

# Outcome of Pediatric Humerus Fracture Treated With Close Reduction and Elastic Intramedullary Nailing

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## ABSTRACT

**Introduction:** Pediatric humeral shaft fractures are infrequent fractures only secondary to trauma or any of the pathological changes in the bone; representing two to 5.5% of all pediatric fractures and occurring predominantly in children younger than three years or older than 12 years of age. These fractures can usually be treated conservatively with functional bracing and splints however conditions like inability to maintain an acceptable reduction, open fractures, floating elbow, closed head injury, and polytrauma patient requiring early weight bearing warrant the surgical intervention. The intramedullary elastic nails have been found to be more effective in treating fracture shaft of humerus of pediatric age group in comparison over other implants used. **Aims:** The aim of this cross-sectional observational study was to evaluate the outcome of shaft of humerus fracture in children treated with retrograde intramedullary kirschner's wire. **Methods:** This prospective study was conducted in the department of Orthopedics in Nepalgunj Medical College Teaching, Kohalpur from January 2020 to March 2021 in 26 children. Children were evaluated for age, sex, side of injury, mechanism of injury, time period for union, implant removal time, outcome and accompanying complications. Patients were evaluated using Broberg and Morrey scoring system for elbow functions and modified Dash criteria for shoulder function. **Results:** In this study of 26 children, 65.4% were boys and 34.6% were girls with average age of  $9.58 \pm 2.1$  years. Left side was prominent side for injury with 69.2%. The average duration for union was found to be  $10.04 \pm 1.42$  weeks. The implant was removed at  $24.19 \pm 1.57$  weeks. Based on Broberg and Morrey score system for elbow, 23 (88.46%) children had excellent result and three (11.54%) had good result. While evaluating for Disabilities of the Arm, Shoulder and Hand (DASH) score for shoulder joint evaluation; all children had excellent result. **Conclusion:** The treatment of pediatric humeral shaft fracture by close reduction and intramedullary kirschner's wire is safe, easy and cost effective operative procedure with good results.

**Keywords:** CRIF, Elastic intramedullary nail, Pediatric humeral shaft fracture

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## INTRODUCTION

Pediatric humeral shaft fractures are infrequent fractures only secondary to trauma or any of the pathological changes in the bone; representing two to 5.5% of all pediatric fractures. They occur predominantly in children younger than three years or older than 12 years of age.<sup>1-3</sup> Humeral shaft fractures commonly result from a direct injuries e.g. Road Traffic Accident, crush injuries and less commonly from indirect injuries e.g. muscle pull or fall on elbow. Pathologic fractures secondary to simple bone cysts are also common.<sup>4,5</sup> These fractures in children can usually be treated conservatively with functional bracing

and splints.<sup>6-8</sup> The indications for surgical form of treatment could be inability to maintain an acceptable reduction, open fractures, floating elbow, closed head injury, and polytrauma patient requiring early weight bearing.<sup>9-17</sup> Open reduction and fixation with plates require extensive dissection and result surrounding neurovascular structures into the risk of injury and hence is not recommended in children.<sup>16-18</sup> The use of intramedullary elastic nails to treat pediatric long bone fractures has become commoner.<sup>19</sup> The retrograde technique is used for intramedullary nail insertion in pediatric humerus as antegrade nail insertion can cause violation of rotator cuff muscles and impingement in shoulder.<sup>18</sup> The aim of this cross-sectional observational study was to evaluate the outcome of

shaft of humerus fracture in children treated with retrograde intramedullary Kirschner's wire in tertiary care center, Nepalgunj Medical College, Kohalpur, Banke in western part of Nepal.

## METHODS

This study was a prospective study done in 26 children between five to 14 years of age, who were admitted in Nepalgunj Teaching Hospital, Kohalpur, Banke from January 2020 to March 2021 who had fracture shaft of humerus. Children meeting the following criteria were included in the study: (1) Closed and grade I & II compound fractures; (2) polytrauma patients with multiple fractures, head injury, and abdominal injury; (3) Diaphyseal humeral fractures with unacceptable alignment (i.e. deformity of more than 30°, 20° and 15° respectively for proximal, middle and distal third fractures of shaft of humerus).<sup>4</sup> Humerus fractures in patients of age less than five years and more than 14 years, Grade III compound fractures, fractures associated with infected wound, fractures associated with severe comminution, massive bone loss, severe osteopenia, and fractures in metaphyseal region of the humerus were excluded from the study.

All of the surgeries were performed under general anesthesia. Preoperative antibiotic 500 mg of intravenous ceftriaxone was given half hour before surgery. The size of the Kirschner's wire was calculated by multiplying the narrowest diameter of medullary cavity of humerus by 0.4 in centimeter.<sup>17</sup> The proximal end was bent for easy passage through the fracture site. Around one to two centimeters of incision was made over midline of distal humerus about the two to three cm above the olecranon tip. Two entry points were made one to two cm proximal to the olecranon fossa on medial as well as lateral side with the help of drill bit at least 0.5 mm greater than the planned kirschner's wire. Now, the pre-bent wire tip was inserted into the medullary canal and advanced to the fractured site. Once the wire reached to the fracture site, close reduction was done under image intensifier and wire was advanced proximally through the fracture site. Reduction and alignment of fracture was manipulated by rotating the wire in appropriate position. The wire was driven proximally within one to two cm of physis and distal end of wire was buried underneath the skin. The wound was washed thoroughly with normal saline and closed in layers. The wires act as an internal splint to maintain the alignment of fracture until it healed. After surgery, above elbow posterior slab was applied over the arm as an additional external support for three weeks. Post-operative x-ray was observed on next day and patients with closed fracture were discharged on the second post-operative day. However, patients with open fracture are kept for at least of three days before discharge. Dressing was done in every alternate day and suture removed in 14<sup>th</sup> day. During this period, patients were encouraged to do the pendulum exercises of arm. Patients were advised to do active as well as passive assisted exercises as tolerated after four weeks of surgery. Radiographs were taken at two weeks, six weeks, 12 weeks, 18 weeks and 24 weeks after surgery to observe the alignment of fracture and fracture healing. The functional outcomes were assessed at least after six months of surgery based on Broberg and Morrey for evaluation of elbow function

and Disabilities of the Arm, Shoulder and Hand (DASH) score for evaluation of shoulder functions. Based on Broberg and Morrey system, categorical ratings were assigned according to the score achieved: A score of 95–100 points is rated excellent; 80–94 points as good; 60–79 points as fair; and <60 points as poor. Based on DASH score, the score 0 indicates no disability while score of 100 indicates most severe disability. Solid union was confirmed when at least three cortices union was seen on anteroposterior and lateral view.

## RESULTS

There were 17(65.4%) boys and nine (34.6%) girls in this study. Average age of patient was  $9.58 \pm 2.1$  years in this study. Out of 26 patients, 11 children sustained the fracture following fall from height and 15 sustained RTA. Four children in this study had compound fracture and rest other children had closed fracture. Out of 26 children, 18(69.2%) children had injury over the left side. The average duration for union was found to be  $10.04 \pm 1.42$  weeks. Following the union, implant was removed at  $24.19 \pm 1.57$  weeks in Operation Theater. Based on Broberg and Morrey score system for elbow, 23(88.46%) children had excellent result and three (11.54%) had good result. While evaluating for DASH score for shoulder joint evaluation; all children had score of 0 suggesting no disability or any of the residual symptoms.

Time of union (weeks)	Number (N)	Percentage (%)	Average weeks
8	2	7.7	10.04 ± 1.42
9	10	38.5	
10	5	19.2	
11	6	23.1	
13	3	11.5	
<b>Total</b>	<b>26</b>	<b>100.0</b>	

*Table I: Time of union in weeks*

Implant removal (weeks)	Number (N)	Percentage (%)	Average weeks
22	4	15.4	24.19 ± 1.57
23	4	15.4	
24	11	42.3	
26	4	15.4	
27	3	11.5	
<b>Total</b>	<b>26</b>	<b>100.0</b>	

*Table II : Implant removal duration in weeks*



**Figure 1: Fracture of 12 years boy at different stages of treatment**

## DISCUSSION

Fracture of humeral shaft in children comprises two to 5.5% of all pediatric fractures.<sup>1-3</sup> Pediatric shaft of humerus fractures can be treated with conservative methods like coaption splint, hanging arm cast, U slab or coaptation splint with excellent to fair result.<sup>7,8</sup> The retrograde elastic intramedullary nailing for pediatric humeral fractures is an ideal procedure with the advantages of minimal periosteal stripping at fracture site; prevention of fracture redisplacement and allows early mobilization of limb.<sup>16-18</sup>

The average time for union in this current study was found to be  $10.04 \pm 1.42$  weeks (eight to 13 weeks) which was found to be consistent with studies from KC et al<sup>17</sup>, Furlan et al<sup>18</sup>, Garg et al<sup>6</sup> and Maruthi et al.<sup>19</sup> The mean duration of implant removal was found to be  $24.19 \pm 1.57$  weeks (ranging from 22 to 27 weeks) which was found to be consistent with KC et al<sup>17</sup> and Ahmad et al<sup>4</sup> with results consistent in the similar range. The final results were described as per elbow score and shoulder score; of which DASH shoulder score was found to be excellent in all patients where as Broberg and Morrey score was excellent in 23 patients and good in three patients which was consistent with KC et al.<sup>17</sup> No cases of complications associated with pin migration; surgical site infection was noticed in the study whereas complications like pin migration and surgical site infection were found in study of KC et al.<sup>17</sup> In this study, no cases of radial nerve palsy was found which doesn't correspond with study of KC et al<sup>17</sup>, Furlan et al<sup>18</sup> and Maruthi et al<sup>19</sup> where transient radial nerve palsy was found which recovered in variable time period. In this current study, retrograde medial and lateral entry portal technique was used which differs with Maruthi et al<sup>19</sup> where two retrograde lateral entry portal was used; however the final outcome was relatable in both of these entry portal techniques

## LIMITATIONS

The results of this study could have been more significant if the sample size for the study was higher. The comparative study with other modalities of surgical

treatment would have made this study more informative.

## CONCLUSION

In the surgical form of treatment for pediatric humeral shaft fracture with intramedullary K-wire in retrograde manner is found to be procedure with acceptable outcome in moderately displaced to displaced fracture with unacceptable alignment. Moreover, fixation with intramedullary k-wire reduces operative time, cost of treatment and chances of iatrogenic radial nerve injury without compromising the final outcomes.

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