

## Comparison of clinical outcome between Triceps-splitting and Triceps-sparing posterior surgical approaches in the supracondylar humeral fractures in children.

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### Abstract

**Background and Objectives:** Supracondylar humeral fractures are the most common type of upper arm injury in children. The treatment is mostly performed via a posterior surgical approach. There is an argument about whether Triceps-splitting or Triceps-sparing posterior surgical approach is the most effective treatment. The literature have supported that Triceps-sparing posterior approach helped preserve the extensor mechanisms, while the Triceps-splitting approach to the posterior humerus provides broad exposure for fracture fixation. This study aims to compare the Triceps-splitting and Triceps-sparing posterior surgical approaches in the treatment of supracondylar humeral fractures in children in terms of functional recovery, operative time, blood loss, radiological result, elbow range of motion and clinical outcome.

**Methods:** The data of eighty-eight patients under ten years of age who presented with supracondylar humeral fractures and were treated between 2012-2020 were collected and evaluated. The patients were separated into two groups according to the surgical approach. Forty-three patients were treated with Triceps-splitting posterior surgery ,and forty-five patients were treated with Triceps-sparing posterior surgery. The study included comparing operative time, blood loss, radiological results, and elbow range of motion.

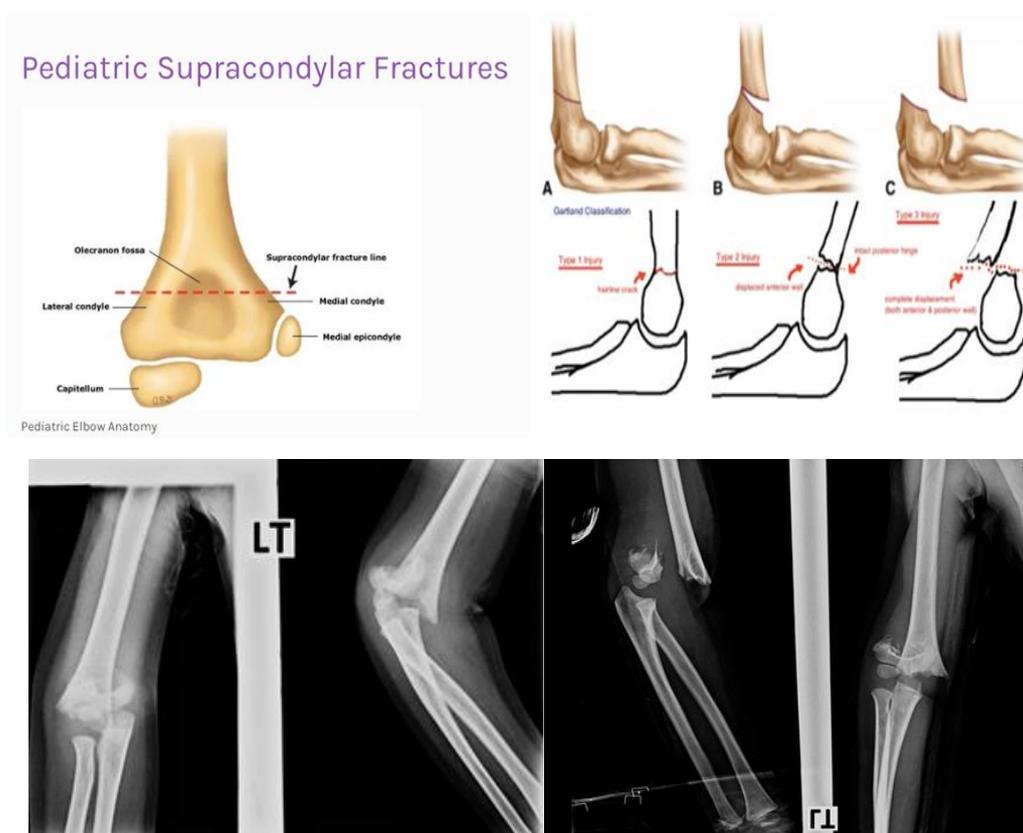
**Results:** Triceps-splitting posterior approach was correlated with significantly shorter operative time compared with Triceps-sparing posterior approach. No significant difference was determined between the groups regarding blood loss, radiological results, elbow range of motion and clinical outcome.

**Conclusion:** In treating supracondylar humeral fractures in children, Triceps-splitting posterior approach was as practical as the Triceps-sparing posterior approach but provided a shorter operative time.

**Key Words:** Supracondylar humeral fractures, Triceps-splitting posterior approach, Triceps-sparing posterior approach.

## Introduction

Supracondylar humeral fractures are the most common type of account for 60% of elbow fracture found in children. The injury is usually caused by a fall with an outstretched hand. The Incidence rate of supracondylar humeral fractures has been reported to be higher in boys than in girls. According to Gartland classification of supracondylar humeral fractures type III: fractures often have oblique patterns with severe displacement and rotation; it is challenging to treat and entails technically complex procedures for orthopedic surgeons. Just 2–12% of these cases require open reduction and internal fixation (ORIF).



A variety of approaches can accomplish surgical exposure. An ideal surgical approach should enable safe and rapid reduction to obtain full anatomic alignment and adequate functional and cosmetic outcomes. A lower rate of complications is also crucial. The literature has concluded that the posterior approach is easier when compared to the combined medial-lateral approach. Although some researchers have supported that Triceps-sparing posterior approach helped preserve the extensor mechanisms esthetically along with satisfactory postoperative function. Triceps-splitting posterior approach affords broad exposure for fracture fixation. It facilitates reduction and fixation of humeral shaft and articular distal humerus fractures.

The purpose of this study was to compare Triceps-splitting and Triceps-sparing posterior surgical approaches in treating supracondylar humeral fractures in children in terms of functional recovery, operative time, blood loss, radiological result, and elbow range of motion. The outcomes will have beneficially resulted in any surgical decision-making in the treatment of supracondylar humeral fractures in children.

## Methods

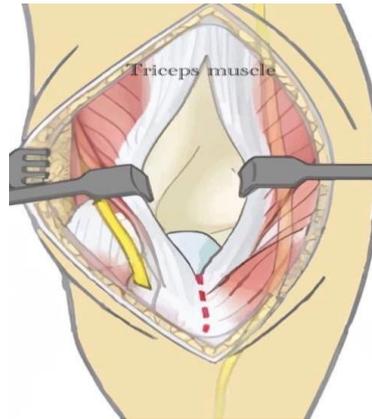
This retrospective review included patients with supracondylar humeral fractures surgically treated at Sawangdandin Crown Prince hospital between August 2012-2020. Inclusion criteria were patients with: (a) acute and unilateral fracture, (b) Gartland classification Type III, (c) Triceps-splitting and Triceps-sparing posterior surgical approaches with K-wire fixation, (d) less than ten years of age, (e) normal elbow function before the injury. Exclusion criteria were patients with: (a) pathological fractures, (b) primary or metastatic bone tumors, (c) bilateral fractures, (d) open fractures, (e) ipsilateral limb injuries, and (f) significant neurological deficits.

The patients from each group of Triceps-splitting and Triceps-sparing posterior surgical approaches with K-wire fixation were randomly selected using the lottery method for the study.

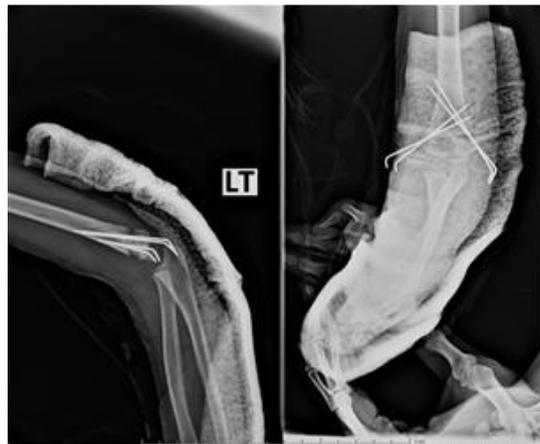
### Surgical technique

For Triceps-splitting posterior approach group, patients with supracondylar displaced humeral fractures (Gartland classification Type III) were treated with open reduction and internal fixation (ORIF) to re-align and hold the bones together with K-wire. In this case, the patients would be given general anesthesia.

The first part was the open reduction, beginning by incising the skin at the tip of the olecranon and running proximally in a straight line along the posterior midline of the arm. Fascia should be split in line with and incision. Then, the subcutaneous tissue was dissected from the deep fascia. The triceps tendon was split in the midline from the tip of the olecranon to the upper limit of the olecranon fossa. The triceps tendon and aponeurosis were further typically split 3-4 cm proximal to the fracture line, providing a clear view of the olecranon fossa. Two smooth soft tissue retractors were inserted, and the triceps muscle was split longitudinally and released the muscle from the bone only as much as needed and protected the ulnar nerve medially.



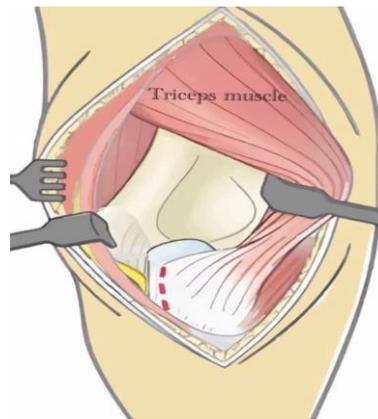
Triceps-splitting posterior approach group



Internal fixation was carried out using 1.6 mm K-wires crossed pinning; two in each column, which was a -robust construction biomechanically.

After inserting the drain, the muscle, fascia, and subcutaneous tissue were closed by an interrupted suture with vicryl, while nylon suture was applied with the skin. A posterior long arm splint was applied with the elbow in 90° flexion and forearm in pronation.

For Triceps-sparing posterior approach group, the patient was taken on general anesthesia and placed in a lateral decubitus position—the same as being performed in Triceps-splitting posterior approach group. A midline posterior skin incision began by incising the skin at the tip of the olecranon and running proximally in a straight line along the posterior midline of the arm. The Fascia should be split in line with an incision. Then, the subcutaneous tissue was dissected from the deep fascia. Once the triceps muscle was in vision, it mobilized and retracted laterally. This might be achieved by bluntly dissecting the medial head of the triceps from the posterior aspect of the humerus. Depending on the fracture location, the exposure might need to be extended distally.



Triceps-sparing posterior approach group

After the fracture site was exposed, internal fixation was carried out using 1.6 mm K-wires crossed pinning, two in each column, which was a robust construction biomechanically. The subcutaneous tissue was closed by an interrupted suture with vicryl while a nylon suture was applied to the skin. A posterior long arm splint was applied with the elbow in 90° flexion and forearm in pronation, the same as in the Triceps-sparing posterior approach group.



The wound closure and postoperative care of both groups were similar. The sutures and the wires were removed after two weeks and four weeks, respectively. Afterward, active elbow motions were exercised. Follow-up examinations of the patients, employing standard anteroposterior and lateral radiographs of the elbow, were made at 4-week intervals until the union was confirmed. The examinations included fracture healing, implant loosening, and reduction loss. In addition, operative time, blood loss, elbow range of motion and complications were documented.



Descriptive statistics were compiled for all data points. The categorical variables were compared using Chi-square while independent samples student's t-test was used to compare continuous variables between two groups. The result was considered statistically significant if the two-sided p value was less than 0.05.

## Results

A total of 88 patients, ranging from 2-10 years or 6.4 years on average, were included throughout the study period. The patients were segregated into two groups: Group 1 included 43 patients operated on using the Triceps-splitting posterior approach, and Group 2 included 45 patients operated on using the Triceps-sparing posterior approach. All patients were followed up for more than three months after discharge from the hospital. The follow-up period range from 3-6 months or 4.4 months on average. The mechanisms of injury and demographic data related to each group are demonstrated in Table 1.

Table 1, The injury mechanism, length of hospital stays, and preoperative demographics of both treatment groups.

Characteristics	Triceps-splitting posterior approach group (n=43)	Triceps-sparing posterior approach group (n=45)	P value
Gender (Male/Female)	25/18	28/17	0.695
Injured arm (Right/Left)	15/28	19/26	0.479
Age (years): mean (sd)	6.3 (2.1)	6.5 (2.2)	0.664
Injury period to operation (days) : mean (sd)	1.5 (0.2)	1.6 (0.3)	0.070
Length of hospital stay (days) : mean (sd)	3.2 (0.4)	3.3 (0.5)	0.304

The mean operative time was 38 minutes for the Triceps-splitting posterior approach group and 53 minutes for the Triceps-sparing posterior approach group. Thus, the difference in the mean operative time of these two groups was considered significant. Nevertheless, according to the 6-month follow-up, the differences in blood loss, radiological result and elbow range of motion were found not significant. The outcomes are given in Table 2.

Table 2, Comparison of outcome between the two treatment groups.

Outcome	Triceps-splitting posterior approach group (n=43)	SD	Triceps-sparing posterior approach group (n=45)	SD	P value
Mean operative time (min)	38 (range, 30-45)	4	53 (range, 45-60 )	4	<0.01
Blood loss (ml)	109 (range, 50-150)	24	111 (range, 50-150)	25	0.703
Baumann's angle difference from normal side (degree)	3.8 (range, 1-7)	1.4	4.0 (range, 1-7 )	1.5	0.520
Shaft condylar angle difference from normal side (degree)	1.9 (range, 1-3)	0.4	2.0 (range, 1-3 )	0.5	0.304
Elbow flexion (degree)	128 (range, 90-145)	8	130 (range, 90-145)	7	0.214
Extension lag (degree)	5.1 (range, 1-10)	2	5.3 (range, 1-10)	2.1	0.648

## Discussion

Most severe displaced supracondylar humeral fracture (Gartland classification Type III) cases that could not be treated by external fixation, primarily caused by muscle, joint capsule and periosteum interposition of fractures. Previous studies also discovered that the brachialis muscle interposed makes it fail to conduct closed reduction with adequate bone alignment. Therefore, open reduction and internal fixation (ORIF) with K-wire are necessary.

Various approaches have reported surgical exposure. However, a good surgical approach involved easy access to fracture, shorter operative time, fewer damaged organs, low risk of stiffness, and a functional and cosmetical elbow resume. The posterior approach had a low risk of stiffness compared with the other surgical approaches.

Some literature described that the posterior approach had shorter operative time than the combined medial-lateral approach since one incision could give the surgeon a good view, and a perfect reduction would be obtained. Correspondingly, the Triceps-splitting approach to the posterior humerus provides broad exposure for fracture fixation and facilitates reduction and fixation of humeral shaft and articular distal humerus fractures. Nevertheless, the Triceps-sparing posterior approach was stated by some researchers for well preserving the extensor mechanisms esthetically along with satisfactory postoperative function.

Accordingly, this study aims to compare outcomes between the Triceps-splitting and Triceps-sparing posterior surgical approach in treating supracondylar humeral fractures in children functional recovery, operative time, blood loss, radiological result, and elbow range of motion. Other complications were also examined.

**Limitation of the study:** it was not a current but a retrospective study.

### **Conclusion**

Triceps-splitting posterior approach was as practical as Triceps-sparing posterior approach in the treatment of supracondylar humeral fractures, with a tendency to achieve comparable good results. However, Triceps-splitting posterior approach had more advantages in shorter operative time than Triceps-sparing posterior approach.

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