Original Article

A Comparative Study of Cross and Parallel Kirschner-Wires Fixation in Gartland Type-III Supracondylar Fracture of Humerus in Children

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ABSTRACT

Aims and Objective: To compare the anatomical and functional results of open reduction and internal fixation of supracondylar fracture of humerus in children with parallel and cross K-wire fixation and to determine the best method of fixation, preventing complications

Study design: A comparative study.

Place and Duration of Study: This study was conducted in Orthopaedics department, District Head Quarter Hospital Dera Ghazi Khan from March 2011 to September 2011.

Materials and Methods: Forty consecutive patients from 4 to 10 years of age (mean age of 6.4 years) with Gartland type-III supracondylar fractures of humerus, received in the emergency department were included in the study.

Results: In this study, patients from 4 to 10 years of age were included. Their mean age was 6.4 years. Their age distribution is shown in Graph-1. Highest numbers of patients were from 6 to 7 years of age. Those were 17 (42.5%). The mean age of the patients in which fracture was fixed by parallel Kirschner wires, was 6.2 years and the mean age of the patients in which fracture was fixed by cross Kirschner wires, was 6.6 years.

Conclusion: On the basis of above mentioned findings and review of the available literature, the conclusion of this study is that cross Kirschner wires configuration is more safer and stronger mode of fixing all Gartland type-III supracondylar fracture of humerus in children.

Key words: Kirschner-Wires Fixation, Gartland Type-III, Supracondylar Fracture of Humerus

INTRODUCTION

It is exclusively a fracture of the immature skeleton[1]. The bone in the supracondylar area is weaker during the last part of first decade because it is undergoing metaphyseal remodeling. As the younger child falls with the outstretched arm, the elbow is hyper extended and the tip of the olecranon is forced into the thinnest portion at the depth of olecranon fossa thus fracturing the Supracondylar area.

Supracondylar fracture is the second most common fracture in children (16.6 %) and the most frequent before the age of seven years[1]. According to Boyd HB, Altenberg AR[2] who studied 713 fractures of the elbow in children, 12 years of age or younger, Supracondylar fracture of Humerus is 65.4% of all the fractures of the elbow in children.

Supracondylar fractures occur as two main types: the common extension type and the rare flexion type. According to Wilkins KE,King RE[3], 97.7% of the fractures were of the extension type, and only 2.2% were of the flexion type.

Supracondylar fractures were described in the writings of Hippocrates[4] during the third and fourth century A.D, but it was not until the 1700s that much was written about supracondylar fractures in the classic medical literature. In a series of pediatric extremity fractures published[5] in 1954, fractures of the supracondylar area had a greater rate of re-reduction, nerve injury, surgical intervention, and poor results than any other type of extremity fracture. In 1959, GartlandJJ[6] described three stages of extension type Supracondylar fracture humerus based on the degree of displacement. Type-I:- Un displaced

Type-II:- Displaced but with intact posterior cortex.
Type-III:- Displaced with no cortical contact. These are further divided Into Posteromedial and posterolateral types.

Treatment of supracondylar fractures iscontroversial and often technically difficult; complications are common. Cubitus varus is the most frequent problem with a mean incidence of 30%[7]. Injury to any of the three major nerves around the elbow occurs in 6-16% of cases[8].

Type I and type II fractures are usually treated conservatively. A variety of methods of treatment for displaced type III fractures has been recommended including closed reduction and immobilisation,[6] traction by various methods[10] and closed[11] or open reduction[12] stabilised by Kirschner wires under image intensifier. Non-operative management by straight lateral traction with the elbow in extension was first reported in 1939[9] and was later reviewed in a study[10].

Open reduction and internal fixation is done in most of the centers in Pakistan, including ours, due to lack of the facility of image intensifier and decrease in the rate of complications as compared to closed reduction.

MATERIALS AND METHODS

This study was conducted in Orthopaedics department, District Head Quarter Hospital Dera Ghazi Khan from

March 2011 to September 2011. Forty consecutive patients from 4 to 10 years of age (mean age of 6.4 years) with Gartland type-III supracondylar fractures of humerus, received in the emergency department were included in the study.

RESULTS

In this study, patients from 4 to 10 years of age were included. Their mean age was 6.4 years. Their age distribution is shown in Graph-1. Highest numbers of patients were from 6 to 7 years of age. Those were 17 (42.5%). The mean age of the patients in which fracture was fixed by parallel Kirschner wires, was 6.2 years and the mean age of the patients in which fracture was fixed by cross Kirschner wires, was 6.6 years.

There were 28 (70%) male patients and 12 (30%) female patients. Out of them, 15 males and 5 females, in which fracture was fixed by parallel Kirschner wires. There were 13 males and 7 females, in which fracture was fixed by cross Kirschner wires.

Left humerus was fractured in 23 (57.5 %) and Right humerus was involved in 17 patients (42.5 %) as shown in Table-3 and Graph-3. Left humerus was fractured in 12 patients and Right humerus was fractured in 8 patients, in which fixation was done by parallel Kirschner wires. Left humerus was fractured in 11 patients and Right humerus was fractured in 9 patients,in which fixation was done by cross Kirschner wires.All the patients included in the study had Gartland type III fracture of humerus. 34 (85%) of them had posteromedial and 6 (15%) of them had posterolateral displacement of distal segment.

In 20 (50%) patients, Supracondylar fracture of humerus was fixed by parallel and in other 20 (50%) patients, fracture was fixed by cross configuration of Kirschner wires.

Table No.1: Metaphyseal-diaphyseal angle

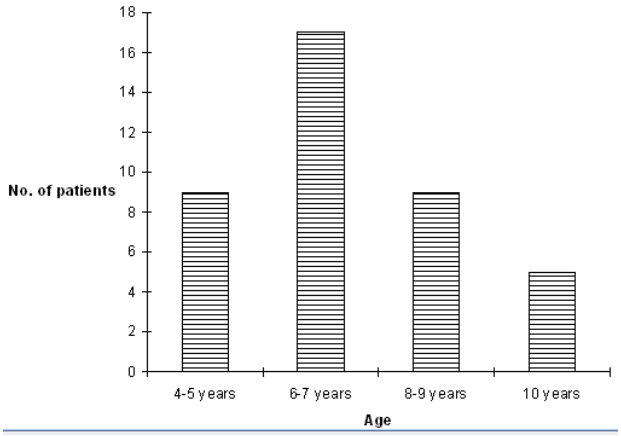
		Parallel wires	Cross wires	P-value
Immediate postoperative Metaphyseal-diaphyseal angle	No. of patients	20	20	0.007878
	Mean	97.25	90	
	SD	11.43345	1.685854	
Metaphyseal-diaphyseal angle at 1st week	No. of patients	16	15	0.001785
	Mean	93.125	90.05	
	SD	3.221949	3.221949	
Metaphyseal-diaphyseal angle at 3rd week	No. of patients	16	20	0.013659
	Mean	93.5	89.95	
	SD	5.853774	1.605091	
Metaphyseal-diaphyseal angle at 6th week	No. of patients	16	19	0.012733
	Mean	93.3125	89.78947	
	SD	5.618051	1.474937	
Metaphyseal-diaphyseal angle at 3rd month	No. of patients	16	19	1.474937
	Mean	93.25	89.78947	
	SD	89.78947	1.474937	
Metaphyseal-diaphyseal angle at 6th month	No. of patients	16	19	0.014496
	Mean	93.1875	93.1875	
	SD	5.36928	1.474937	

Table No.2: Range of motion

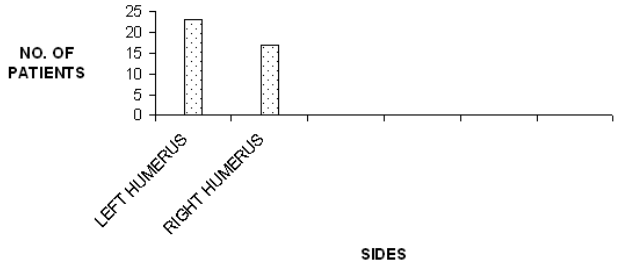
		Parallel wires		Cross wires		P.-value
		Mean	SD	Mean	SD	
3rd post-operative week	Experimental fixation arc	30.625	7.274384	31.05263	6.141604	0.851517
	Supinatiion-pronation arc	109.6875	16.47915	116.0526	13.2894	0.214591
6th post-operative week	Extension-flexion arc	81.25	11.32843	83.68421	9.104655	0.485757
	Supinatiion-pronation arc	126.5625	17.29342	130.2632	13.2784	0.479106
3rd post-operative month	Extension-flexion arc	94.6875	9.393038	96.31579	11.76649	0.658306
	Supinatiion-pronation arc	133.75	16.38088	137.3684	11.82845	0.454235
6th post-operative month	Extension-flexion arc	128.75	17.27233	133.1579	17.57607	0.461581
	Supinatiion-pronation arc	156.5625	28.26769	162.8947	19.38755	0.439279

Table No.3: Complications

	Revised fixation	Pin-track infection	Cubitus varus	Anterior bone block	Tourniquet palsy
Parallel wires	4	2	3	1	0
Percentage	20.0	12.5	18.7	6.2	-
Cross wires	-	2,0	1,0	1.0	1.0
Percentage	-	10.0	5.2	5.2	5.0



Graph No.1: Age Distribution



Graph No.2: Side Involved

DISCUSSION

Supracondylar fracture of humerus is a fracture of the immature skeleton. The bone in the supracondylar area is weaker during the last part of first decade because it is undergoing metaphyseal remodeling. In my study, 40 patients from 4 to 10 years of age were included. Their mean age was 6.4 years. Highest numbers of patients were from 6 to 7 years of age were 17 (42.5%).

Wilkins reviewed 4520 patients with supracondylar fracture of humerus in 31 major series[13]. He observed that most of these fractures occurred between the ages of 5 and 8 years.

In a study, 46 patients of supracondylar fractures of humerus were included. Maximum patients were from 7 to 9 years of age[14].

In another study, 62 patients of supracondylar fractures of humerus were included.Maximum patients were from 4 to 9 years of age[15].

46 patients with supracondylar fractures of humerus were included in a study[16]. The mean age of the patients was 6 years.

The mean age of 71 patients with supracondylar fractures of humerus, included in a study conducted was 6 years[17]. In this study, out of 40 patients, there were 28 males (70%) and 12 female patients (30%).

Boys outnumbered girls by 119 to 111 (52 % and 48% respectively) in a study conducted[18].

In a study, 71 patients with supracondylar fractures of humerus were included[17]. Among them 41 (57.7%) were boys and 30 (42.2%) were girls. In this study, left humerus was fractured in 23 (57.5%) and right humerus was involved in 17 patients (42.5%). These findings were comparable with previous studies as mentioned below.

One hundred and forty-five (63%) of the injuries were in the left elbow and eighty-five (37%) were in the right in a study [18].

In a study conducted on supracondylar fracture of humerus in children, the left side was injured in 22 (62.8%) patients, and the right side in 13 (37.1%) patients[19]. Left humerus was fractured in 35 (74.46%) and right in 12 (25.5%) children, in a study conducted by Richard et al[20]. Posteromedial displacement of the distal segment was observed in more patients as compared to posterolateral,probably secondary to the pull of the triceps, which originates more medially.In this study distal segment of the fracture was displaced posteromedially in 34 (85%) and posterolaterally in 6 (15%) children, which is comparable to the reports of other authors .

Posteromedial displacement of the distal segment was observed in 94 (81.03%) and posterolateral in 22 (18.96%) children in a study[18].

In a study done, Posteromedial displacement of the distal segment was observed in 23 (58.9%) and posterolateral in 16 (41.02%) children[20].

In another, displacement of the distal fragment has been specifically noted, 75% of the time the fragment was displaced posteromedially[9]. Acute compromise of either the neural or circulatory status in the extremity is not uncommon after fractures about the elbow in children. Fortunately, most compromises are transient. In this study transient radial nerve palsy was encountered in 2 (5%) children with posteromedial displacement of the distal segment. Complete nerve functions recovered after 2 months in each case. No other neurovascular

(Brachial artery, Median or Ulnar nerve) injury was observed.

In a retrospective review of displaced extension-type supracondylar fractures of the humerus in 101 children revealed neural injuries in 13 (12.8%) children[22].

In a study it was observed nerve injuries in 3 (8.8%) out of 34 patients of supracondylar fractures, two of which involved the radial nerve and one the median nerve[19]. All resolved spontaneously between four and six months postinjury. One patient had no radial pulse upon presentation. However, the pulse returned promptly with reduction of the fracture.

The incidence of neural injuries in association with supracondylar fracture of humerus has been estimated to range from 5 to 19 per cent in studies done by other authers as well[23].

In a study, transient nerve palsies was observed in 5 (11.1%) out of 46 patients with supracondylar fracture of humerus, 3 of these 5 patients involving the radial nerve and 2 involving the median nerve. Complete nerve functions recovered after 3 months, in each case[24].

Four patients (20%) whose fracture was fixed by parallel Kirschner wires, lost fixation and required revised surgery because in the immediate post-operative radiographs, distal segment of the fracture was seen markedly rotated. Not a single patient required revised fixation, in whom fracture was fixed by cross Kirschner wires. This finding was very significant statistically.

It was also reported loss of fixation in 11(13.75%) of 80 patients in whom only two lateral wires had been used[11]. The loss of fixation was attributed to technical errors, such as failure to engage the proximal and distal cortices and crossing of the wires at the fracture site. The authors concluded that, although the use of two lateral wires eliminates the risk of injury to the ulnar nerve, it is technically very demanding.

In a study the use of parallel wires led to re-displacement of the supracondylar fracture in 4 (57%) out of 7 patients despite an initial anatomical reduction[17].

Cubitus Varus developed in 18.7% of the patients, in which fracture was fixed by parallel wires. Cubitus Varus also developed in 5.2% of the patients, in which fracture was fixed by cross Kirschner wires. This difference was significant statistically. 2 (4.34%) out of 46 patients,whose fracture was fixed by cross wires, developed cubitus varus deformity postoperatively. There was no significant difference in the rate of pin track infection, torniquet palsy and anterior bone block, among both study groups.

CONCLUSION

On the basis of above mentioned findings and review of the available literature, the conclusion of this study is that cross Kirschner wires configuration is more safer and stronger mode of fixing all Gartland type-III supracondylar fracture of humerus in children.

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