

# Transolecranon and lateral Kirschner wire fixation for displaced supracondylar humeral fracture in children

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## Introduction

Percutaneous pinning of supracondylar humerus fracture (SCHF) in children is an effective way to maintain the anatomic reduction of a displaced, closed reduction and percutaneous pinning (CRPP) had been considered the standard treatment for displaced SCHF in children.

## Patients and methods

A prospective case series, was conducted at the emergency department of Helwan university hospital from February 2020 to September 2021. It includes 40 patients with Gartland type III fracture who presented to the orthopaedic casualty and were included in the study. Four patients (10%) had the transolecranon wire was directed intramedullary, 11 patients (27%) had the wire directed posterolaterally, and 16 patients (40%) had the wire directed posteromedially and 9 patients (23%) had the wire directed posteriorly.

## Results

The mean age was 5.57 years (range from 2–12 years). The mean Baumann angle in the patients was  $(70.89 \pm 2.40)$ . The mean follow-up duration was 3 months (range from 3–3.2 months). with mean carrying angle was about  $(9.37 \pm 2.52)$  and no one of the patients had an excessive deformity of carrying angle that required correction. Regarding ROM loss, there were 25, but always poor. A few complications occurred including pin tract infection and broken transolecranon wire and all were tolerable with no effect on the outcome.

## Conclusion

The Transolecranon and lateral Kirschner wires fixation is an effective option that provides good stability with the little number of trials in the management of supracondylar fracture of the humerus in children, and the risk of nerve injury or fishtail deformity was avoided especially in the hands of junior trainees in their first 3 years of training.

## Keywords:

closed reduction, supracondylar humeral fractures, transolecranon pin fixation

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## Introduction

A supracondylar humerus fracture is the most common elbow fracture in children. They account for 55% to 70% of all elbow fractures and are seen most frequently in children between the ages of 3 and 10 years. The chances of residual deformity are rare but devastating neurovascular complications make supracondylar humerus fractures a dreaded injury. Over time, we have advanced from the conservative approach to an operative approach with closed reduction percutaneous pinning as the acceptable mode of treatment [1].

Supracondylar fractures are commonly classified based on the Gartland system of classification, where they are divided into three types: Type I being non-displaced, type II being displaced but with an intact posterior cortex, and type III being displaced and without any cortical contact [2]. Although type I is generally treated nonoperatively, type II and type III are generally

managed with closed reduction and pinning to avoid malunion [3]. The 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].

Closed reduction and internal fixation using percutaneous pinning are the main treatments for supracondylar humerus fractures (SCHF). However, there are still some debates regarding the choice of pinning configuration for fixating the fractures. Currently, crossed pinning or lateral pinning using two

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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 [5].

Percutaneous pinning of SCHF in children is an effective way to maintain the anatomic reduction of a displaced fracture. closed reduction and percutaneous pinning (CRPP) had been considered the standard treatment for displaced SCFH in children. The main goal for treatment in SCFH is to achieve and maintain a closeness to anatomic reduction until the fracture is healed while minimizing the risks of complications in children. In the treatment of pediatric type IV fractures, multidirectional instability is the main difficulty for closed reduction [6]. Herein, we describe in this study an effective technique for closed reduction of Gartland type IV fractures using a transolecranon pin in children.

### Aim of the study

This study aimed to evaluate the clinical, radiological, and functional outcomes of Transolecranon and lateral Kirschner Wire Fixation for Displaced Supracondylar Humeral Fractures in Children.

### Patients and methods

#### Patients

A prospective case series, was conducted at the emergency department of Helwan university hospital from February 2020 to September 2021. It includes 40 patients with Gartland type III fracture who presented to the orthopaedic casualty and were included in the study. The inclusion criteria for the study were children aged 2–12 years old, Displaced types of supracondylar humerus fractures Gartland type III. An open fracture, Irreducible fracture. Vascular injury and the patient presented 5 days after fracture were excluded. Data recorded included: Age, Sex, Side of injury, Mode of trauma, Gartland type, Time to surgery, Operative time, Number of transolecranon wire trials, Direction of transolecranon wire, Time of wires removal, Postoperative complications, Baumann angle, Carrying angle, Flexion loss and Extension loss.

#### Radiographic and clinical assessment

Standard radiographs were done before and after surgery, including anteroposterior (AP), lateral, oblique views, and forearm X-rays were done also with clinical assessment and parent satisfaction are the main tools for judgment of outcome. All the protocols and procedures applied in this study were approved

by the administration department of this institution. Patients were scheduled for surgery. Time from trauma to surgery has been recorded; 30 patients (75%) have done the operation on the same day of trauma while 4 patients (10%) have done it on the second day and 6 patients (15%) have done it in the third day following trauma (the lag period in this group was due to their late presentation) Surgery was performed in the casualty department of Helwan university hospital, after taking a written and informed consent from the parents and proper preparation of the patients for the surgery. General anesthesia 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 the image intensifier which was adequate for the surgery due to the small size of the elbow. Closed reduction was done and confirmed by an image intensifier. The reduction can be considered a 'standard' technique that involved manual traction with the elbow flexed at 20 degrees. 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. This technique was adequate for the reduction in all the patients in the study. Reduction acceptability was confirmed by assessment of displacement, angulation, and rotation in the coronal and sagittal planes under an image intensifier (Fig. 1).

Under complete aseptic condition Two 1.6 mm 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 (Fig. 2).

The second wire is inserted from the lateral column across the fracture at (30–40) degree to the opposite cortex of the humerus (Fig. 3).

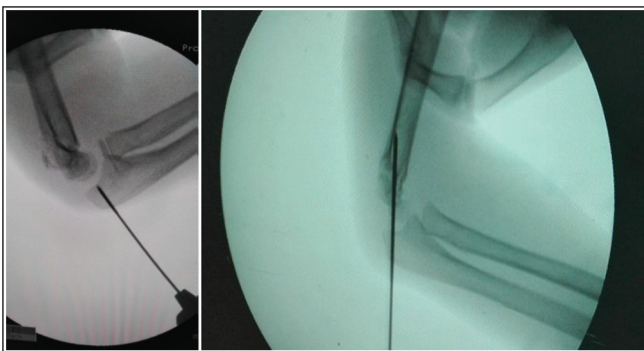
Four patients (10%) had the transolecranon wire was directed intramedullary, 11 patients (27%) the wire directed posterolaterally, 16 patients (40%) the wire directed posteromedially and 9 patients (23%) the wire directed posteriorly. After assessment of stability, the wires were then bent and cut outside the skin. Elbow was immobilized in a plaster of Paris back slab in 90° of flexion depending upon the swelling and neurovascular status. All patients were given single dose of broad spectrum antibiotics followed by oral antibiotics for 5 days. Neurovascular observation over the 1st 24 hours of hospitalization was done. Patients were admitted overnight and all of them were discharged over 24 hours and all the patients were followed up at the orthopaedic out-patient clinic and reviewed.

Figure 1



Reduction confirmation under image intensifier.

Figure 2



Transolecranon wire insertion under image intensifier.

Postoperative radiographic evaluation was performed by anteroposterior and lateral radiographs of the elbow. All the patients were evaluated clinically and radiographically at one week, three weeks, six weeks and three months and parents were strictly instructed not to remove the slab at home.

## Results

In the period between February 2020 to September 2021, forty patients with Gartland type III displaced supracondylar humerus fracture were treated and followed up until achieving fracture union, got a functional range of motion, and recovered from any complications such (pin tract infection & broken transolecranon wire) during the study.

### A-perioperative criteria

#### Operative time

Operative time range from 10–50 min with mean 27 min, we counted the operative time after induction of anaesthesia (including draping, reduction, wires insertion and splint application) (Table 1).

Number of transolecranon wire trials and operative time according to level of training:

Thirty patient (75%) were done by junior residents (level I training) with mean operative time = 29 min and standard deviation=11.93, 5 patients (12.5%) were done by mid senior resident (level II training) with mean operative time=27 min and standard deviation=10.31, 3 patients (7.5%) were done by senior resident (level III training) with mean operative time=21 min and standard deviation=7.63 and 2 patients (5%) were done by senior staff member (level V training) with mean operative time=17 min and standard deviation=3.53 and this difference in operative time was clinically insignificant. In regard to transolecranon wire trials the number of trials range from (1–5 trials) with mean=2 trial and standard deviation=1.12 (Fig. 4); while in relation to level of training: level I training has mean=2.6 trials, level II training has mean=2 trials, level III training has mean=2 trials and level V training has mean=1 trial.

### B-Radiological results

#### Baumann angle

Results were within normal range for all patients. The mean Baumann angle in the patients was (70.89) degree and standard deviation was (2.40).

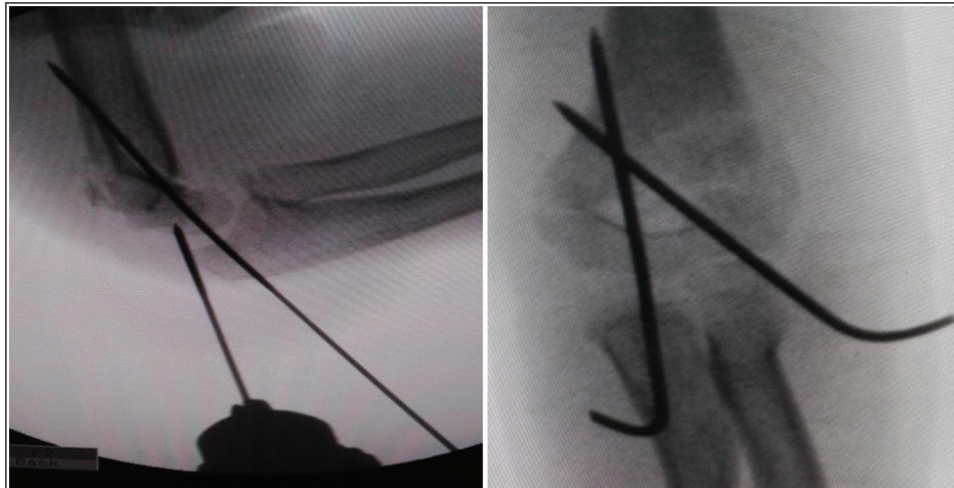
#### Time of wires removal

Postoperatively, anteroposterior & lateral views were done and wires were removed by 3 weeks if clinical and radiological evidence of early bone union is present and if not wires removal was postponed one week later.

Four patients (10%) had the wires removed by 3rd week, 34 patients (85%) the wires removed by 4th week, 1 patient (2.5%) the wires removed by 5th week and 1 patient (2.5%) the wires removed by 6th week (this



Figure 3

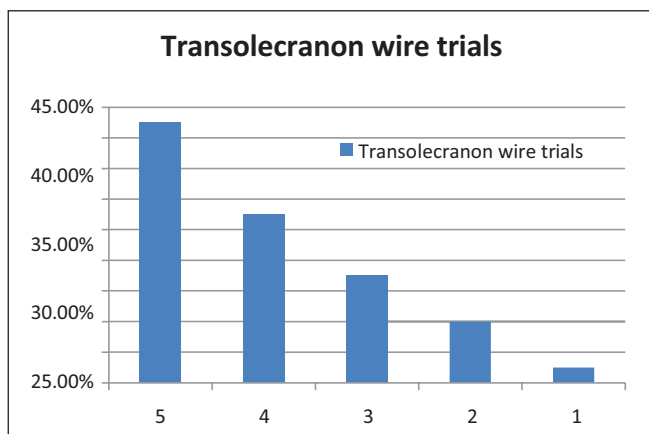


Lateral wire insertion under image intensifier.

Table 1 Operative time (minutes)

N	Mean	Std. deviation	Median	Minimum	Maximum
40	27.125	10.7946	25.000	10.0	50.0

Figure 4



Transolecranon wire trials.

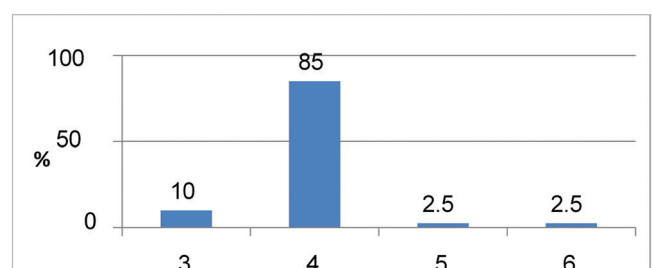
delay was due to incomppliance of the parents) (Fig. 5), with mean=3.97 week and standard deviation = 0.47.

After wires removal the plaster of paris splint was retained until 6 weeks postoperatively, intermittent active flexion extension exercises of the elbow were encouraged and lifting heavy objects by the affected limb was postponed until 12 week postoperatively.

**C-Results according to Flynn criteria**

All patients were available for clinical evaluation and all of them were evaluated at 3 months using the Flynn grading system, based on the difference in carrying angle and range of movement between the injured and uninjured elbow. The mean follow-up duration was

Figure 5



Time of wires removal in weeks.

3 months (range from 3–3.2 months). The mean age was 5.57 years (range from 2–12 years).

*Carrying angle*

All patients are within normal range (5–15 degree), with mean carrying angle was about (9.37) degree, standard deviation was (2.52) and no one of the patients had excessive deformity of carrying angle that required correction.

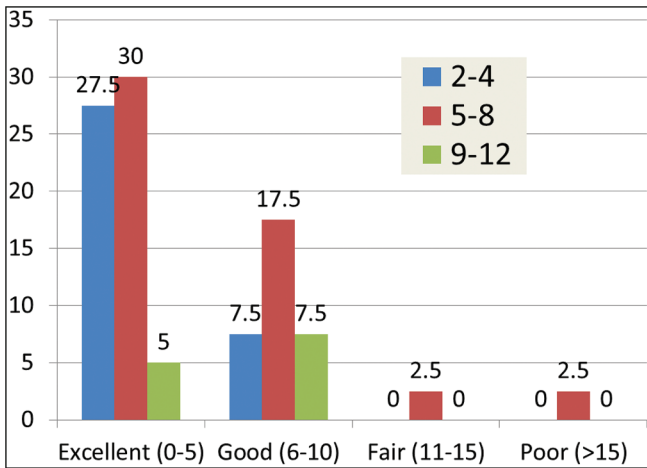
*ROM loss*

There were 25 patients (62.5%) excellent, 13 patients (32.5%) good, 1 patient (2.5%) fair and 1 patient (2.5%) poor (Fig. 6), with mean ROM loss was about (5.46) degree and standard deviation was (4.80).

*Extension loss*

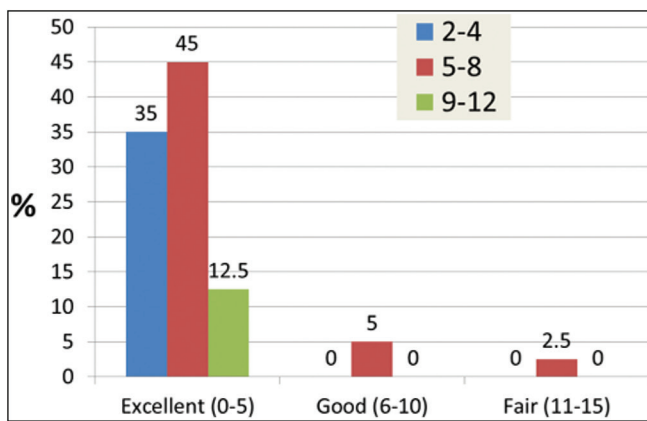
There were 37 patients (92.5%) excellent; 14 patients in the age group 2–4 years, 18 patients in the age group 5–8 years and 5 patients in the age group 9–12 years, 2 patients (5%) good; all are within age group 5–8 years, 1 patient (2.5%) fair; this patient was within age group 5–8 years and no poor patients. With mean extension loss was about (2.51) degree and standard deviation was (2.98) (Fig. 7).

Figure 6



ROM loss according to age.

Figure 7



Extension loss according to age.

**Flexion loss**

There were 37 patients (92.5%) excellent; 14 patients in the age group 2–4 years, 18 patients in the age group 5–8 years and 5 patients in the age group 9–12 years), 2 patients (5%) good; all are within age group 5–8 years, 1 patient (2.5%) fair; this patient was within age group 5–8 years and no poor patients. With mean flexion loss was about (2.95) degree and standard deviation was (2.32) (Fig. 8).

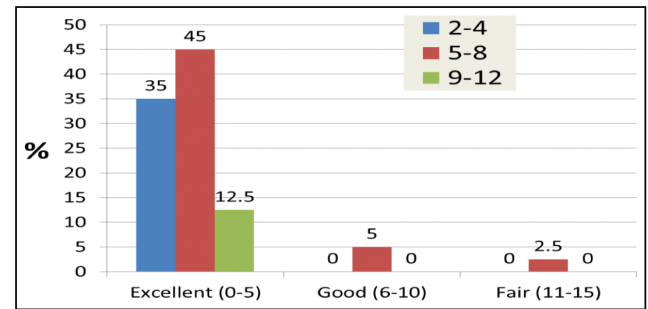
The results according to Flynn criteria: there were 25 patients (62.5%) excellent, 13 patients (32.5%) good, 1 patient (2.5%) fair and 1 patient (2.5%) poor Table 2.

Few complications occurred and all were tolerable with no effect on final outcome and these were pin tract infection in 2 patients & broken transolecranon wire in 1 patient (Fig. 9).

**Pin tract infection**

2 patients (5%) had pin tract infection discovered during removal of the wires, for these 2 patients, pin

Figure 8

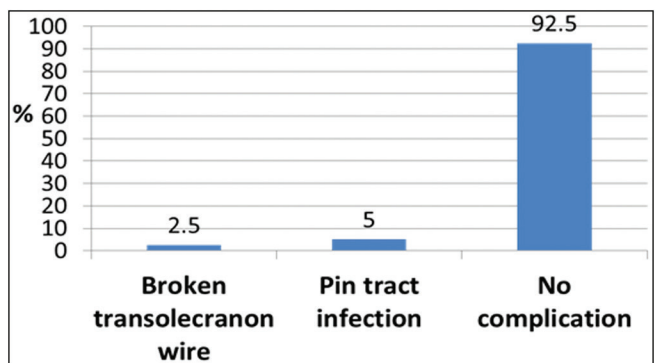


Flexion loss according to age.

Table 2 Analysis of carrying angle loss, elbow extension loss, elbow flexion loss and Rom loss by using Student t test

Parameter	Transolecranon wire fixation (Mean±SD)	P value (student t test)
Carrying angle loss	12.8±5.75	0.906
Elbow extension loss	2.51±2.98	0.802
Elbow flexion loss	2.95±2.32	0.802
Rom loss	5.46±4.80	0.540

Figure 9



Postoperative complications.

site cleaning by removal of crusts, repeated dressing and oral antibiotic (1st generation cephalosporin) for 1 week and this led them all recover at the subsequent follow-up.

**Broken transolecranon wire**

1 patient (2.5%) has broken transolecranon wire inside joint. This complication appeared at 3<sup>rd</sup> week follow-up and this was due to slab removal by the patient at home against medical advice.

The patient brought and operated upon 4<sup>th</sup> week and we remove a wire through posterior approach to the humerus (this wire was easily removed as its proximal end was prominent enough to be pulled up) and the patient put in a back slab for another 2 weeks. Then at 6 weeks from 1<sup>st</sup> operation slab removed and the patient start intermittent active flexion extension of the

elbow and obtained full ROM at 12<sup>th</sup> weeks without any reflection on the final outcome.

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## 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 hyperflexion and extension of the distal fragment and thus avoid postoperative deformity [7], which has been reported to be as high as 17 [8].

Closed reduction with percutaneous pin fixation for the management of displaced or angulated supracondylar humeral fractures in children has become widely adopted, but optimal pin configuration remains controversial [9,10]. Open reduction is usually unnecessary, although it sometimes can be required to obtain complete reduction especially in cases in which the fracture cannot be reduced because of the presence of a vascular lesion [11].

Our technique has been mentioned by (Sharma *et al.*, 2015) [12] which has in his prospective study 50 patients with Gartland type II & III supracondylar humerus fractures (with mean age: 7.27 years) was treated to evaluate the outcome after closed reduction and pinning using a Kirschner wire inserted laterally and another inserted vertically through the olecranon, with mean follow-up duration was 13 months. They found that according to Flynn grading system the outcome was excellent in 35 patients, good in 9, fair in 2 and poor in 4. Outcome did not differ significantly between patients operated on within 24h of injury and those operated on 2 to 5 days after injury. One patient developed superficial pin tract infection, two patients developed cubitus varus deformity and no patient sustained iatrogenic nerve injury. They concluded that transolecranon vertical and lateral Kirschner wire fixation is a viable option for displaced supracondylar humeral fractures in children, especially when there is massive swelling.

In our study, 40 patients with displaced supracondylar humerus fractures (Mean age was 5.57 years) were treated to assess the outcome after closed reduction and pinning using transolecranon & lateral Kirschner wires fixation especially in the presence of elbow swelling (made lateral condyle very difficult to palpate), fractures that need more than 2 lateral wires or those need medial wire for fixation, especially in the hands of junior trainee in their first 3 years of training. In regard to transolecranon wire trials we obtain successful wire insertion with small number

of trials with a range (1–5 trials), with mean=2 trial and standard deviation=1.12. The mean operative time was (27 min), we counted the operative time after induction of anaesthesia (including reduction, draping, wires insertion and splint application). We found that according to Flynn grading system the outcome was excellent in 25 patients, good in 13, fair in 1 and poor in 1. Outcome did not differ significantly between patients operated on within 24h of injury or those operated after. We have 2 patients developed superficial pin tract infection, 1 patient has a broken transolecranon wire inside elbow joint and these complications didn't affect the final outcome. No patient sustained iatrogenic nerve injury and no patients develop fixation loss.

All patients regained their ROM, only 2 were referred to physiotherapy, all other 38 patients regained their final satisfactory ROM without any need to specific therapy program. All of them given instruction to actively mobilize their elbows, the 2 patients that were referred to physiotherapy were reluctant to actively mobilize their elbows.

No radiological evidence of articular damage occurred because smooth pins were used, also we cannot comment on the occurrence of fishtail deformity because of short term follow-up. No infective arthritis occurred despite the Kirschner wire across the joint, probably because of aseptic precautions intra and postoperatively.

The limitations of this study is the lack of a control group for comparison, short duration of follow-up and lack of biomechanical study of the stability of the construct.

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## Conclusion

According to our results, we conclude that the Transolecranon and lateral Kirschner wires fixation is an effective option that provides good stability with little number of trials in management of supracondylar fracture of the humerus in children, and the risk of nerve injury, or fishtail deformity (Dissolution of distal humerus) were avoided especially in the hands of junior trainees in their first 3 years of training.

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Nil.

## Conflicts of interest

Authors have no conflict of interest to declare.

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## Reference

- 1 Shah S., Parikh K., Paraliya P. A study on outcome of various K-wire fixations in paediatric supracondylar humerus fractures. *Int J Res Orthop* 2020; 6:896–901.
- 2 Leung S, Paryavi E, Herman MJ, Sponseller PD, Abzug JM. Does the modified Gartland classification clarify decision making?. *J Pediatr Orthop* 2018; 38:22–26.
- 3 Mulpuri K, Hosalkar H, Howard A. AAOS clinical practice guideline: the treatment of pediatric supracondylar humerus fractures. *J Am Acad Orthop Surg* 2012; 20:328–30.
- 4 Brighton B, Abzug JM, Ho CA, Ritzman TF. Current strategies for the management of pediatric supracondylar humerus fractures: tips and techniques for successful closed treatment. *Instr Course Lect* 2016; 65:353–60.
- 5 Zhao H., Xu S., Liu G., Zhao J., Wu S., Peng L. Comparison of lateral entry and crossed entry pinning for pediatric supracondylar humeral fractures: a meta-analysis of randomized controlled trials. *J Orthop Surg* 2021; 16:366.
- 6 Picado A., Morán G., Moraleda L. Management of supracondylar fractures of the humerus in children. *EFORT Open Rev* 2018; 3:526–540.
- 7 Howard A, Mulpuri K, Abel MF, Braun S, Bueche M, Epps H, *et al.* American Academy of Orthopaedic, The treatment of pediatric supracondylar humerus fractures. *J Am Acad Orthop Surg* 2012; 20:320–27.
- 8 Vallila N, Sommarhem A, Paavola M, Nietosvaara Y (2015): Pediatric distal humeral fractures and complications of treatment in Finland: a review of compensation claims from 1990 through 2010. *J Bone Joint Surg Am* 97:494–99.
- 9 Edmonds EW, Roocroft JH, Mubarak SJ. Treatment of displaced pediatric supracondylar humerus fracture patterns requiring medial fixation: a reliable and safer cross-pinning technique. *J Pediatr Orthop* 2012; 32:346–51.
- 10 Prashant K, Lakhota D, Bhattacharyya TD, Mahanta AK, Ravooof A. A comparative study of two percutaneous pinning techniques (lateral vs medial-lateral) for Gartland type III pediatric supracondylar fracture of the humerus. *J Orthop Traumatol* 2016; 17:223–29.
- 11 Muchow RD, Riccio AI, Garg S, Ho CA, Wimberly RL. Neurological and vascular injury associated with supracondylar humerus fractures and ipsilateral forearm fractures in children. *J Pediatr Orthop* 2015; 35:121–12.
- 12 Sharma A., Kahal K., Sharma S. Transolecranon and lateral Kirschner wire fixation for displaced supracondylar humeral fracture in children. *J Orthop Surg* 2015; 23:319–22.