

# *Clinical efficacy of closed reduction combined with percutaneous cross Kirschner wire fixation for the treatment of supracondylar fractures of the humerus in children*

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**Abstract:** Closed reduction combined with percutaneous cross Kirschner wire fixation is a minimally invasive surgery for treating fractures. The method involves making a small incision on the skin and inserting a specially designed Kirschner wire into the fracture site to achieve reduction and fixation of the fracture site. Compared with traditional open reduction and internal fixation surgery, this treatment method has the advantages of minimal trauma and fast postoperative recovery. It is more suitable for minimally invasive fractures such as femoral shaft fractures and supracondylar fractures of the humerus in children. Using this method to treat supracondylar fractures of the humerus in children can faster heal the fracture site, restore elbow joint function, and further improve the quality of life of children. It can also reduce the incidence of postoperative adverse events and improve the satisfaction of patients and their families with the treatment services provided by our hospital.

Humeral supracondylar fracture is the most common type of fracture in children, often caused by accidental falls or other accidents during exercise. The incidence rate of supracondylar fracture of humerus in children is high, the main reason is that the bone is not fully developed. For the treatment of supracondylar fractures of the humerus in children, open reduction, internal fixation and other surgeries are currently the main methods in clinical practice. Although this technique can effectively stabilize the fracture, the postoperative trauma is significant and can affect the growth and development of the child<sup>[1]</sup>. In recent years, with the development of medical technology, various new surgical methods have also emerged, among which closed reduction combined with percutaneous cross Kirschner wire fixation is a relatively ideal surgical method<sup>[2]</sup>. This method achieves the goal of reducing and fixing the fracture by inserting a Kirschner wire into the fracture site. It has the characteristics of minimal trauma and fast postoperative recovery, and can better preserve the bone development function of the child<sup>[3]</sup>. This article selects 70 children with supracondylar fractures of the humerus admitted from January 2022 to September 2023 as the research subjects, aiming to explore the clinical effect of closed reduction combined with percutaneous cross Kirschner wire fixation for the treatment of supracondylar fractures of the humerus in children. The report is as follows.

## 1. Materials and Methods

### 1.1 General Information

70 children with supracondylar fractures of the humerus admitted to our hospital from January 2022 to September 2023 were selected and divided into two groups by drawing lots. The control group consisted of 35 cases, 21 males and 14 females, aged 5-9 years, with an average age of  $(7.46 \pm 1.60)$  years; The study group consisted of 35 patients, including 18 males and 17 females, aged 6-11 years, with an average age of  $(7.78 \pm 1.35)$  years. There was no statistically significant difference in the general data comparison between the two groups of children,  $p > 0.05$ .

Inclusion criteria: (1) All children without clinically confirmed supracondylar fracture of the humerus. (2) The patient's information is complete. (3) The child and their family members are aware of this study and agree to participate. (4) The age range is between 5 and 12 years old. Exclusion criteria: (1) Individuals who are allergic to surgical anesthesia drugs. (2) Those with congenital malformations at the fracture site. (3) Individuals with mental illness who are unable to communicate normally. (4) Those with poor coordination during the research process and those who withdrew midway.

### 1.2 Methods

The control group underwent traditional open reduction and internal fixation surgery: under the C-arm X-ray machine, the child was placed in a supine position and the affected limb was placed on an image intensifier to ensure a clear surgical field of view. During the operation, when the chief surgeon grabs the child's wrist and holds it vertically, the assistant supports the child's upper arm. At the same time, the surgeon will gently bend the child's elbow to approximately 120 degrees with the other hand to correct the sagittal fracture displacement<sup>[4]</sup>.

The research group used closed reduction combined with percutaneous cross Kirschner wire fixation: the child was placed in a supine position on the operating table, the fracture site was confirmed by preoperative X-ray, the upper arm was fixed, and the surgeon straightened the affected elbow joint and pulled it. The lateral displacement of the distal end towards the inside or outside was corrected first, so that the elbow was extended in a backward and vertical direction. Firstly, the doctor needs to correct the coronal misalignment of the fracture, and then use forearm pronation or supination to correct the child's rotational misalignment. Then the doctor will perform continuous traction, first push the olecranon of the ulna forward from behind the elbow, maintain the elbow joint in the over flexion position to lock the position of the distal end, and make the elbow of the child bend 90 degrees to correct its sagittal deviation. Under the C-arm X-ray machine fluoroscopy, the reduction situation of children is evaluated. When the humeral angle recovers to 60-80 degrees in the anterior and posterior positions, good reduction is the criterion. Percutaneous cross Kirschner wire fixation was used. Three Kirschner wires with a diameter of 1.5-2.0 mm were used to cross drill holes at a 45° angle between the inner and outer epicondyle of the humerus and the humeral shaft in children. The puncture intersection point of the Kirschner wire was about 1 cm from the proximal end of the fracture, and its stability was determined on an X-ray machine. After determining the fixation, bend the Kirschner wire outside the skin into a hook and cut its end. And then doctor will place a dressing between the skin and the needle tail hook to reduce the probability of exudation and secondary infection caused by the relative movement of the skin and needle tail. Then the doctor needs to conduct routine follow-up checks after the surgery and remove the Kirschner wire based on the healing status of the fracture<sup>[5]</sup>.

### 1.3 Observation indicators

(1) Then we compare the recovery of elbow joint function between the two groups of children, mainly evaluating the extension and bending angles of the affected elbow joint before and 3 months after surgery. (2) The quality of life of two groups of children was compared using our hospital's self-made scoring table, and the maximum score for each indicator was 100, with a positive correlation between the score and quality of life. (3) Statistical analysis was conducted on the occurrence of four adverse events: postoperative internal fixation loosening, cubitus varus, limited extension and flexion of the elbow joint, and traumatic arthritis in two groups of children, and the incidence of postoperative adverse events was compared between the two groups of children. (4) Using a self-made questionnaire from our hospital, the treatment satisfaction of patients was statistically analyzed and compared, total satisfaction rate = satisfied + somewhat satisfied.

### 1.4 Statistical Analysis

SPSS22.0 analyzed and processed the data, with measurement data represented by  $(\bar{x} \pm s)$ , using t-test, and count data represented by (%), chi square test, and  $P < 0.05$  indicating statistically significant differences.

## 2. Results

### 2.1 Comparison of elbow joint function recovery

Before surgery, there was no significant difference in the elbow joint extension angle between the two groups of children,  $p > 0.05$ ; Three months after surgery, the elbow joint extension angle of the study group was greater than that of the control group ( $p < 0.05$ ); The comparison of elbow joint bending angle before surgery was also meaningless,  $p > 0.05$ ; Three months after surgery, the elbow joint bending angles of both groups of children were greater than before surgery, and the recovery of the study group was better, with a bending angle greater than that of the control group ( $p < 0.05$ ). Please refer to Table 1 for details.

Table 1: Comparison of elbow joint function recovery between two groups. ( $\bar{x} \pm s$ , %)

Group	Number of cases	Straightening angle		Bending angle	
		pre-operation	postoperation	pre-operation	postoperation
Control Group	35	119.63±2.35	168.67±1.86	108.39±2.87	130.29±1.60
Study Group	35	120.41±2.02	177.53±1.26	109.65±2.61	141.90±1.15
<i>t</i>		1.489	23.332	1.922	34.859
<i>p</i>		0.141	0.000	0.059	0.000

### 2.2 Comparison of Quality of Life

The quality of life of the children in the study group was higher than that of the control group, and their scores in social function, emotional function, cognitive function, and physical function were all higher than those in the control group ( $p < 0.05$ ). Please refer to Table 2 for details.

Table 2: Comparison of Quality of Life Scores between Two Groups. ( $\bar{x} \pm s$ , points)

Group	Number of cases	Social function	Emotional function	Cognitive function	Physical function
Control Group	35	72.64±2.67	73.97±2.79	76.05±1.42	74.53±2.60
Study Group	35	78.31±2.23	82.19±2.08	81.83±1.06	82.16±1.86
<i>t</i>		9.643	13.974	19.297	14.120
<i>p</i>		0.000	0.000	0.000	0.000

### 2.3 Comparison of adverse event occurrence rates

The study group only had 1 case of limited elbow joint extension and flexion, and no other adverse events occurred. However, the control group had 3 cases of loose internal fixation, 1 case of cubitus varus, 2 cases of limited elbow joint extension and flexion, and 1 case of traumatic arthritis. The total incidence of adverse events in the study group was 2.86%, which was lower than the control group's 20.00%,  $p < 0.05$ . Please refer to Table 3 for details.

Table 3: Comparison of adverse event incidence rates between two groups. [n(%)]

Group	Number of cases	Loose internal fixation	Cubitus varus	Elbow joint extension and flexion limitation	Traumatic arthritis	Total occurrence rate
Control Group	35	3(8.57)	1(2.86)	2(5.71)	1(2.86)	7(20.00)
Study Group	35	0(0.00)	0(0.00)	1(2.86)	0(0.00)	1(2.86)
$\chi^2$						5.081
<i>p</i>						0.024

### 2.4 Comparison of treatment satisfaction rates

Two cases in the study group were dissatisfied, while nine cases in the control group were dissatisfied. The total satisfaction rate in the study group was 94.29%, which was higher than 74.29% in the control group ( $p < 0.05$ ). Please refer to Table 4 for details.

Table 4: Comparison of treatment satisfaction rates between two groups.[n(%)]

Group	Number of cases	Satisfied	Quite satisfied	Dissatisfied	Total satisfaction rate
Control group	35	9(25.71)	17(48.57)	9(25.71)	26(74.29)
Study group	35	18(51.43)	15(42.86)	2(5.71)	33(94.29)
$\chi^2$					5.285
<i>p</i>					0.022

## 3. Discussion

The main reason for supracondylar fractures of the humerus in children is that the child's bones have not yet fully developed, and the supracondylar area of the humerus has not been successfully shaped, exhibiting a thin cortical layer of bone and a short anterior posterior diameter. In addition, during the growth period of children, the bone tissue is relatively soft and prone to fractures,

especially during intense movements such as running, jumping, and climbing. Once a child falls, the first reaction is to use their hands to support the ground. At this time, pressure will quickly spread to the distal end of the humerus, which is prone to supracondylar fractures of the humerus<sup>[6]</sup>. Once a supracondylar fracture of the humerus occurs, if not properly treated, it is highly likely to form ischemic contracture and even lead to deformities such as cubitus varus, which will have a significant negative impact on the physical and mental health and daily life of the child. Therefore, in order to reduce nerve damage and complications, it is necessary to adopt scientific and reasonable treatment methods.

The traditional treatment method mainly adopts open reduction and internal fixation surgery. Although this technology can effectively repair stable fractures, due to the large trauma, it can cause strong postoperative pain for children, which can easily lead to a decrease in their treatment compliance after surgery; At the same time, traditional treatment methods slow wound healing, leading to an increased risk of postoperative wound infection in children, resulting in secondary trauma; In addition, traditional treatment methods have significant adverse effects on the growth and development of children<sup>[7]</sup>. Therefore, which method to use to treat pediatric supracondylar fractures of the humerus has become a medical concern. In recent years, with the advancement of medical technology and the increasing maturity of minimally invasive surgical techniques, closed reduction combined with percutaneous cross Kirschner wire fixation has attracted much attention in clinical practice as a new treatment method. This method uses percutaneous puncture to insert the Kirschner wire into the fracture end, which can achieve reduction and fixation of the fracture site without opening the skin, thus reducing the operational trauma<sup>[8]</sup>. Closed reduction combined with percutaneous cross Kirschner wire fixation is a safe, reliable, and safe treatment method, which can ensure the normal growth of children and avoid the adverse effects of conventional surgery on their growth and development<sup>[9]</sup>. In addition, the recovery speed of the patient after surgery is faster, and the pain of the patient is also less, which can help the patient better cooperate with subsequent rehabilitation treatment.

The control group used traditional open reduction and internal fixation surgery, while the research group used closed reduction combined with percutaneous cross Kirschner wire fixation surgery. The research results showed that there was no significant difference in the elbow joint extension angle between the two groups of children before surgery,  $p > 0.05$ ; Three months after surgery, the elbow joint extension angle of the study group was greater than that of the control group ( $p < 0.05$ ); The comparison of elbow joint bending angle before surgery was also meaningless,  $p > 0.05$ ; Three months after surgery, the elbow joint bending angle of both groups of children was greater than that before surgery, and the recovery of the study group was better, with a bending angle greater than that of the control group ( $p < 0.05$ ); The quality of life of the children in the study group was higher than that of the control group, and their scores in social function, emotional function, cognitive function, and physical function were all higher than those in the control group ( $p < 0.05$ ); The study group only had 1 case of limited elbow joint extension and flexion, and no other adverse events occurred. However, the control group had 3 cases of loose internal fixation, 1 case of cubitus varus, 2 cases of limited elbow joint extension and flexion, and 1 case of traumatic arthritis. The total incidence of adverse events in the study group was 2.86%, which was lower than the control group's 20.00%,  $p < 0.05$ ; Two cases in the study group were dissatisfied, while nine cases in the control group were dissatisfied. The total satisfaction rate in the study group was 94.29%, which was higher than 74.29% in the control group ( $p < 0.05$ ). The results indicate that the treatment effect of closed reduction combined with percutaneous cross Kirschner wire fixation for children with supracondylar fractures of the humerus is better than traditional open reduction and internal fixation surgery. It can heal the fracture site faster, restore elbow joint function, further improve the quality of life of children, reduce the incidence of postoperative adverse events, and

improve the satisfaction of children and their families with the treatment services provided by our hospital.

In summary, the clinical effect of closed reduction combined with percutaneous cross Kirschner wire fixation for the treatment of supracondylar fractures of the humerus in children is good and worthy of promotion and application.

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