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Evaluation and Outcome of Kirschner Wire Fixation in Gartland Type III Supracondylar Fracture in Children, Tertiary Hospital in Bangladesh

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Abstract **Original Research Article**

Background: A displaced supracondylar fracture in children presents a severe degree of injury often associated with potential neurovascular complications. We conducted this study to assess the functional and radiological outcome and complications of supracondylar fractures Gartland type III treated with closed manipulation and Kirschner wire fixation. ***Methods*:** We analyze clinical and radiographic data from n = 37 Gartland type III supracondylar fracture children, which was retrospectively collected at Islami Bank Medical College Hospital and multicentered hospital, Rajshahi, Bangladesh, over the 2-year period of January 2019 to December 2020. The average follow-up duration was over 1 year in all cases. Flynn criteria, pain, neurovascular examination and complications were included in the clinical assessment (infection or iatrogenic nerve injuries). In the final radiograph, the humeroulnar angle was measured. ***Results*:** The average duration of follow-up was 22 months. The children's average age was 7.4 years. According to Flynn's criteria, functional outcomes in 100% were acceptable and aesthetic results in 89.18% of patients were satisfactory. In 4 (10.8 percent) patients, the results were classified as poor owing to loss of angle. The average angle on the reverse side was 9.40, whereas it was 11.20. The average visual analogue scale (VAS) score was 0 at the last follow-up. Complications associated with the damage were the missing pulse of 3 (8.1%) and 1 (2.7%) primary median nerve paralysis. Complications related to treatment include 3 (8.1%) iatrogenic ulnar nerve paralysis. ***Conclusion:*** Closed and percutaneous manipulation Kirschner wire attachment Garland type III supracondylar fracture is a successful technique that is minimally invasive. The wire fixation of Kirschner offered a biomechanically stable fixation, but with an increased risk of ulnar nerve damage.

Keywords: Supracondylar fracture, Closed manipulation, Kirschner wire fixation, Islami Bank Medical College.

INTRODUCTION

Supracondylar fractures in children comprise 50% to 70% of all juvenile fractures and 7% to 9% of all childhood fractures [1]. 95% (percent) of supracondylar fractures are due to extension injuries and flexion type remaining [2]. Extension type supracondylar fractures were categorized according to the distal fracture fragment displacement by Gartland [3]. Wilkins split Gartland modified classification and type III fracture into the posteromedial displacement type III and the posterolateral displacement type III b in 1984 [4]. Treating fully displaced Gartland type III supracondylar fractures is a problem. Closed reduction and immobilization [5-6].

Kirschner(K) wires are included in treatment options for supracondylar type III fracture[7-11]. The current preferred treatment of Gartland type III supracondylar fractures comprises closed handling and percutaneous fixing of the Kirschner wire [12-14]. Two K-wires put through the lateral and medial cortex provide better stability; nevertheless, the drawback is that the ulnar nerve with the medium-posted pin has possible iatrogenic damage [15]. Higher postoperative sequelae, residual rigidity, and nerve damage were seen in postoperative and rotational displacement fractures [16].

Aim

This research aims to evaluate the functional and radiological results and the consequences of Gartland type III supracondylar fractures treated with closed reduction and Kirschner wire fixing.

MATERIALS AND METHODS

This retrospective research was performed at the Islami Bank Medical College Hospital and multicentered hospital in Rajshahi, Bangladesh, between January 2019 and December 2020.

The study inclusion criteria were

1. Supracondylar Gartland type III fracture.
2. Children under 12 years of age.
3. Time less than 72 hours at presentation.
4. At least one year of follow-up.

The study exclusion criteria were

1. Flexion type fractures supracondylar.
2. Previous or related fractures of the ipsilateral elbow.
3. Open fractures.

Data about preoperative, surgical and postoperative details were acquired via an examination of the charts from the institution's medical records department. Patients were contacted to schedule a follow-up appointment via telephone or mail. All patients have given informed permission to the research.

44 individuals with Children Gartland type III supracondylar fracture were enrolled for the research. No follow-up was provided for seven patients. Thirty-seven individuals (84.09%) were finally available for analysis. To categorize fractures, the modified Gartland classification was employed. We have 22 Type III patients injured, and 15 Type III b injured patients.

Surgical technique

The kid was put under general or regional anaesthetic in the supine posture. Closed manipulation of the medium and lateral displacements was conducted. A fluoroscopic anteroposterior and lateral image were acquired to demonstrate reduction without altering the elbow position. The first pin was placed across the lateral cortex from the lateral side of the elbow and kept the elbow bent. The elbow was then stretched to under $90^{0\ (Degree)}$ to feel the ulnar nerve. The second pin from the media epicondyle was then placed to tie the lateral cortex. A third pin from the lateral cortex was placed if there is comminution or if the attachment is less secure. When the closed reduction could not be accomplished, a small open reduction was obtained. After surgery, a cast above the elbow was provided, and patients were released for one to three days.

Follow up protocol

All patients were seen 1 week, 3-4 weeks, 6 weeks, 12 weeks and 1 year following the accident at the ambulatory clinic. Cast and pin removed for children under the age of 6 at 3 weeks follow-up and four weeks follow-up for children above 6 years. After removing the pin, the elbow range of motion was begun.

The clinical evaluation was conducted by measuring the carrying angle, range of motion (ROM) of the damaged elbow, neurovascular examination, suffering and the search for consequences such as infection, growth disorders and nerve injuries. The ROM and the carrying angle were measured using a manual goniometer and compared to the opposing arm. The criteria of Flynn were used to measure the clinical result. In order to evaluate pain, the visual analogue scale (VAS) with a score of 0 (no pain) to 10 (the greatest pain) was employed. Radiographic evaluation was performed using the damaged elbow anteroposterior and lateral radiographs. The humeroulnar angle was determined on an anti-posterior radiograph using Webb and Sherman's technique during the last follow-up examination.

STATISTICAL ANALYSIS

Continuous variables with mean, % and standard range deviation have been analyzed.

RESULTS

A total of 37 patients treated with Gartland type III supracondylar fracture were available with closed manipulation and Kirschner wire fixation for study. The follow-up duration averaged 22 months (range 13 to 44 months). The average age was 7.4 years (range 3.6 to 12 years). There were 26 boy and 11 girls. The right elbow was wounded in 16 cases, and the left in 21 individuals. All the patients had surgery the same day or the following day if they reported late in the night. Thirty-four patients were handled with closed manipulation and K-wire fixation, while a small open technique was used to accomplish a reduction in three patients.

Clinical Result

Based on the functional outcomes achieved by Flynn in 100 per cent of patients and in 89.18% (percent) of patients, aesthetic results were acceptable (Table 1). The outcomes were not acceptable in 4 patients compared to the undamaged elbow as loss of carrying angle. The average bearing angle was 9.40 (range of 40-160) compared to 11.20 (range of 80-180). At the final follow-up, all patients recovered their full elbow function (Fig. 1). None of the patients complained about any of these symptoms at the last follow-up assessment, and the average VAS score was 0.

Table-1: Results according to Flynn's criteria

Result	Cosmetic factor			Functional factor		
	Loss of carrying angle	No of patients	Percentage	Loss of motion	No of patients	Percentage
Excellent	$0\text{-}5^0$	33	89.18%	$0\text{-}5^0$	37	100%
Good	$6\text{-}10^0$	4	10.81%	$6\text{-}10^0$	0	0
Fair	$11\text{-}15^0$	0	0	$11\text{-}15^0$	0	0
Poor	$>15^0$	0	0	$>15^0$	0	0

Fig-1: Preoperative (a) anteroposterior and (b) side X-rays showing a fracture of Gartland type III of a six-year-old child. Immediate postoperative radiographs (c) & (d) with excellent Kirschner wire fixation decrease and fixation Radiograms (e) & (f) demonstrating healed and reshaped fracture for 18 months. Radiographic outcome: Fracture union seen by 3 months in all our patients (100%) (Fig. 1). During the follow-up, no subsequent displacement was observed. The mean angle of the humeroulnar was 10.20 (range 40-180).

Complications

Complications linked to trauma have been observed in 4 individuals (Table 2). 3 individuals were detected without pulse, and one patient had primary median nerve damage. All patients were restored with one exception following closed reduction and fixation of the Kirschner wire. There was no active intervention with a pulseless hand in the kid since the hand was perfused nicely. Spontaneously healed after 8 weeks, the patient with initial median nerve damage. Three patients reported postoperative ulnar nerve damage. All patients healed after an average of 13.3 weeks spontaneously (10-16 weeks). There were no studies with iatrogenic median or radial nerve injuries. Cubitus varus deformity has been seen in 4 cases, and no corrective osteotomy has been necessary since it is aesthetically acceptable for parents. Superficial pin tract infection was seen in 2 individuals.

Table-2: Complications

	Total numbers of patients	Percentage
Injury-related complications		
1.Absent radial pulse	3	8.1%
2.Primary median nerve injury	1	2.7%
Treatment-related complications		
1.Postoperative ulnar nerve palsy	3	8.1%
2.Cubitus varus deformity	4	10.81%
3. Superficial K-wire tract infection	2	5.4%

DISCUSSION

Supracondylar fracture of Children Gartland III's indicates a severe range of injuries with considerable swelling and a higher risk of neurovascular consequences [17]. The goal in managing the displaced pediatric supracondylar fracture is to provide a safe and stable reduction until the fracture is recovered. Closed handling and percutaneous fixation of Kirschner wire is generally recommended as a therapy for Gartland type III supracondylar fractures [16]. The elbow may be split into less flexion after Kirschner's wire fixation, reducing the danger of limb perfusion. There was no report of subsequent physical damage after smooth K wire implantation in the Flynn et al. trial [18, 19]. As stated in the biomechanical investigations, medial and lateral pin designs are more

stable than lateral pin alone [20]. Cubitus varus is the most often mentioned problem in the literature [21]. There have been aesthetically poor results in 3 of 72 patients 4.2% (percent) owing to a loss of the angle of carrying of Flynn *et al*. [19]. Mandl *et al*. found satisfactory Elbow mobility on 2 out of 78 patients (2, 6 percent) with cubitus varus deformation. The carriage angle decreased in our series 4 from 37 patients (10.8%) during the end follow-up. Our findings indicate that the statistics reported in the literature are not affected by the carrying angle [22]. According to Flynn criteria, 100% of patients had acceptable functional outcomes, and 89.18% achieved aesthetic improvements. The vascular complication is documented in supracondylar fractures of type III of Gartland between 2-38%. With careful monitoring of the vascular state of the limb, the fracture should be minimized and stabilized as soon as feasible. The handling of the viable pulseless hand is divided by suggestions that range from observation to urgent operation. Choi *et al*. reported their experiences with the conservative method and highlighted the significance of perfusing the hand instead of having a pulse. Weller *et al*. [23], in their series, reported 20 Gartland type III supracondylar fractures with pulseless hands after the decrease. 19 of the 20 patients had a tangible pulse return throughout the follow-up without clinical consequences. In our research, we presented three instances with no pulse. In 2 cases, the pulse reappeared after closure reduction. The third instance featured a perfused hand with no pulsation and conservative treatment. At the final follow-up, no clinical consequences were observed.

Shim *et al*. found no UPPP in a series of 63 juvenile supracondylar fractures treated with 3 K wires by Kirschner wire fixation [24]. Royce *et al*. had one radial (0,7%) and three ulnar (2,1%) postoperative nervous paralysis in their series. We had three (8.1 percent) postoperative ulnar nerve paralysis, which recovered spontaneously by 13.3 weeks on average. Our findings suggest that the probability of postoperative ulnar nerve damage is enhanced when Kirschner wire fastening is done.

CONCLUSION

In short, closed manipulation and Kirschner wire fixation of the superordinate fracture of children Gartland type III leads to a low-complicated functional and aesthetically acceptable limb. It is a consistent and safe technique, except for an increased frequency of postoperative ulnar damage.

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