

# Outcome of Closed Reduction and Percutaneous Cross K-Wire Fixation of Supracondylar Fractures of Humerus in Children

Mohammed KH<sup>1</sup>, Rahman MA<sup>2</sup>, Pervin A<sup>3</sup>, Ahmed N<sup>4</sup>, Hossain MF<sup>5</sup>

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### Key Words:

Supracondylar fractures, closed reduction, percutaneous k-wire fixation, Flynn Criteria, cross k wires.

### Abstract:

**Background:** Supracondylar fractures of humerus are common skeletal injuries in paediatric age group in between 50-70% of elbow injuries. They are often associated with complications and are very notorious for neurovascular injuries between 5 to 9 years of age.

**Objective:** To evaluate the outcome of supracondylar fracture of humerus with closed reduction and percutaneous cross k-wires fixation.

**Materials and method:** A prospective study of 30 patients of Gartland type III fractures admitted in the orthopaedics department of 250 Bedded General Hospital, Tangail from January 2021 to December 2021.

**Results:** Regarding FLYNN CRITERIA, there were 24 excellent, 3 good, 2 fair and 1 poor results. Fair and poor results were due to poor compliance with follow up and postoperative rehabilitation. There were 4 cases with pin tract infection, 1 with elbow stiffness, and 1 with cubitus varus.

**Conclusion:** Closed reduction and percutaneous cross k-wire fixation is a very effective and minimally invasive way of treatment of displaced supracondylar fractures of humerus. Crossed K-wire biomechanically better way of the stability of fracture reduction.

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### Introduction:

Supracondylar fracture of humerus is very common skeletal injury in pediatric age group. It consists of 50 to 70% of elbow injuries.<sup>1</sup> This fracture is very potential for neurovascular injury between 5 to 9 years of age.<sup>2</sup> The most common mechanism of injury is fall on outstretched hand. About 70% of cases, non-dominant limb is commonly involved. Usually these fractures in younger children result due to falls sustained while playing, fall from stairs and missing a step while running and the falls are usually of high energy trauma to cause this type of fractures.<sup>3,4</sup> Supracondylar fracture of humerus are of two types, extension type which is most common type 95-98% and another flexion-type, rare type <5%. In extension type

supracondylar fracture of humerus, distal fragment displaced posteriorly and proximal fragment lies anteriorly, the relative position of these fragments determines complications.<sup>5,6,7</sup> Gartland classified these fractures according to degree of displacement of distal humerus. Type I is undisplaced, type II is displaced but posterior cortex is intact and type III completely displaced, no contact between bone fragments.<sup>8,9</sup> The main complication related to supracondylar humeral fractures are limitation of elbow movements, malunion, compartment syndrome, neurovascular complication and myositis ossificans.<sup>10</sup> Various modalities of treatment for these fractures which include closed reduction and posterior slab, closed reduction and percutaneous cross k-wires fixation under C-arm guidance and open reduction and internal fixation. Swenson technique of cross k-wires fixation is being used today with excellent outcome.<sup>11,12</sup> In our country delayed presentation is much higher because of poverty, ignorance and time to reach tertiary level hospital. Type II supracondylar fractures in children are usually reduced by close reduction technique and Gartland Type III Supracondylar Fractures of humerus after closed reduction are stabilized with percutaneous k-wire fixation, however open reduction and internal fixation is recommended, especially when closed reduction is not achieved. Two k-

1. Dr. Khandaker Haris Mohammed, Junior Consultant of Orthopaedics, 250 Bedded General Hospital, Tangail.
2. Dr. Md. Asjadur Rahman, Assistant Professor of Orthopaedics, Sheikh Hasina Medical College, Tangail.
3. Dr. Amina Pervin, Lecturer of Pathology, Mugda Medical College, Dhaka.
4. Dr. Nadim Ahmed, Senior Consultant of Surgery, Shaheed Suhrawardy Medical College Hospital, Dhaka.
5. Dr. Mohammad Forhad Hossain, Assistant Professor (Orthopaedics), Sheikh Hasina Medical College, Tangail.

**Correspondence to:** Dr. Khandaker Haris Mohammed, Junior Consultant of Orthopaedics, 250 Bedded General Hospital, Tangail. Email: [khandaker.md.1319@gmail.com](mailto:khandaker.md.1319@gmail.com). Mobile no: 01935062448

wires inserted through medial and lateral cortex in the management of Gartland type III supracondylar fractures of humerus from 5 to 9 years of age. In our study Flynn criteria for reduction assessment was used.<sup>13, 14</sup>

#### Method and Materials:

This prospective descriptive study was carried out at orthopaedics department of 250 Bedded General Hospital, Tangail from January 2021 to December 2021. Thirty patients of Gartland type III close supracondylar fractures of humerus were included in this study. A written informed consent was obtained from all the patients or by their parents. Open fracture, associated neurovascular injury and history of previous elbow fracture were excluded from the study. After admission to orthopaedics ward of 250 Bedded General Hospital, Tangail detailed history and clinical examination, operative radiographs (Anterior-posterior and lateral views) were taken in each patient. Under general anesthesia, with and C-arm guidance fracture reduction was done by traction and counter traction followed by controlled flexion at elbow. After satisfactory C- arm reduction, fracture was stabilized with 2 cross k -wires (1.5 to 1.8 mm depending on age of the patient). First k- wire was introduced from lateral side and then on medial side, ulnar nerve was placed posteriorly behind medial epicondyle with the help of the thumb of one hand and k-wire was inserted. If the k-wires were in a good position in both views, the fracture was usually satisfactorily stable to allow the arm to be externally rotated to plan the lateral view. The wires are bending over and cut, being left percutaneous. After satisfactory k-wire fixation antiseptic dressing was done and posterior long arm slab support applied with elbow flexed at right angle. At the end of the procedure the radial pulse is examined. Patients were carefully observed for 24- 72 hours and then discharged from hospital. Regular follow up was done at 1 week, 3 weeks and 5 weeks. After 3 weeks posterior slab was removed and active exercise was started .K-wire removed at 4-5 weeks. Clinical assessment was done according to Flynn criteria and radiological examination was made by assessing the Baumann's angle in pre-operative and post operative X-rays. Final follow up was done after one year using Flynn criteria.

**Table-I**

Showing Flynn Criteria		
Results	Cosmetic factor-loss of carrying angle (degree)	Functional factor -loss of motion (degree)
Excellent	0-5	0-5
Good	6-10	6-10
Fair	11-15	11-15
Poor	>15	>15



**Figure 1 :** Pre-operative A-P and Lateral radiographes showing supracondylar fractures of Humerus.



**Figure 2 :** Post-operative A-P and lateral radiographes showing crossed k-wire fixation of supracondylar fractures of humerus.

#### Results:

Among 30 studied patients, 18 were male and 12 were female and 28 patients were of extension type, 2 flexion type. 86.7% were anatomical reduction according to radiological assessment and 13.3% had posterior displacement. Left side was involved in 22 patients, 8 in right. Age was from 3 to 9 years with maximum patients in 5 to 8 years of age. As per Flynn criteria 24 were excellent, 3 good, 2 were fair and 1 remained poor (table-II). Results in our study were excellent in carrying angle and functional outcome with full range of motion. Two cases were graded fair due to poor compliance to follow up. During early course of follow-up 1 patient presented with elbow stiffness with restriction of elbow flexion and extension. 4 patients reported with pin tract infection, 1 Patient with Cubitus varus with late presentation (table - III). Union was achieved without any neurovascular complication.

**Table-II**

<i>Outcome characters among study group</i>			
		No.	%
Flynn cosmetic	Excellent	24	80.1
	Good	3	10
	Fair	2	6.6
	Poor	1	3.3
Flynn function	Excellent	24	80.1
	Good	3	10
	Fair	2	6.6
	Poor	1	3.3
Radiological	Anatomical reduction	26	86.7
	Posterior displacement	4	13.3

**Table-III**

<i>Complications among study group</i>		
Complication	No.	%
Vascular	0/30	0.0%
Pin tract infection	4/30	13.3%
Ulnar nerve injury	0/30	0.0%
Cubitus varus	1/30	3.3%

**Discussion:**

Fractures around the elbow joint account for 10% of all pediatric orthopedic trauma, and supracondylar humeral fractures account for 60-70% of all elbow fractures. There are various treatment options for the supracondylar fractures of humerus in children including closed reduction and posterior long arm slab, percutaneous k-wire fixation or open reduction and k-wire fixation. Closed reduction and percutaneous k-wire fixation is widely accepted, has become the treatment of choice for displaced fractures. Success of treatment of displaced supracondylar fractures in children depends on achieving and maintaining anatomical reduction and stable fixation following clinical and radiographic union without complications. Our study focused on type III supracondylar fractures of humerus which are usually unstable with displacement and rotation which may leads to cubitus varus deformity. Extension type fractures were 28 with non-dominant limb predominantly involved, similar to study conducted by Cekanuska<sup>15</sup>, due to reflex response of falling human body to protect dominate side. Percutaneous pinning has been used for these fractures utilizing either parallel or crossed k-wires. Cross k-wires

gives better stabilization and biomechanical advantage as well as parallel pins do not allow full extension at elbow during early followup.<sup>13</sup> We didn't encounter any loss of reduction during follow up, these cross k-wires provide strong stability and prevent the displacement after fracture reduction. The cross k-wires fixation included the placement of two ascending k-wires, one of them inserted through the lateral condyle and the other through the medial condyle. With this technique, the ulnar nerve could be injured by the medial k-wire as it is passed through the medial condyle. There is higher risk of nerve injury in close reduction and percutaneous pinning, with 0 to 5% incidence of iatrogenic ulnar nerve injury cause by medial pin. The rate of ulnar nerve injuries varies in different studies. Lyons et al.,<sup>25</sup> have reported this number as 6%, Royce et al.,<sup>26</sup> as 3%, Agus et al.,<sup>27</sup> as 58%. In our study we had no case of nerve injury, which is quite excellent than other studies.<sup>16,17,18</sup> We did not come across any feature suggestive of compartment syndrome. Ring D et al found two patients with compartment syndrome with closed reduction and cast immobilization.<sup>19</sup> In post-operative period, physiotherapy plays a significant role in increasing the range of motion of the elbow joint. Those patients who had fair results were having severe soft tissue injuries or repeated closed reduction. Cubitus varus deformity is the late complication of supracondylar fractures treatment. The deformity is due to coronal rotation, or medial displacement of the distal fragment of humerus<sup>28</sup>. Other concept is that varus deformity due to epiphyseal growth disturbance or rotation of the distal fragment of humerus.<sup>29</sup> Smith suggested that residual medial displacement after reduction is the most important factor in varus angulations<sup>30</sup>. This concept has become popular in understanding the consequence of alteration in carrying angle<sup>31</sup>. Our results match with Williamson DM et al who treated the supracondylar fracture by traction, reduction and percutaneous cross k-wires fixation<sup>20</sup> and also with Harrington P et al, who observed 83% good to or excellent results.<sup>21</sup> In our study 4 patients had superficial pin tract infection which resolved with antibiotics.<sup>22,23,24</sup> All patients with pin tract infection were coming from poor socioeconomic status with no care about posterior slab. Due to availability of C-arm and other facilities in our emergency operation theatre, our results are better than previous published studies from developing countries.

**Conclusion:**

Closed reduction and percutaneous cross k-wire fixation is a rapid, minimal invasive, safe method for treatment of unstable supracondylar fractures in pediatrics with less or minimal complication. Use of strict per operative criteria to obtain anatomical reduction and stable fixation minimizes the risk of complications.

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