their meta-analysis favor lateral pinning with the explanation that for every 100 children treated by cross pinning versus lateral pinning, two extra cases of loss of fixation are prevented but five extra cases of ulnar nerve damage are caused.

Meta-analysis of randomized controlled trials by Zhao et al. (24) also states that cross pinning increases the risk of ulnar nerve injury. On the other side, authors like Zamzam et al. (23) and Edmond et al. (6) still favor cross pinning and state that there is no significantly higher risk of ulnar nerve lesion with pinning in elbow extension because this position relaxes any tension on the ulnar nerve and limits the risk of injury.

Because of lack of nerve lesion and stable fracture fixation we concluded that lateral pinning is safer and successful method of treatment compared to cross pinning.

In some cases cross pinning is necessary and should be performed with additional methods (greater extension of the elbow, mini incision before medial pin placement or retrograde medial pin placement) to minimize possibility of ulnar nerve injury (4,6,23).

CONCLUSION

Procedure of lateral pinning in displaced Gartland type II and III supracondylar humeral fractures in children is safe and effective method of therapy in terms of nerve injuries and esthetic effect. Elbow function after all procedures was similar.

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