

# Percutaneous transolecranon pinning and lateral pinning versus lateral pinning in displaced supracondylar fractures of the humerus in children: A comparative study

El Sayed Sadek Ramadan Fayad<sup>1</sup>, MSc; and Ahmed Shaban Hassan<sup>2</sup>, MD

1- MSc. in Orthopedic Surgery, Al Helal hospital, Egypt.

2- Lecturer of Orthopaedic Surgery, Faculty of Medicine, Helwan University, Egypt.

## ABSTRACT

### Background

Supracondylar humerus fracture in children is a very common elbow injury. The commonly accepted treatment of type II and III, extension-type supracondylar fractures of humerus in children is closed reduction with transolecranon pinning & lateral pinning. transolecranon pinning & lateral pinning has advantage of avoiding the possibility of iatrogenic ulnar nerve injury. Therefore, this prospective study was conducted to compare the stability of transolecranon pinning & lateral pinning and lateral pinning in treatment of type II and type III supracondylar humerus.

### Methods

A prospective case series, was conducted at emergency department of Helwan university hospital and Elhelal Hospital from February 2020 to September 2021. It includes 30 patients below 10 years with Gartland types II and III supracondylar humeral fractures, the patients were divided into two equal groups; A and B. Patient treated by lateral pin and transolecranon pin were kept in Group A and those treated with 3 lateral pins in Group B, all of them were included for the study and analysis of results regarding Functional outcome was graded according to Flynn's criteria and Baumann's angle.

### Results

Thirty children were treated for displaced supracondylar fracture of humerus during the study period male six patients in group A and 10 patients females in group B with a mean age  $5.43 \pm 1.699$  in group A; a mean age  $5.16 \pm 1.789$  in group B, The mean follow up duration was  $2.9000 \pm 2.07364$  (6 months). In lateral and transolecranon pinning group (9) patients with excellent results and (5) patient was good and (1) patient was fair, in lateral pinning technique (14) patients with excellent results and (1) patient was fair.

### Conclusion

There was statistically no significant difference between transolecranon pinning and lateral pinning and lateral pinning technique regarding carrying angle, time of surgery and flexion loss.

## INTRODUCTION

Supracondylar Humerus Fracture (SCHF) is the most common elbow fracture in children. They account for 55% to 70% of all elbow fractures (which account for 10% of all childhood fractures) and are seen most frequently in children between the ages of 3 and 10 years. Although the chances of residual deformity are rare, devastating neurovascular complications make supracondylar humerus fractures a dreaded injury. [1]

Supracondylar fractures are commonly classified based on the Gartland system of classification, where they are divided into four types: Type I being non-displaced, type II being displaced but with an intact posterior cortex, type III being displaced and without any cortical contact and type IV being completely displaced with multidirectional instability [2]. Although type I is generally treated nonoperatively, type II, type III and type IV are generally managed with closed reduction and pinning in order to avoid malunion [3]. Optimal pin configuration and the number of pins required to provide adequate fracture stability to maintain reduction and promote proper union, while minimizing the risk of neurovascular injury remain issues of debate [4]. In the treatment of pediatric type IV fractures, the multidirectional instability is the main difficulty for closed reduction. [5]

### Keywords:

Supracondylar fracture humerus, transolecranon pinning, lateral pinning.

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There are still some debates regarding the choice of pinning configuration for fixating the fractures. Currently, crossed pinning or lateral pinning using two or three pins is the most common pinning configuration for SCHF, although many reports have compared these two methods in terms of surgical outcomes, which one method produces the best functional outcomes remains controversial [6].

Medial and lateral pin fixation has been presumed to be more stable, however it has the risk of iatrogenic ulnar nerve injury. Lateral only pinning( LOP) is riddled with issue of lesser torsional stability but avoiding neurological complications. Recently ‘trans-olecranon fossa-four cortex purchase (TOF-FCP)’ pin fixation technique has reports of having better torsional stability than conventional LOP and retaining its fewer complications[7]

**Aim of the Study:**

The aim of this prospective study is to compare the clinical, radiological and functional outcomes of percutaneous transolecranon pinning and lateral pinning Vs lateral pinning in displaced supracondylar fractures of the humerus in children

**Patients and methods**

**Patients:**

A prospective randomized study, was conducted at Helwan university hospital from February 2020 to September 2021. It includes 30 patients between 1-8 years of age with Gartland types II and III supracondylar humeral fractures wit follow up period of six months ,the patients were divided into two equal groups; A and B. Patient treated by lateral pin and transolecranon pin were kept in

Group A and those treated with 3 lateral pins in Group B.

**Preoperative evaluation:**

Patients were subjected to thorough preoperative evaluation both clinically and radiographically after taking a written and informed consent from the parents. The medical status of the patients were revised to avoid any complications during anaesthesia or surgery caused by medical illness or associated fractures (especially those in ipsilateral forearm). In addition to neurovascular examination and examination for any evidence of compartment syndrome.

**Radiographic and clinical assessment:**

Standard radiographs were done before and after surgery, including an anteroposterior (AP), lateral, oblique views and forearm X-rays were done also, along with the clinical assessment of degree of elbow swelling, motor examination and distal (radial and ulnar) pulsation.

Data were statistically described in terms of mean and standard deviation (SD). All data were compiled and calculated by SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 20 for Microsoft Windows. Significance of difference was measured by determining P-value and value less than <0.05 was considered significant.

Surgical protocol and operative details: Patients were scheduled to surgery. Time from trauma to surgery has been recorded; 8 patients (53.3%) from group A have done the operation in the same day of trauma while 7 patients (46.7%) from group B have done in the second day and 2 patients (13.3%) from group A have done in the third day following trauma. and only one patient (6.7) have done in the fifth day following trauma (Figure 1 ).

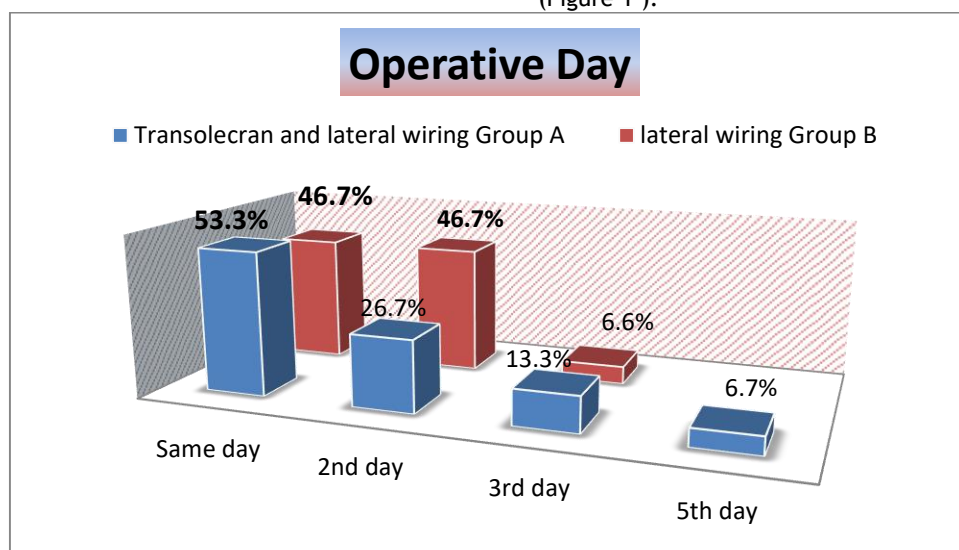


Figure (1 ): Operative Day

### Operative technique

Surgery was performed in the casualty department of Helwan university hospital after proper preparation of the patients for the surgery. General anaesthesia was used for all patients with the injured upper limb at the side of the table. 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 (Figure 2)



**Figure (2):** The elbow over the plate of image intensifier.

Under complete aseptic condition, Closed reduction was done and confirmed by image intensifier. Reduction can be considered a “standard” technique which involved manual traction with the elbow flexed at 20 degrees (Figure 3).



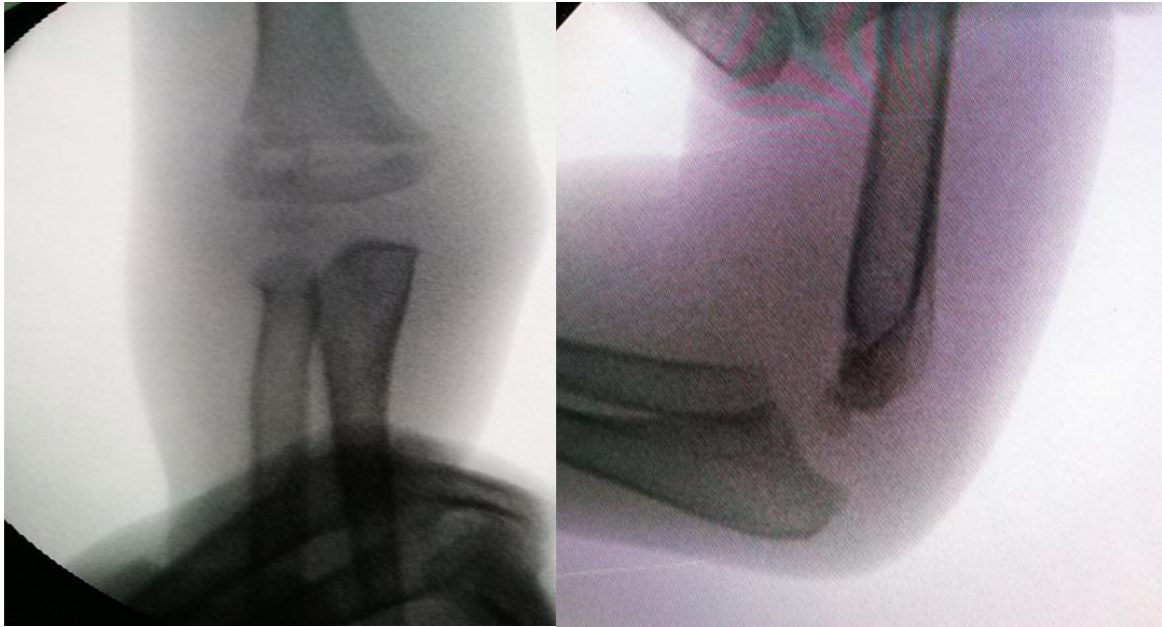
**Figure (3):** Manual traction of the elbow.

Controlling rotation of the fracture by the medial and lateral humeral epicondyles; the forearm was then pronated, as this controls the medial rotation, and with flexion locks the fracture in place (Figure 4).



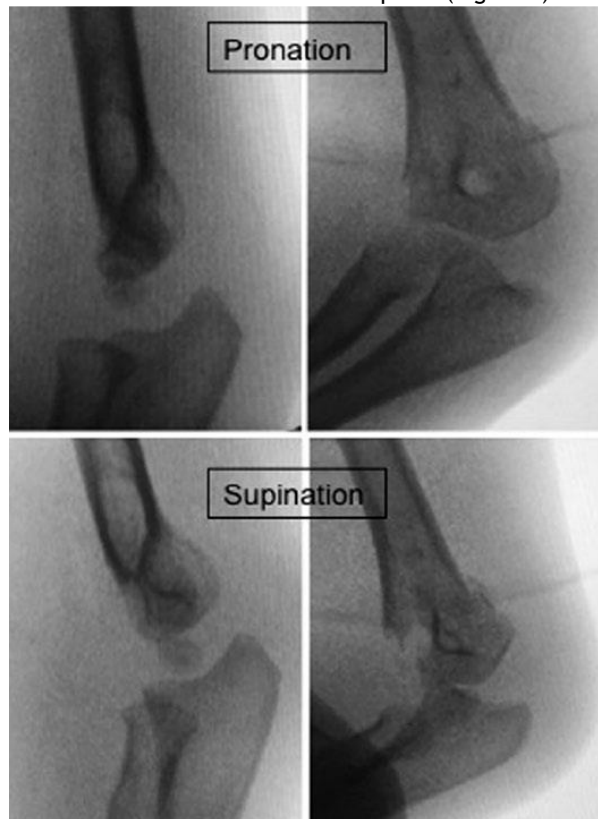
**Figure (4):** Locking of the elbow.

This technique was adequate for reduction in all the patients of the study. Reduction acceptability was confirmed by assessment of displacement, angulation, and rotation in the coronal and sagittal planes under image intensifier (Figure 5).



**Figure (5):** Reduction confirmation under image intensifier.

The reduction was done first in the AP plane while maintaining constant traction with varus-valgus correction controlling rotation of the fracture by the medial and lateral humeral epicondyles. The elbow was then hyperflexed using thumb pressure over the olecranon to reduce the fracture, and the forearm was then fully pronated as this controls the medial rotation, and with flexion locks the fracture in place (Figure 6).



**Figure (6):** When posteromedial displacement is present, forearm pronation helps with fracture reduction. Forearm supination will be a difficult reduction in these cases.

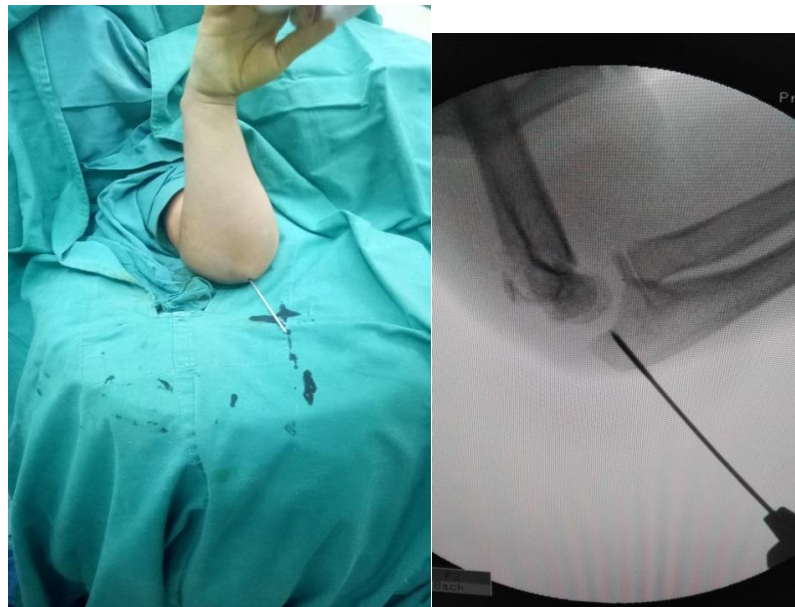
If the reduction cannot be achieved and there was no clear bone contact, it may suggest muscle entrapment.

Milking maneuver over the muscles by starting from middle of the humerus to elbow is a good maneuver to release the soft tissue around the shaft(Figure 7).



**Figure (7):** Milking maneuver

In group A: Two Kirschner wires were inserted for fixation, with elbow flexion to about 90 °; the first one is inserted vertically through the olecranon across the fracture into the metaphysis of the humerus (Figure 7, 8). The second wire is inserted from the lateral column across the fracture at (30-40) degree to the opposite cortex of the humerus



**Figure (8 ):** group A: transolecranon wire insertion

In group B: the distal wire was inserted first. The insertion site was made so that the wire traversed the lateral portion of the ossified capitellum, cross the physis, proceed up the lateral column, and always engage the opposite medial cortex proximally. The point of entry of the proximal wire was in the metaphyseal part and not in the diaphyseal part of the humerus. The second pin is positioned up at the lateral column in a direction divergent or parallel to the first, which maximizes pin separation at the fracture site. This is the key point of this procedure (figure 9).

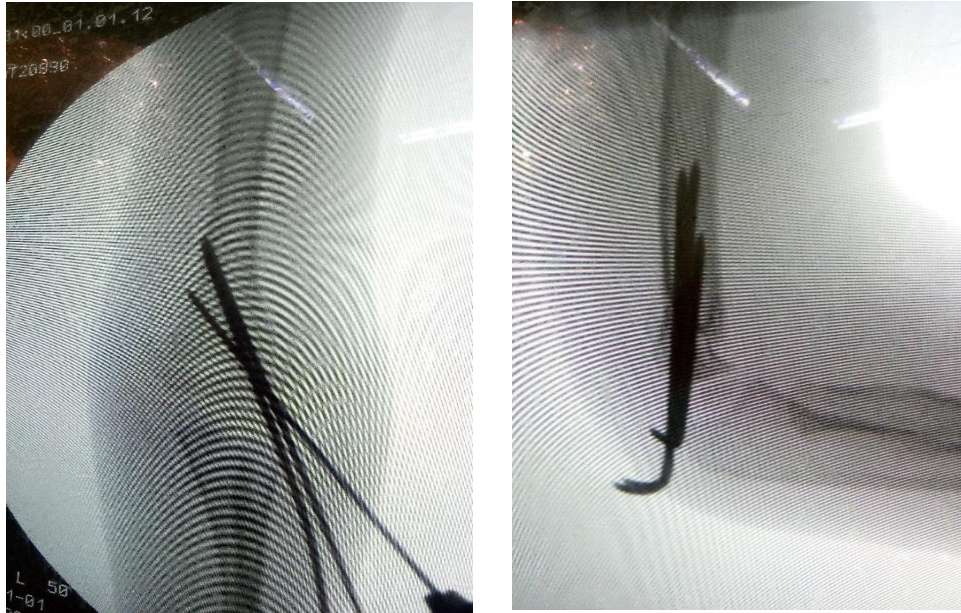


Figure (9 ) group B: Lateral wire insertion

### Results

In the period between February 2020 to September 2021, thirty patients with Gartland type II and III displaced supracondylar humerus fracture were treated and followed up until achieving fracture union, getting functional range of motion and recovering from any complication during the study.

### A-perioperativecriteria:

#### 1-operativetime:

The time of surgery ranged from 10-40 minutes with mean of  $19.4 \pm 8.559$  in group A. While in group B, ranged from 12-45 minutes with mean of  $24.066 \pm 9.996$  (Table1).

Table (1) Time of surgery (minutes)

Procedure	N	Minimum	Maximum	Mean	Std. Deviation
Transolecranon and lateral wiring (Group A)	15	10.00	40.00	19.400	8.559
Lateral wiring (Group B)	15	12.00	45.00	24.066	9.996

Table( 2): Comparison between both groups regarding number of shots and time of surgery (N=15)

Items	Transolecranon and lateral wiring (Group A)	lateral wiring (Group B)	T test	P value
<b>Time of surgery (minutes)</b>				
10- < 25	11 (73.3%)	8 (53.3%)	1.26	0.22
25- 45	4 (26.7%)	7 (46.7%)		
<b>Number of shots of the image intense fire</b>				
8 -10	2 (13.3%)	9 (60%)	3.68	0.002*
11 -15	5 (33.3%)	6 (40%)		
16 -30	7 (46.7%)	0 (0.0%)		
More than 30	1 (6.7%)	0 (0.0%)		
Mean $\pm$ SD	21.66 $\pm$ 10.89	10.53 $\pm$ 2.32		

There was statistically significant difference between the two groups regarding number of the shots of the image

intensefire: 7 cases (46.7%) in transolecranon and lateral wiring technique (Group A) using 16-30 shots of the image intensefire while9 cases (60%) lateral wiring technique using 8-10 shots of the image intensefire with p value = 0.002. while there was no significant difference between the two groups regarding time of surgery.

\*Statistically significant p = ≤ 0.05

**B-RadiologicalResults:**

**1- Timeofwiresremoval:**

In all patients wires removed after 3<sup>rd</sup> week, while six patients (40%) in group A wires removed after 4<sup>th</sup> week (no radiological signs of complete union).

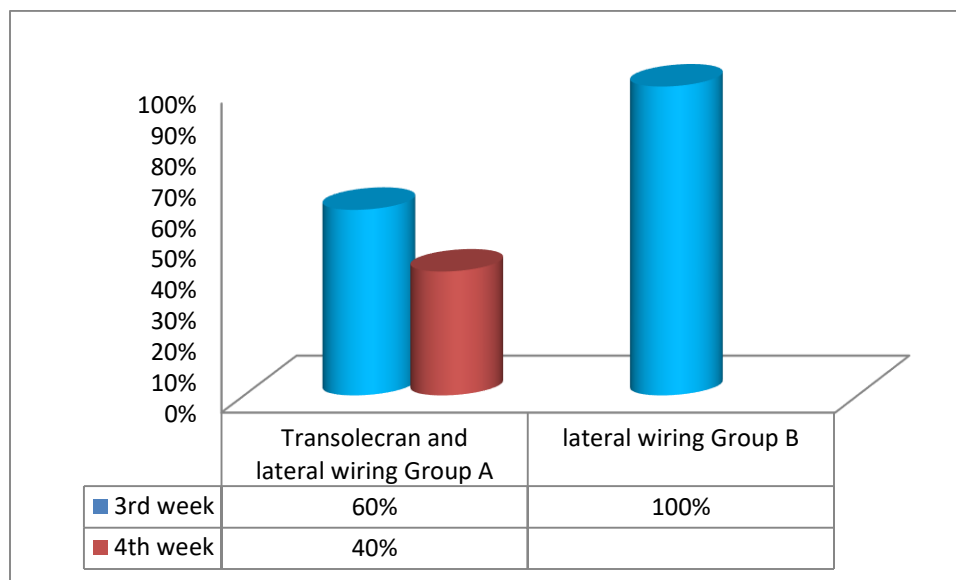


Figure ( 10 ):Wires removal

**C-Resultsaccording toFlynncriteria:**

All patients were available for clinical evaluation and all of them were evaluatedat 3monthsusingtheFlynn gradingsystem, basedonthedifferencein carryingangleandrangeofmovement betweentheinjuredand uninjured elbow. The mean follow up duration was 2.9000 ±2.07364 (range from 1 - 6 months). The mean age was 5.43+1.699 (range from 1-4 years) in group A. While in group B; 5-8 years with a mean age 5.16+1.789.

**1- Carryingangle:**

**Table (3)Comparison between lateral wiring and transolecranon wiring regarding carrying angle (N=15)**

Items	Transolecranon and lateral wiring (Group A)	lateral wiring (Group B)	T test	P value
<b>Carrying angle</b>				
5.60- 11.60	9 (60%)	7 (46.7%)	1.006	0.332
11.80- 15.60	6 (40%)	8 (53.3%)		
Mean ± SD	10.86 ± 2.81	11.90 ± 2.79		

There was no significant difference between the two groups regarding carrying angle. All patients are within normal range (5-15 degree), with mean carryinganglewasabout(10.86)degree,standarddeviationwas(2.81) in group A. While in group B, the mean carryinganglewasabout(11.90)degree,standarddeviationwas(2.79)

Table( 4): Comparison between both groups regarding mean scores of flexion loss, extension loss and range of motion loss (N=15)

Items	Transolecranon and lateral wiring (Group A)	lateral wiring (Group B)	T test	P value
<b>Flexion loss</b>				
Mean ± SD	2.60 ± 2.16	2.26 ± 2.91	0.523	0.609
<b>Extension loss</b>				
Mean ± SD	2.00 ± 2.82	0.20 ± 0.77	3.06	0.008 *
<b>Range of motion loss</b>				
Mean ± SD	4.60 ± 4.15	2.46 ± 3.52	3.70	0.002 *

There was statistically significant difference between the two groups regarding extension loss with mean extension loss was about (2.00) degree and standard deviation was (2.82) in group A. There was statistically significant difference between the two groups regarding range of motion loss with mean range of motion loss was about (4.60) degree and standard deviation was (4.15) in group A.while there was no significant difference between the two groups regarding flexion loss.

\*Statistically significant p = ≤ 0.05

### Complications:

Few complications occurred and all were tolerable with no effect on final outcome and these were pin tract infection in 2 patients in group A (Figure 11 ).

#### Postoperative complications among the studied groups

All patients in group B had not pin tract infection while only two patients (13%) had pin tract infection in group A

#### Treatment of pin tract infection:

- Antibiotic
- Pin care is done by cleaning each pin site with a new sterile cotton-tipped applicator that has been soaked in a normal saline. Dry sterile gauze is wrapped around each pin site.

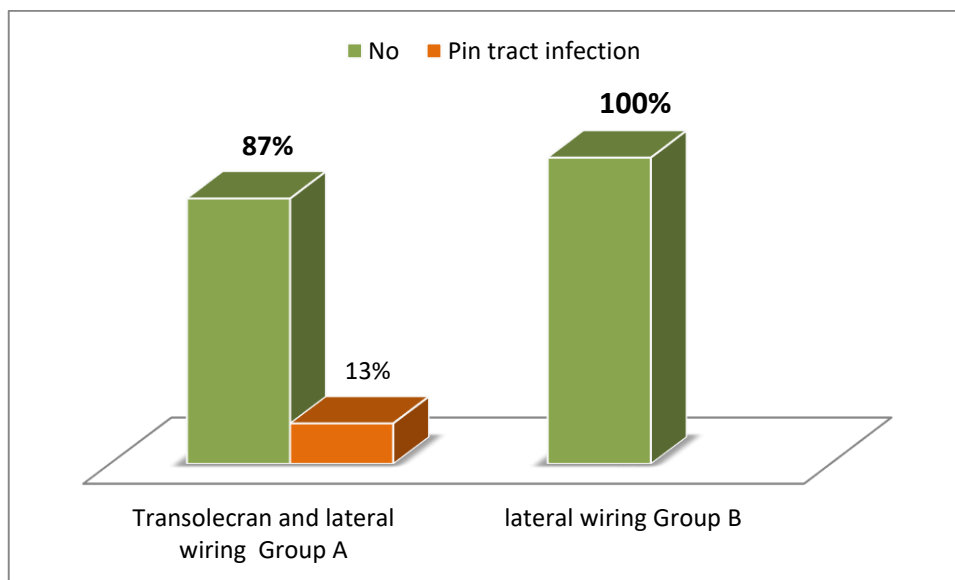


Figure ( 11 ):Postoperative complications among the studied groups

#### Discussion

The main goal of surgery in pediatric

supracondylar humerus fracture is the safe creation of a construct that is stable enough to prevent axial



rotation and hyper flexion and extension of the distal fragment, and thus avoid postoperative deformity [8, 9].

There was statistically significant difference between the two groups regarding number of the shots of the image intensifier: 7 cases (46.7%) in transolecranon and lateral wiring technique (Group A) using 16-30 shots of the image intensifier while 9 cases (60%) lateral wiring technique using 8-10 shots of the image intensifier with p value = 0.002. while there was no significant difference between the two groups regarding time of surgery.

**Sharma et al., (2015) [10]** in study underwent closed reduction and pinning using a Kirschner wire inserted laterally and another inserted vertically. displaced extension-type supracondylar humeral fractures (Gartland types II and III). The mean follow-up duration was 13 months. the injured elbows had a mean±standard deviation (SD) loss of flexion of  $4.52^{\circ} \pm 4.16^{\circ}$ , a mean±SD loss of extension of  $1.7^{\circ} \pm 4.32^{\circ}$ , and mean±SD change in carrying angle of  $3.47^{\circ} \pm 4.70^{\circ}$ .

While in current study, the injured elbows had a mean±standard deviation (SD) loss of flexion of  $(2.60 \pm 2.16)$  in group A.  $(2.26 \pm 2.91)$  in group B, a mean±SD loss of extension of  $(2.00 \pm 2.82)$  in group A.  $(0.20 \pm 0.77)$  in group B, and mean±SD change in carrying angle of  $(10.86 \pm 2.81)$  in group A.  $(11.90 \pm 2.79)$  in group B.

**Jindal et al., (2019)[11]** in study on 30 patients with type II and III supracondylar humerus fractures were divided into two groups A and B, 15 in each group. Both the Groups achieved 90% satisfactory results, but 10% unsatisfactory results recorded in Group A only rather than in Group B. Although the transolecranon wire has the disadvantage of limiting the flexion and extension of the elbow, this does not influence the final-outcome much as the elbow is fixed in a plaster of paris splint for minimum 3 weeks in all patients in both groups.

Also in current study, there was no statistical significant difference between the two groups regarding flexion loss. There was statistically significant difference between the two groups regarding extension loss with p value = 0.01. There was high statistically significant difference between the two groups regarding range of motion loss with p value = 0.001.

**Kasirajana, et al ,2018 [12]** aimed at a functional analysis of trans-olecranon fossa four-cortex purchase lateral pinning for displaced supracondylar fracture of the humerus (SCFH) in children and found that all 48 children with a mean follow up of 20 months (range: 6-26 months) were assessed with modified Flynn's criteria, results were excellent in 40 children (83.3%), good in six children (12.5%), and fair in two children (4.2%). There were no poor results. Full range of motion was achieved on an average of 20 days after K-wire removal. This technique is simple, safe, and reproducible, with good clinical results.

**While in current study,** There was no significant difference between the two groups regarding carrying

angle. All patients are within normal range (5-15 degree), with mean carrying angle was about (10.86) degree, standard deviation was (2.81) in group A. While in group B, the mean carrying angle was about (11.90) degree, standard deviation was (2.79). and also there was high statistically significant difference between the two groups regarding range of motion loss with p value = 0.001.

**Shah et al., (2020) [3]** who compare the cosmetic and functional outcome of medial-lateral pinning, lateral only pinning, and Lateral Trans olecranon fossa four cortex purchase pinning and found that functional and cosmetic outcome of all three pinning technique after operative intervention of paediatric supracondylar humerus fracture is similar in expert hands. The incidence of complications with TOF-FCP construct is less amongst the lateral only pinning.

**Wei, et al., (2020) [13]** in a study on multidirectionally unstable fractures treated with transolecranon pin joystick technique of closed reduction and percutaneous pinning (CRPP) (group A) had a shorter surgical time and better quality of reduction on the AP radiographic view than treatments with CRPP (group B). both groups, no postoperative complications were observed and the range of motion was similar on the last follow-up appointment in group A.

**While in current study** the time of surgery ranged from 10-40 minutes with mean of  $19.4 \pm 8.559$  in group A. While in group B, ranged from 12-45 minutes with mean of  $24.066 \pm 9.996$

**As regard to pin tract infection, in current study**, All patients in group B had not pin tract infection while only two patients (13%) had pin tract infection in group A. those results were comparable to other series such as **Oetgen, et al., (2015) [14]**, reported that only 3 patients from a total of 709 patients developed an infection. Also **Ducic, et al. (2016)[15]** among 369 patients only 3 patients developed an infection. Furthermore, **Abdul-Azim et al., 2021 [16]**, found pin tract infection in 2 patients.

## CONCLUSION

According to our results, we conclude that the transolecranon and lateral pin fixation are effective and safe in avoiding iatrogenic ulnar nerve injury or fishtail deformity (Dissolution of distal humerus) and is an appropriate treatment option for providing stable fixation of displaced supracondylar humeral fractures in children.

However due to small sample size a possibility of bias error should be taken in consideration, and a larger study with enough power is needed for further assessment of these two techniques of treatment.

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