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Original Article

Functional Outcome of Intramedullary Kirschner Wire Fixation of Unstable Radius-Ulna Fractures in Children

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ABSTRACT

Pediatric patients with unstable radius-ulna fracture can be treated with intramedullary Kirschner wire fixation. **Objective:** To determine the functional outcome of Intramedullary Kirschner Wire fixation in unstable radius-ulna fractures in children. **Methods:** All pediatric age patients were enrolled into the study with unstable radius and ulna fracture. Informed consent was taken before study. Proper history, examination and X-rays of the forearm was taken after taking consent from the guardian of the patient. Under general anesthesia and tourniquet, control radius was first fixed through a small volar incision by drilling a k wire at fracture site in radius so that the wire exits on the dorsolateral side of the radius. The fracture was than reduced and the wire tapped with hammer to the radial head. Similarly, ulna was fixed by first drilling the wire up to the olecranon process and after reduction of the fracture down to the styloid process. After checking stability both bones, both wounds were washed with normal saline and closed in reverse order and above elbow cast was applied for three to four weeks. **Results:** In this study, as per functional outcomes, 5(4.0%) patients had good outcome, 80(64%) patients had excellent outcomes whereas 40(32%) patients had poor outcomes. **Conclusions:** This study demonstrates excellent functional outcome of Intramedullary Kirschner Wire fixation in unstable both bone forearm fractures in children.

INTRODUCTION

Bone fracture of both long bones and short is a prevailing problem in all age groups and is most common in pediatric age group as compared to adult age group. Fracture of bone in children is a common problem in developing countries and has great burden on the budget allocated for health [1]. A large portion of falls occur during sports, in home, school, parks and restaurants [2]. Fractures are common in childhood, approximately one-third of boys and girls sustaining at least one fracture before 17 years of age [3]. Overall both bone forearm fractures are more common in the non-dominant hand, in boys, and in both distal forearm bones[4, 5]. The treatment of unstable radius and ulna fracture has changed recently with more deviation to surgical fixation due to early return to work, better alignment of bones and fewer complications [6]. The recommendations are based on an ongoing assessment of management modalities problems due to procedure, complications due to overall management plan and final results[7]. In the past 95.9% of fractures that were treated conservatively presented with bad functional results because most of these fractures healed with malalignment and nonunion. The differentiated use of conservative and

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surgical options should minimize final functional sequelae [8]. Treating children with unstable radius and ulna fracture, conservative treatment should be the first line of treatment however treatment modality can be changed according to deviation of fracture bone segments, especially there should be no hesitation in considering surgical treatment when the patients have a malalignment of more than 15 degree [9]. Over 90% of these fractures have been treated with closed reduction and plaster of Paris casting, and this has been historically the primary mean of treating patients with both stable and unstable one fracture. Often pose a therapeutic challenge, with little data available to compare outcomes [10]. Forearm fractures in pediatric age are treated differently from adult fractures because growth plates are not closed in both bones (radius and ulna) after the fracture has healed. Rotational deformity does not remodel while linear fractures remodel, unstable metaphyseal fractures should be percutaneously pinned under strict fluoroscopic guidance. Unstable diaphyseal fractures can be treated by intramedullary fixation [11]. The pediatric musculoskeletal system differs greatly from that of an adult and because of that they present with unique injury patterns and pose diagnostic and therapeutic challenges [12]. In children, intramedullary fixation by using standard K-wires plus cast immobilization provides effective treatment for unstable diaphyseal forearm fracture when closed management has failed [13, 14]. And surgical results are 85% excellent and 10% good [15]. While Vishwanath and Satheesh reported excellent results in 18(78%) patients, poor results in 5(22%) patients [16].The importance of the study is that it will contribute to the literature regarding the management of unstable radius and ulna fractures in pediatric patients. It will provide guidelines for pediatric orthopedic surgeons in managing fracture of forearm bones. Kirschner wire are easily available and cost effective and more compatible to body tissues as compare to Nancy wire and titanium wire which is more expensive and not easily available in our part of the world.

METHODS

This was a Descriptive Study conducted in the department of orthopedic surgery at Khalifa Gul Nawaz Teaching Hospital Bannu after taking ethical approval certificate from institutional review board. All pediatric patients presented to OPD or ER section of orthopedic surgery of unstable radius and ulna fractures diagnosed with digital x rays, were enrolled to the study after taking informed consent. All patients in the study were properly evaluated with pertinent history, relevant examination and x-rays of the forearm performed. Patients were sampled through consecutive non probability method by applying inclusion and exclusion criteria. Inclusion criteria included patients of both genders, age of 3-15 years and had unstable radius ulna fracture of more than 2 weeks. Exclusion criteria included all patients with open fracture of radius ulna and those who with poly trauma. All procedures were performed by single experienced orthopedic surgeon with special interest in this field of orthopedics pediatric section under general anesthesia in properly sterilized condition. Before induction of anesthesia all patients were given iv antibiotics according to weight and under tourniquet control through small volar incision radius fixed. A Kirschner wire of appropriate thickness was first drilled down with flexed and ulnarly deviated wrist so that the wire exits on the dorsolateral side of the radius distally. The fracture was than reduced and the wire driven up to the radial head. Similarly ulna was fixed by first driving the wire up to the olecranon process and after reduction of the fracture down to the styloid process. After checking stability both wounds were thoroughly washed and closed and skin approximated with prolene suture, and the forearm put in above elbow cast for three to four weeks. All sufferers had been observed month-to-month for medical and radiological union of fracture and for complication of surgery. The Kirschner wires have been eliminated after restoration of fractures. All sufferers had been strictly observed for six months at predesigned time table and appropriate report was maintained for all sufferers in the study. SPSS Version 19.0 was used for analyzing the data. Frequencies and percentages was recorded for categorical variables like gender, fracture side and time passed since fracture. Mean ± SD was calculated for continuous variables like age and duration of fracture fixation. Functional outcome was stratified among age, side of fracture and duration of fracture fixation to know the effect modifiers the usage of chi square test. p-value less than or equal to 0.05 was regarded as significant. The results are presented in form of tables and graphs.

RESULTS

This study was conducted on 125 pediatric patients at the Department of Orthopedics Surgery Khalifa Gul Nawaz teaching hospital Bannu. Mean ± SD for age was 11.5±3.23 (yr). Mean ± SDs for duration of disease was 4.4±1.12 (wk). 45(36%) patients were recorded in 4-7 years age group, 80(64%) patients were recorded in 8-15 years age group. 83(64.4%) patients were male, 42(33.6%) patients were female(Table 1).

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Table 1: Demographics of patients in the sample (n=125)

Demographics	Variables	Frequency (%)
Age	4-7 Years	45 (36)
	8-15 Years	80 (64)
Gender	Male	83 (66.4)
	Female	42 (33.6)

As per functional outcomes, 5(4.0%) patients had good outcome, 80(64%) patients had excellent outcomes whereas 40(32%) patients had poor outcomes (Table 2).

Table 2: Functional Outcome (n=125)

Functional Outcome	Frequency (%)
Good	05 (4.0)
Excellent	80 (64)
Poor	40 (32)

Functional outcome was measured in term of loss of angle of forearm rotation, which was measured with goniometer at six months follow up. Functional outcome was stratified into excellent, good and poor with forearm rotation angle of less than 15º, 15º-39º and angle greater than 90º respectively as shown in Table 3 and 4.

Table 3: Stratification of functional outcome with respect to age (n=125)

Functional Outcome		Age Groups		P value
		4-7 Years	8-15 Years	
Good	Yes	03 (6.6%)	06 (7.5%)	0.76
	No	17 (37.7%)	27 (33.75%)	
Excellent	Yes	7 (15.5%)	15 (18.75%)	0.072
	No	4 (8.8%)	9 (11.25%)	
Poor	Yes	8 (17.7%)	13 (16.25%)	0.082
	No	6 (13.3%)	10 (12.5%)	

Table 4: Stratification of functional outcome with respect to age (n=125)

Functional Outcome		Duration of Fracture		P value
		< 4 Weeks	> 4 Weeks	
Good	Yes	04 (6.6%)	06 (9.23%)	0.75
	No	19 (31.6%)	19 (29.2%)	
Excellent	Yes	10 (16.6%)	11 (16.9%)	0.056
	No	7 (11.6%)	9 (13.8%)	
Poor	Yes	12 (20%)	12 (18.46%)	0.059
	No	8 (13.3%)	8 (12.3 %)	

DISCUSSION

Fracture is a break in continuity of the bone which can be in cortex or inner layer of bone and in pediatric age group it occur commonly in upper limb, mostly in wrist and forearm as a consequence of fall in sports, restaurants , home and school while in adults, fracture occur as a result of road traffic accident, fall or sports. Fracture of upper limb bones in pediatric population add significant morbidity and mortality in developing countries like Pakistan, Bangladesh and India [1]. Fractures are a common in childhood and adults with about 30% of pediatric population sustaining at least one fracture before 17 years of age. Looking into the incidence of fracture in forearm it is greater frequent in the non-dominant hand in male populace [2]. The management of bone fracture in both adults and pediatric age group has changed exclusively in the near past due to changes in overall health care system, from in patient facility to day care surgery, from open surgery to endoscopic surgery and from conservative treatment to fixation in orthopedic. The guidelines are based on type of fracture, age group, level of activity and final results of the procedure which were performed for management of fractured bone. In the previous 95.9% of fractures that have been dealt with conservatively had been tainted with horrific consequences due to the fact that most of these fractures were healed with malalignment and nonunion. The proper indicated use of management lines in the form of conservative management and surgical measures either open or endoscopic should minimize patients' symptoms, signs, comorbidities, functional outcome and finally radiological findings [3]. The 1st line of treatment in patient with fracture of forearm bones is conservative, but if there is more than 15 degree malalignment then surgical procedures should be kept on priority as this has far good result as compared to conservative management [4]. Closed discount and casting has been the 1st line of administration in sufferers with unstable foremost ability of remedy in most of the fractures[5]. Unstable diaphyseal fractures of radius and ulna can be stabilized by means of intramedullary fixation of the radius and ulna [6]. In growing age especially under 12 year age musculoskeletal system vary greatly from those whose skeletal system are mature and metaphysis and diaphysis are fused. Although these differences fade away with age, when they come across injury they present with unique fracture and pose difficulty in the diagnosis and overall management plan [7]. In this study, as per functional outcomes, 5(4.0%) patients had good outcome, 80(64%) patients had excellent outcomes whereas 40(32%) patients had poor outcomes. In children and adolescents, intramedullary fixation with standard Kirschner wires and cast immobilization offers effective treatment for unstable radial shaft fractures when medical treatment has failed or not been initiated [8]. It shows 85% excellent and 10% good results [9]. While Vopat *et al.*, reported excellent results in 18(78%) patients, poor results in 5(22%) patients [10] which as compared to this study, 9(6.04%) patients had good outcome, 92(61.71%) patients had excellent outcomes whereas 48(32.21%) patients had poor outcomes (Table 2). Our results are comparable with that of Van der Reis *et al.*, who had 24(80%) patients with excellent results, 5(16.6%) with good results and 1(3.3%) with fair results [17]. Chapman *et al.*, reported in their study, though their sample size was small

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but they have concluded excellent results in 21(84%), good results in 4(16%) and no patients have poor results[18]. In a retrospective study performed by Cullen *et al.*, in which 23 patients were treated with plate fixation and 18 patients with intramedullary nailing, they have concluded excellent results in 18(78%) patients and poor results in 5(22%) patients at follow up of 12 months post-surgery. The functional outcome, rate of union and other complications were statistically similar in both groups[19]. Schemitsch *et al.*, in their study at university hospital between 2000 to 2007 total 22 pediatric patients with forearm fractures were treated by ESIN, their study shows favorable results after ESIN at 12.4 years of surgery [20]. Hence after comparing results of various studies it has been declared that intramedullary nailing for radius and ulna fracture has good results in term of patient's symptoms, functional outcome and radiological findings.

CONCLUSION

This study demonstrates excellent functional outcome of Intramedullary Kirschner Wire fixation in unstable radius-ulna fractures in youngsters.

Authors Contribution

Conceptualization: IK
Methodology: MR, IK
Formal analysis: MK, AK
Writing-review and editing: AH, AK

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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