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# SYSTEMATIC REVIEW OF SUPRA CONDYLAR HUMERAL FRACTURE IN CHILDREN MANAGED BY CLOSED REDUCTION AND PERCUTANEOUS PINNING: REVIEW ARTICLE

By

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## ABSTRACT

**Background:** Supracondylar fracture of the humerus is the second most frequent types of bone injury in children. For treatment of this fracture, closed reduction and percutaneous pinning, and open reduction and internal fixation were two common managements for supracondylar fracture of the humerus.

**Objective:** To review systemically the efficacy of different pin configurations in management of supra condylar humeral fracture in children.

**Materials and methods:** This was a systematic review about supra condylar humeral fracture in children managed by closed reduction and percutaneous pining. The search was conducted by using the databases: MEDLINE, Cochrane library and Google Scholar, PubMed, using the following keywords: "supracondylar, humerus, children, pinning," for published studies from 2010-2020.

**Result:** The carrying angle loss was measured in three studies, 2 used lateral divergent pinning and showed excellent in about 96.6%, good (6.67%), and 1 used medio-lateral entry pin showed excellent (43.75%), good (50%), poor (6.25%), and this showed that lateral divergent pinning had better. As regard mean loss in elbow, extension was 2.4 in lateral divergent pinning, 8.2 in medio-lateral entry pin, 1.7 in lateral pin trans olecranon, and mean Baumann angle loss was 1.3 in lateral divergent pinning, 2.45 in medio-lateral entry pin 4.3 in infrafocal pin.

**Conclusion:** Our review after studying the four type of pinning fixations we found that lateral divergent pinning had better outcome and lower complications. Hence, lateral divergent pinning is the favored procedure.

**Keywords:** Closed reduction, Supracondylar humeral fractures, Meta-analysis.

## INTRODUCTION

Supracondylar fractures are the most common pediatric fracture. Humeral fractures are common in the pediatric population and account for almost 70% of elbow fractures, their treatment is controversial when displacement has occurred, although percutaneous pinning is usually advocated *(Yaokreh et al., 2012)*.

The incidence peaks between the ages of 5 - 8 years *(Devkota et al., 2011)*. These fractures are either extension or flexion type with varied mechanism of injury; extension type fractures account

for 96-99% of all supracondylar fractures *(Mahan et al., 2010).*

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 *(Lee et al., 2010).*

The original technique involved the use of one lateral and one medial pin inserted percutaneously but recently, some authors have reported iatrogenic ulnar nerve injury rates of up to 10% for medial pin placement and have advocated lateral pin fixation alone to reduce this complication *(Larson et al., 2010).*

Although these nerve injuries usually resolve within a year, persistent ulnar nerve palsy has also been reported *(Kalenderer et al., 2012).* Moreover, authors of retrospective clinical studies have concluded that pin insertion through the lateral condyle alone, which avoids injury to the ulnar nerve, is as clinically effective as crossed-pin insertion through the medial epicondyle and lateral condyle in stabilizing supracondylar humeral fractures *(Woratanarat et al., 2012).*

The Posterior intrafocal pin improves sagittal alignment in Gartland type III pediatrics supracondylar humeral fractures. Adding one posterior intrafocal pin to crossed pinning can facilitate fracture reduction and enhance fixation stability.

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 pop splnt for minimum 3 weeks – in all patients. So, in this study we aim to review the literatures as a systematic review to spot light the advantages and disadvantages of each wire configuration and which one is the best mechanically and functionally.

## PATIENTS AND METHODS

This was A systematic review about supra condylar humeral Fracture in children managed by closed reduction and percutaneous pining.

**Identification of studies:** We performed the literature search using the following search terms: supracondylar, humerus, children, pinning. Search queries were limited to the title and abstract, and the language is restricted to English. Search strategy for identification of studies: The search was conducted by using the databases: MEDLINE, Cochrane library and Google Scholar, PubMed, using the following keywords: "supracondylar, humerus, children, pinning," for published studies from 2010-2020.

**Types of studies:** We included randomized controlled trials, including cluster RCTs, controlled (non-randomized) clinical trials or cluster trials, prospective and retrospective comparative cohort studies, and case-control or nested case-control studies. We excluded cross sectional studies, case series, case reports and literature not in English.

**Inclusion Criteria:** Publications from the year 2010-2020, published only, full text articles and English literature only and article type: clinical trial, comparative study and case study.

**Exclusion criteria:** Duplicated articles for the same authors unless with longer

follow up studies, non-English papers, articles with no clinical data and publications before the year 2010.

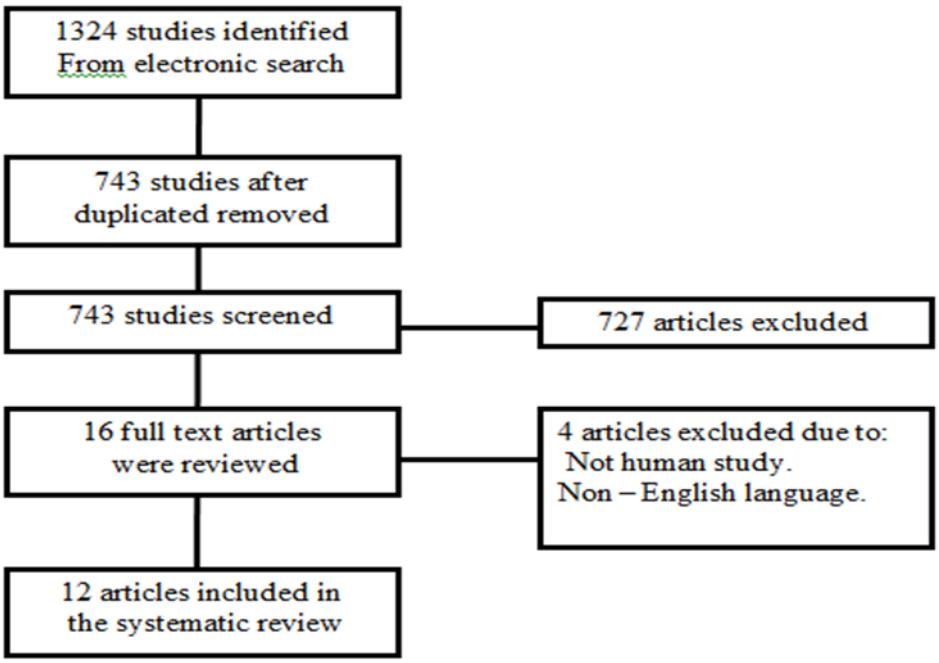
**Points of comparison:** Number of cases, patient characteristics, type of surgical procedure, mean follow up, patients-reported functional outcome, radiological outcomes and complications.

**Methods of the review:** Locating and selecting studies: Abstracts of articles identified using the above search strategy was viewed, and articles that appear to fulfill the inclusion criteria was retrieved in full, when there is a doubt, a second reviewer was assess the article and consensus was reached.

**Data extraction:** Data was independently extracted by two reviewers and cross-checked. Statistical considerations: Outcomes from included trials were combined using the systematic review manager software and manually screened for eligibility to be included. PRISMA flowchart was produced based on the search results and the inclusion/exclusion criteria. To facilitate the assessment of possible risk of bias for each study, information was collected using the (Cochrane collaboration tool for assessing the risk of bias).

## RESULTS

From electronic search, a total of 1324 studies were identified, 743 studies remained after duplicated were removed. Based on titles and abstracts 727 studies were removed. Full text of 16 studies were reviewed, four of them were excluded because either, not human study or non – English language.




This systemic review to review systemically the efficacy of different pin configurations in management of supra condylar humeral Fracture in children, we compare lateral divergent pinning , Medio-lateral entry pin, lateral pin with transolecranon and infrafocal pin 12 studies were collected and were analysed.

Studies characteristics: Twelve studies were prospective, one randomized control study and one observational study (Table 1).

**Table (1): Studies characteristics**

| Author | Year | Type of study |
|---|---|---|
| Fahmy et al. | 2010 | Prospective |
| Gopinathan et al. | 2018 | Prospective |
| Guy et al. | 2011 | Prospective |
| Jain et al. | 2019 | Prospective |
| Jindal et al. | 2019 | Observative study |
| Kandel et al. | 2015 | Prospective |
| Kao et al. | 2016 | Prospective |
| Kasirajan et al. | 2018 | Prospective |
| Khairy | 2016 | Prospective |
| Othman et al. | 2017 | RCT |
| Shamma et al. | 2020 | Prospective |
| Sharma et al. | 2015 | Prospective |

**Patient's characteristics:** A total of 379 patients were involved 197 were males and mean age was 6.48 years (Table 2).

**Table (2): Patient's characteristics**

| Author | Year | Number | Age | Male |
|---|---|---|---|---|
| Fahmy et al. | 2010 | 29 | 5.25 | 17 |
| Gopinathan et al. | 2018 | 11 | 7.6 | 6 |
| Guy et al. | 2011 | 25 | 5 | 14 |
| Jain et al. | 2019 | 84 | ND | ND |
| Jindal et al. | 2019 | 15 | 7.2 | 7 |
| Kandel et al. | 2015 | 30 | 7.6 | 20 |
| Kao et al. | 2016 | 35 | 7.2 | 28 |
| Kasirajan et al. | 2018 | 48 | 7.4 | 30 |
| Khairy | 2016 | 20 | 6.2 | 15 |
| Othman et al. | 2017 | 17 | 5.5 | 11 |
| Shamma et al. | 2020 | 15 | 5.1 | 12 |
| Sharma et al. | 2015 | 50 | 7.27 | 39 |

Lesion characteristics: 165 were in left side and 99 were in right side, mode of trauma was mentioned in two studies and was (fall to the ground in 19 patients, fall downstairs in 7 patients and fall from height in 4 patients, Fall from height while playing in 8 patients, Road Traffic accident in 10 patients, others in 2paients) as regarding type was mentioned in one study and was flexion (2), extension (28). Grade according to Gartland II (101), and type III (231), displacement was mentioned in 5 studies and was (30) posterolateral displacement, 68 posteromedial displacement, 7 Posterior **(Table 3)**.

**Table (3): Lesion characteristics**

| Author | Year | Side | Mode of trauma | Grade | Displacement | Ideal time of surgery\ days |
|---|---|---|---|---|---|---|
| Fahmy et al. | 2010 | 21 left, 8 right | ND | Gartland type II (11), III (16) | posteromedial (3), posterior(1) | ND |
| Gopinathan et al. | 2018 | 9 left 2 right | ND | Gartland type III (11) | 7 posterolateral displacement, 4 posteromedial displacement | 1.5 |
| Guy et al. | 2011 | 15 left,10 right | ND | Gartland type IIB (10) and type III (15) | no | 1.2 |
| Jain et al. | 2019 | ND | ND | Gartland type II (34), III (50) | ND | 0.5 |
| Jindal et al. | 2019 | 8 left, 7 right | ND | ND | Posteromedial 11, Posterolateral 4 | 0.5 |
| Kandel et al. | 2015 | 11 left, 14 right | ND | Gartland Type II (5) and IIIA (10) and IIIB (5) | ND | 1.3 |
| Kao et al. | 2016 | 22 left, 13 right | ND | Gartland type III (35) | ND | ND |
| Kasirajan et al. | 2018 | 26 left 22 | ND | Gartland type IIB (12) and type III (36) | | 1.5 |
| Khairy | 2016 | 16 left, 4 right | Fall from height While Playing in 8 patients , Road Traffic accident in 10 patients , others in 2paients | Gartland's types III (20) | Posteromedial 13, Posterolateral 6, Posterior 1 | 1 |
| Othman et al. | 2017 | ND | ND | Gartland's types II (8) , III ( 9) | ND | 1.3 |
| Shamma et al. | 2020 | 9 left, 6 right | Fall to the ground in 15 patients, fall downstairs in 9 patients and fall from height in 6 patients | Gartland type IIB (1) and type III (14) | no | 2 |
| Sharma et al. | 2015 | 37 left 13 right | ND | Gartland types II (20) and III (30) | Posteromedially (28), posterolaterally (7), or posteriorly (15) | 1.3 |

**Outcome measures:** The carrying angle loss was measured in three studies 2 used lateral divergent pinning and showed excellent in about (96.6%), good (6.67%) and 1 used medio-lateral entry pin showed excellent (43.75%), good (50%), poor (6.25%) and this showed that lateral divergent pinning had better The carrying angle loss, the mean carrying angle loss was 3.4 in lateral divergent pinning, 3.05 in medio-lateral entry pin, 0.47 in lateral pin transolecranon and 5.05 in infrafocal pin and this showed that infrafocal pin had higher mean loss of carrying angle followed by lateral divergent pinning **(Table 4)**.

**Table (4): Outcome measures**

| Author | Year | Wire configurations | The carrying angle loss | Mean loss in carrying angle |
|---|---|---|---|---|
| Fahmy et al. | 2010 | Infrafocal pin | ND | ND |
| Gopinathan et al. | 2018 | Lateral divergent pinning | Excellent (100%) | No |
| Guy et al. | 2011 | Lateral divergent pinning | No | No |
| Jain et al. | 2019 | Infrafocal pin | ND | 5.05 |
| Jindal et al. | 2019 | Lateral pin transolecranon | ND | ND |
| Kandel et al. | 2015 | Medio-lateral entry pin | ND | 2.93 |
| Kao et al. | 2016 | Infrafocal pin | ND | ND |
| Kasirajan et al. | 2018 | Lateral pin transolecranon | ND | ND |
| Khairy | 2016 | Medio-lateral entry pin | ND | 3.17 |
| Othman et al. | 2017 | Medio-lateral entry pin | Excellent (43.75%), good (50%), poor (6.25%) | ND |
| Shamma et al. | 2020 | Lateral divergent pinning | Excellent (93.33%), good (6.67%) | 3.4 |
| Sharma et al. | 2015 | Lateral pin transolecranon | ND | 0.47 |

As regard mean loss in elbow extension was 2.4 in lateral divergent pinning, 8.2 in medio-lateral entry pin, 1.7 in lateral pin transolecranon and mean Baumann angle loss was 1.3 in lateral divergent pinning, 2.45 in medio-lateral entry pin 4.3 in infrafocal pin **(Table 5)**.

**Table (5): Mean loss in elbow extension and mean Baumann angle loss**

| Author | Year | Wire configurations | Mean loss in elbow extension | Mean baumann angle loss |
|---|---|---|---|---|
| Fahmy et al. | 2010 | Infrafocal pin | ND | ND |
| Gopinathan et al. | 2018 | Lateral divergent pinning | No | 0.45 |
| Guy et al. | 2011 | Lateral divergent pinning | No | ND |
| Jain et al. | 2019 | Infrafocal pin | ND | 7.07 |
| Jindal et al. | 2019 | Lateral pin transolecranon | ND | ND |
| Kandel et al. | 2015 | Medio-lateral entry pin | ND | ND |
| Kao et al. | 2016 | Infrafocal pin | ND | 1.7 |
| Kasirajan et al. | 2018 | Lateral pin transolecranon | ND | ND |
| Khairy | 2016 | Medio-lateral entry pin | 8.2 | 4.8 |
| Othman et al. | 2017 | Medio-lateral entry pin | ND | 0.11 |
| Shamma et al. | 2020 | Lateral divergent pinning | 2.4 | 2.3 |
| Sharma et al. | 2015 | Lateral pin transolecranon | 1.7 | ND |

**Flynn`s criteria:**

Is the study was to know the treatment outcomes following fixation of displaced supracondylar fractures by closed reduction and percutaneous pinning. It was excellent (86.4%), good (9.2%), poor (6.5%) in lateral divergent pinning, excellent (85.5%), good (16%), fair (5.6%) in medio-lateral entry pin, excellent (59.9%), good (27.9%), fair (9.5%), poor(8%) in lateral pin transolecranon and excellent (60.92%), good (28.2%), poor (4.8%) in infrafocal pin and this showed that the best result obtained in lateral divergent pinning and the worest in lateral pin transolecranon **(Table 6)**.

**Table (6): Flynn`s criteria**

| Author | Year | Wire configurations | Flynn`s criteria |
|---|---|---|---|
| Fahmy et al. | 2010 | Infrafocal pin | Excellent (77.8%), good (18.5) and poor (3.7) |
| Gopinathan et al. | 2018 | Lateral divergent pinning | Excellent (82%), good (9%), poor (9%) |
| Guy et al. | 2011 | lateral divergent pinning | Excellent (84%), good (12%), poor (4%) |
| Jain et al. | 2019 | Infrafocal pin | Excellent (44.04%), good (38.09%) poor (5.95%). |
| Jindal et al. | 2019 | Lateral pin transolecranon | Excellent 26.7% ,good 53.3%, fair 20% |
| Kandel et al. | 2015 | Medio-lateral entry pin | Excellent (83%), good (17%) |
| Kao et al. | 2016 | Infrafocal pin | ND |
| Kasirajan et al. | 2018 | Lateral pin transolecranon | Excellent (83), good (12.5) , fair (4.5) |
| Khairy | 2016 | Medio-lateral entry pin | Excellent (80%), good (15%), fair (5%) |
| Othman et al. | 2017 | Medio-lateral entry pin | Excellent 93.75% , fair 6.25% |
| Shamma et al. | 2020 | Lateral divergent pinning | Excellent (93.33%), good (6.67%) |
| Sharma et al. | 2015 | Lateral pin transolecranon | Excellent (70%), good (18%), fair (4%), poor (8%) |

**Complications:** Founded in 2 patients in lateral divergent pinning in form of compartment syndrome (1), superficial pin site infection (1) , 7 patients in medio-lateral entry pin in form of Iatrogenic postoperative ulnar nerve injuries (4), pin tract infection (3), 5 patients in lateral pin transolecranon in form of superficial pin tract infection (3), cubitus varus deformity (2), 18 in infrafocal pin in form of superficial pin tract infection (6), significant varus deformity (5), significant loss of range of movement (6), loss of reduction (1), and this showed that lateral divergent pinning had lower complications **(Table 7)**.

**Table (7): Complications**

| Author | Year | Wire configurations | Complication |
|---|---|---|---|
| Fahmy et al. | 2010 | Infrafocal pin | No |
| Gopinathan et al. | 2018 | Lateral divergent pinning | Compartment syndrome (1) |
| Guy et al. | 2011 | Lateral divergent pinning | Superficial pin site infection (1) |
| Jain et al. | 2019 | Infrafocal pin | Superficial pin tract infection (5), significant varus deformity (5), significant loss of range of movement (6) |
| Jindal et al. | 2019 | Lateral pin transolecranon | No |
| Kandel et al. | 2015 | Medio-lateral entry pin | Ulnar nerve injury (2) |
| Kao et al. | 2016 | Infrafocal pin | Pin site infection (1), loss of reduction (1) |
| Kasirajan et al. | 2018 | Lateral pin transolecranon | Superficial pin tract infection (2) |
| Khairy | 2016 | Medio-lateral entry pin | Superficial infection (1) |
| Othman et al. | 2017 | Medio-lateral entry pin | Iatrogenic postoperative ulnar nerve injuries (2), pin tract infection(2) |
| Shamma et al. | 2020 | Lateral divergent pinning | Superficial tract infection |
| Sharma et al. | 2015 | Lateral pin transolecranon | Superficial pin tract infection (1), cubitus varus deformity (2) |

## DISCUSSION

Supracondylar fractures are the most common pediatric fracture. Humeral fractures are common in the pediatric population and account for almost 70% of elbow fractures, their treatment is controversial when displacement has occurred, although percutaneous pinning is usually advised.

A bio-mechanical compare of all pin types were performed by *Lee et al. (2010)* in extension, varus, valgus, internal rotation and external rotation employing an artificial bone model. Divergent configuration laterally to forestall nerve palsy had enough stability however in rotation testing; this type of configuration had less stability than different configurations. During this study divergent pins provided a lot of stability than crossed pin in extension, and varus testing and this goes with our result.

*Reynolds and Jackson (2010)* prompt that stability depends on 3 factors that are below the management of the surgeon: the dimensions of the pin, the space between the pins on the road of the fracture, the

pins being within the bone on either side of the fracture.

According to *Skaggs et al. (2010)*, the engagement of the adequate bone within the proximal and distal fragment is additional vital. Most separation of the pins at the fracture line is incredibly vital for the bio-mechanical stability. Iatrogenic nervus ulnaris injury is often better known complication within the treatment of CRPP of displaced SCHF with the utilization of medial pin *(Devnani et al., 2011)*. Though most of the nervus ulnaris injuries recover spontaneously at intervals four and 6 months, permanent injury has been reported within the literature *(Dekker et al., 2016)*.

The authors of a large study of 345 patients, concluded that fixation of both type II and type-III pediatric SCHFs with only lateral pins provides adequate fixation while avoiding iatrogenic injury to the ulnar nerve *(Skaggs et al., 2010)*.

A biomechanical search elucidated that 2 divergent lateral-entry pins gift further stability in extension loading than do two crossed pins *(Pradhan et al., 2016)*. On the idea of those results, we have a tendency to believe that it's a very important issue for biomechanical stability is greatest separation of the pins at the fracture. It's been shown that 3 lateral pins offer additional torsional stability than do 2 lateral pins *(Silva et al., 2013)*.

On contrast to one randomized, prospective study by Kocher et al. (2012), examined loss of reduction and found a loss of reduction rate of 21% (6/28) in lateral-only pins. Medial and lateral pins had a statistically significant lower loss of reduction rate of 4% (1/24). This loss of reduction was not clinically significant enough to warrant reoperation in either group.

Another Meta-analysis of low-quality and moderatequality studies found no statistically significant difference between lateral and medial pin configurations with respect to Baumann angle, Baumann angle change, Flynn criteria, and infection *(Mulpuri et al., 2012)*.

Previous debates led to a systematic review that concluded there was a 42% reduction in fixation failure and deformity with cross pinning, but at the cost of five times higher risk of iatrogenic ulnar nerve injury *(Brauer et al., 2011)*.

As regard Flynn`s criteria in our review, we found that Flynn`s criteria was Excellent (86.4%), good (9.2%), poor (6.5%) in lateral divergent pinning , Excellent (85.5%), good (16%), fair (5.6%) in medio-lateral entry pin, excellent (59.9%), good (27.9%), fair (9.5%), poor(8%) in lateral pin transolecranon and excellent (60.92%), good (28.2%), poor (4.8%) in infrafocal pin and this showed that the best result obtained in lateral divergent pinning and the worst in lateral pin transolecranon.

*Mulpuri et al. (2012)*, conducted a systematic review and included 44 studies, and they suggested that closed reduction with pin fixation (2 or 3 laterally introduced pins) for patients with displaced supracondylar fractures of the humerus.

Two studies compared cross pins with two divergent lateral pins utilizing a capitellar starting point. *Marsland et al. (2014)* found no significant differences in stiffness between the two configurations in the internal rotation test. In contrast,

*Larson et al. (2010)* reported significantly greater stability of cross pins withan intact medial column.

*Zionts et al. (2010)* used a different lateral pin pattern. In the two divergent lateral and three divergent lateral pin configurations, the most distal two pins came cross each other at the fracture site. As it is commonly accepted, the greatest stability of pin fixation requires maximal pin separation at the fracture site and an adequate amount of bone proximal and distal to the fragment should be engaged *(Omid et al., 2012)*.

This helps to explain the obvious weaker torsional strength of two to three lateral pins than two cross pins in *Zionts's et al. (2010)* study. *Wang et al. (2012)* used two divergent medial pins configuration and they reported that this configuration was significantly more resistant to varus and torsion than two divergent lateral pins (P=0.002, 0.001, and 0.02, respectively).

It seemed like two divergent medial pins could provide as much stability as two cross pins under each loading condition. In their in-vitro study, *Marsland et al. (2014)* tested the mechanical property of a novel pin configuration that combined an intrafocal posterior pin with a lateral pin. This technique was reported to be potentially safer and to provide torsional stiffness comparable to that of standard two cross and two lateral pins (P>0.9).

As regard Complications in our review we found that complications Founded in 2 patients in lateral divergent pinning in form of compartment syndrome (1), superficial pin site infection (1), 7 patients in Medio-lateral entry pin in form of Iatrogenic postoperative ulnar nerve injuries (4), Pin tract infection (3), 5 patients in lateral pin transolecranon in form of superficial pin tract infection (3), cubitus varus deformity (2), 18 in infrafocal pin in form of superficial pin tract infection (6), significant varus deformity (5), significant loss of range of movement (6), loss of reduction (1). And this showed that lateral divergent pinning had lower complications.

Another reports showed that there was no significant difference between the occurrence of ulnar nerve injury (RR=0.86, 95% CI 0.36, 2.02, P=0.725). Two lateral pins was an effective and relative stable method to avoid of iatrogenic ulnar nerve injury. Though, cross-pinning was associated with an increase of the occurrence of ulnar nerve injury, long-terms follow-up revealed that ulnar nerve injury will recover spontaneously without complication *(Lyons et al., 2010)*. Thus, closed reduction was more preferable than open reduction for consideration of the ulnar nerve injury.

In a systematic review on closed reduction with pin fixation for patients with displaced (e.g, Wilkins type II and III and displaced flexion) pediatric supracondylar fractures of the humerus. Data on 28 outcomes from 8 studies were analyzed. Significant flaws in study design limited the strength of all the studies. The critical outcomes studied were cubitus varus, hyperextension, loss of reduction, malunion, pain, and elbow stiffness. Statistically significant data were found for only 2 of these outcomes. The ulnar nerve was injured in 3 of 557 (0.53%) cases with laterally introduced

pins. Medially introduced pins resulted in 49 of 808 (6%) cases of ulnar nerve injury. Iatrogenic ulnar nerve injury was noted to be statistically significant in favor of lateral pinning in 6 of 11 studies *(Mulpuri and Wilkins, 2012)*.

A meta-analysis of these studies and 3 additional underpowered studies (1 moderate quality and 13 low quality) also demonstrated a statistically significant effect in favor of lateral pinning (NNH = 22, odds ratio = 0.27). This suggests a 1 in 22 chance of harm resulting from the medial pinning techniques used in these studies. The NNH is similar to the results of a recently published meta-analysis on iatrogenic ulnar nerve injury after surgical treatment of displaced supracondylar fractures of the humerus, which had an NNH of 28 *(Slobogean et al., 2010)*.

*Aktekin et al. (2012)* reported that stiffness was greater in the patients treated with open reduction compared with patients treated with a closed reduction and pinning. *Li et al. (2012)* reported that the fractures treated open had a lower incidence of loss of reduction compared with displaced fractures that could be managed successfully with closed reduction and pinning. *Sibly et al. (2010)* found no statistically significant difference between groups for cubitus varus or elbow stiffness.

This higher rate was ascribable to the frequency of cutaneous complications after ESIN, in agreement with earlier data *(Lascombes et al., 2012)*. With ESIN, the longer time to hardware removal (mean, 55 days) and very short immobilisation provide greater opportunities for impingement on the skin compared to the other fixation methods. Despite this problem, the radiographic outcomes were similar to those in the other groups and to earlier data *(Eberl et al., 2011)*.

Secondary displacement occurred in 9% of patients in the L group, in keeping with previously published results *(Gaston et al., 2010)*.

Secondary displacement was significantly less common in the M + L group (2% vs.9%). This finding is consistent with biomechanical studies showing better resistance to torque with a medial and a lateral pin in an X configuration *(Weinberg et al., 2011)*.

Nevertheless, some studies found no difference between the two configurations *(Larson et al., 2010)*. A literature review by *Brauer et al. (2011)* showed a significantly lower relative risk of residual deformity when a medial pin was added (0.58; 95% confidence interval, 0.36–0.93; P = 0.02).

Recently, *Basaran et al. (2016)* stated that the medial pin should be inserted percutaneously when the ulnar nerve is palpable, to improve the cosmetic outcome. However, strong evidence indicates that the ulnar nerve cannot be identified by palpation when the elbow is swollen *(Wind et al., 2010)*.

## CONCLUSION

After studying the four type of pinning fixations, lateral divergent pinning had better outcome and lower complications. Hence, lateral divergent pinning is the favored procedure.

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# دراسة منهجيه في علاج حالات كسور أسفل عظمة العضد عند الأطفال عن طريق الرد المغلق و التثبيت بواسطة الأسلاك المعدنية من خلال الجلد: مقال مرجعي

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**خلفية البحث:** كسر عظم العضد هو ثاني أكثر أنواع إصابات العظام شيوعًا عند الأطفال. لعلاج هذا الكسر، كان التخفيض المغلق والتثبيت عن طريق الجلد، والتخفيض المفتوح والتثبيت الداخلي، من وسائل الإدارة الشائعة لكسر عظم العضد فوق اللقمتين.

**الهدف من البحث:** كان الهدف من هذا العمل هو المراجعة المنهجية لفعالية تكوينات الدبوس المختلفة في إدارة الكسر العضدي فوق اللقمي عند الأطفال.

**المواد وطرق البحث:** كانت هذه مراجعة منهجية حول الكسر العضدي فوق اللقمي عند الأطفال تدار عن طريق الاختزال المغلق والألم عن طريق الجلد.

تم إجراء البحث باستخدام قواعد البيانات MEDLINE، مكتبة COCHRANE و SCHOLAR ،GOOGLE ،PUBMED باستخدام الكلمات الرئيسية التالية "SUPRACONDYLAR العضد، الأطفال، التثبيت" للدراسات المنشورة من 2010-2020.

**نتائج البحث:** تم قياس خسارة زاوية الحمل في ثلاث دراسات: أثنتين استخدمتاً التثبيت الجانبي المتباعد وأظهرت نتائج ممتازة في حوالي (96.6٪)، جيد (6.67٪)، ودبوس إدخال متوسط جانبي مستخدم أظهر

نتائج ممتازة في 43.75٪ ، وجيد (50٪)، وضعيف (6.25٪). وهذا قد أظهر أن التثبيت الجانبي المتباين كان أفضل وفيما يتعلق بمتوسط الخسارة في تمديد الكوع كان 2.4 في التثبيت الجانبي المتباعد، 8.2 في دبوس الدخول المتوسط الجانبي، 1.7 في الدبوس الجانبي عبر الزليج، وكان فقدان زاوية بومان 1.3 في التثبيت الجانبي المتباين، 2.45 في دبوس الإدخال الوسيط الجانبي 4.3 في دبوس البؤرة.

**الاستنتاج:** في مراجعتنا بعد دراسة الأنواع الأربعة من التثبيت وجدنا أن التثبيت الجانبي المتباين كان له نتائج أفضل ومضاعفات أقل. ومن ثم، فإن التثبيت المتباين الجانبي هو الإجراء المفضل.

**الكلمات الدالة:** الرد المغلق، الكسور فوق اللقمية، التحليل التلوي.