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COMPARISON OF TREATMENT OUTCOMES OF SUPRACONDYLAR FRACTURES OF HUMERUS BY LATERAL ENTRY K WIRES VERSUS CROSS K WIRES IN CHILDREN

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Abstract:

Objective: *To relate the results of patients with supracondylar fractures of the humerus managed with lateral K entry wires and cross K wires in children.*

Study Design: *A randomized controlled trial study.*

Place and Duration: In the Orthopaedic department of Fazaia Medical College and Hospital Islamabad for one-year duration from March 2018 to March 2019.

Methods: *A total of 200 patients divided into A and B. Fixation of the cross k-wire was done in group A and lateral fixation of the k cable was done in group B. Loss of reduction was evaluated and recorded postoperatively and three weeks after the K wires removal. The elbow range of motion is excellent, evaluated at the end of 12 weeks postoperatively.*

Results: *200 patients were selected for the study. Eighty patients (80%) were men, and twenty subjects (20%) were women in which cross k-wire were done, seventy-eight (78%) men, and twenty-two (22%) were female were dining in lateral k wire group. Thirty patients in group A (30%) and forty patients in group B (41%) were found to have loss of reduction. In Group A, seventy-two patients (72%) had excellent outcome. Twenty-eight patients (28%) did not gain the preferred range of motion within the elbow. In group B, excellent results were obtained in 65 patients (65%), while the preferred motion range was not achieved in 35 patients (35%).*

Conclusion: *Lateral fixation with wire k is as effective as cross k-wire in the treatment of displaced supracondylar fracture of the humerus in children who maintain the technical aspect of fracture reduction. Even if the fracture has lost the reduction; excellent results in range of motion can be gained.*

Key Words: *Anterior humeral line, Baumann angle, reduction loss, range of motion.*

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INTRODUCTION:

The most common elbow fractures (60%) in children was the distal humerus supracondylar fractures. It is a fracture in the distal humerus metaphysis or the supracondylar region[1]. Unlike adults, children are often exposed to the upper extremity fractures. Among all fractures of the upper extremity, the humerus supracondylar fracture is the most common injury, but results in severe problems if not managed properly[2]. Gartland planned a useful supracondylar fractures classification: Type I, without displacement; with intact posterior cortex and displaced in type II; and displaced type III without cortical contact. Type III fractures move posterolaterally or posteromedially without reduction or cortical contact is problematic and without internal fixation treatment is not possible[3-4]. Type IV fracture is an extension fracture with multiple instability determined during operation[5]. It is estimated that the associated neurological damage rate is as high as 49% and the compartment syndrome rate is between 0.1% and 0.3%[5]. In general, fractures are treated conservatively in children. Surgical treatment is reserved for some physical injuries, fractures associated with neurovascular compromise and open fractures[6]. Non-displaced type I fractures can be managed satisfactorily by closed handling. Type II fractures are replaced and treated with closed method or percutaneous fixation with kirschner wire. Closed reduction following percutaneous fixation of K wires is 1st line of treatment for type III fractures, whether lateral entry wires k or cross wires k. In our configuration, both methods are used, but k-wires are related with iatrogenic damage to the ulnar nerve (0% to 5%)[7]. The excellent result in the motion range was 91% for the lateral fixation of the input cable k and 66% for the transverse cable k fixation. In the past, worsening, ie, ulna varus or valgus, has been thought to occur mainly because the growth of the physics of the distal humerus has stopped, rather than reducing fracture. Modern methods for management have significantly reduced the rates of compartment syndrome and disunion[8]. If the supracondylar type II fracture needs to be managed operationally or nonoperatively and management of the dysvascular limb is required, there is still much debate about the treatment of these injuries, including pin placement[9]. Ulna and range of motion loss are the most common postoperative sequelae that occur after loss of loss and contribute to significant morbidity for the child and the family.

MATERIALS AND METHODS:

This randomized controlled trial study was held in the Orthopaedic department of Fazaia Medical College and Hospital Islamabad for one-year duration from March 2018 to March 2019. 200 total patients divided into A and B. Elbow radiographs were taken to know the fracture type. Into group A and group B; subjects were divided randomly. In Group A, fixation of cross K wire and B group and lateral fixation of K wire were performed. Patients aged 3-10 years included Gartland type II fractures, Gartland type III fractures and supracondylar fractures fresh from the humerus within one week after injury. Patients with humerus supracondylar fracture with vascular or nerve lesions, supracondylar fracture of the humerus with ipsilateral forearm fracture and open supracondylar humerus fracture were excluded. Vascular and neurological status were evaluated. After the first closed reduction, the back plate was applied. The patients were brought to the supine position with the injured upper limb near the operating table. After thoroughly rubbing and closing the injured elbow, a closed manipulative reduction was done and the reduction was confirmed by image intensifier. If the reduction is manageable, the k wires (0.062 mm) have been passed under the image amplifier, the k wires have passed through the A group, and the k wires are located at the side entrance within the B group or two more closed reduction attempts. If no acceptable reduction was achieved, open reduction was performed and k-wire fixation was performed, cross-wire (group A) or k-wire lateral entry (group B). In the case of open reduction, the wound was closed on drainage and the posterior plate was applied at a 90 degrees elbow flexion. All cases were followed in the OPD. Radiological examination of the elbow was performed every two weeks. At 3 weeks postoperatively, K wires were removed and the results were evaluated by X-rays, Baumann angle and anterior humerus lines were radiographed postoperatively and at 3 weeks. In the elimination of wires, the values were recorded and compared. Deviation from normal values of any of the Baumann angles of the anterior humeral line was considered a loss. After removal of the posterior plate, soft range of motion exercises of the operated elbow were initiated and any range of motion loss was recorded at the end of the 12th week postoperatively, with an excellent result compared to the elbow. Loss of reduction was evaluated and recorded postoperatively and three weeks after the removal of the wires. The range of motion of the elbow is excellent, evaluated at the end of 12 weeks postoperatively. The first closed reduction trial is indicated for almost all displaced supracondylar fractures that are not open. When the patient is under general anesthesia, fracture is reduced first by fluoroscopic verification in the frontal plane. The olecranon is then pushed forward to correct the sagittal deformity and reduce fracture. Acceptable reduction criteria include the restoration of the Baumann angle on an AP radiograph, the intact

lateral and lateral columns as seen on inclined radiographs, and the anterior humeral line that passes through the middle third of the capitellum on the lateral radiograph. It is detrimental to the stability of any malignant rotary fracture, so special attention should be paid to the stability of the reduction, if any, and possibly a third fixation pin should be used. Fracture reduction is achieved by two or three Kirschner wires. The elbow is fixed at a degree of bending of 40 to 60 degrees, depending on the amount of swelling and vascular condition. If there is a significant gap in the fracture site, or if the fracture cannot be reduced by the so-called rubbery sensation during the reduction attempt, the brachial artery and median nerve may become trapped in the fracture site. Open reduction occurs in the case of failed closed reduction, a open fracture and devascular limb.

RESULTS:

Patients who underwent K-wire fixation for displaced supracondylar fractures in children were identified by two different methods, namely cross K wire (group A) fixation and lateral entry k wire (group B). A total of 200 patients, 100 in each group, were treated. The mean age of patients in group A in the cross group was 6.51 ± 2.26 years and 5.83 ± 1.83 years in lateral entry group B. In Group A, 59 patients (59% were 3 to 6 years and 41 (41%) were between 7 and 10 years.

Table 1: Age distribution of patients in both groups (n=200)

Age in years	Group A	Group B
3-6	59(59%)	58(58%)
7-10	41(41%)	42(42%)

Similarly, in Group B, 58 patients (58%) were 3 to 6 years and 42 patients (42%). (Table 1) 80 patients (80%) were male and 20 patients (20%) were female in Group A. Male and female ratio was 4.0: 78 patients (78%) in Group B male, 22 patients (22%) female and male ratio was 3.54: 1 (Table 2), normal Baumann angle was 64 to 81 ° (mean 72 degrees) on AP radiographs. 94) had a normal Bauman status and was abnormal in six patients (6%), with an average Baumann angle (and standard deviation) of 74.90 ± 6.85 °, in a postoperative period 82 patients (82%) had a normal Bauman angle in 18 patients.

Table 2: Sex distribution in both groups

Gender	Group A	Group B
Male	80(80%)	78(78%)
Female	20(20%)	22(22%)

The mean Baumann angle (and standard deviation) was 77.60 ± 4.40 and the p value was 0.12 (Table 3). The anterior humeral line was intact in 70 patients (70%), and intact in 30 patients (30%) in group A Be Similarly, in 59 patients (59%) the anterior humeral line was intact and incomplete. In Group B, 41 patients (41%), immediately postoperatively.

Table 3: Comparison of immediate postoperative Bauman's angle in both groups

Bauman's angle	Group A	Group B
Normal (64-81°)	94(94%)	82(82%)
Abnormal (<64 and >81°)	6(6%)	18(18%)

The difference between the two groups was 2.64 (Chi square test) and P value was 0.10 (Table 4).

Table 4: Comparison of immediate postoperative anterior humeral line of patients in both groups

Anterior humeral line	Group A	Group B
Intact	70(70%)	59(59%)
Non intact	30(30%)	41(41%)

P value 0.10

The comparison of the angle of Baumann was also made during the removal of k (3 weeks after the date of use of the wires). In Group A, Baumann angle was normal in 90 patients (90%), abnormal in 10 patients (10%), with a mean Baumann angle (and standard deviation) of 77.50 ± 5.09. In group B, it was normal in 78 patients (78%), abnormal in 22 patients (22%) (Mean standard deviation) 77.70 ± 6.30 and p value 0.037 (Table 5).

Table 5: Comparison of Bauman's angle after 3rd postoperative week in both groups

Bauman's angle	Group A	Group B
Normal (65 to 82°)	90(90%)	78(78%)
Abnormal (<64 and >81°)	10(10%)	22(22%)

Anterior humeral line during association, ie 3 weeks after operation between groups. The anterior humeral line was intact in 70 patients (70%) and intact in 30 patients (30%) in group A. Similarly, in 59 patients (59%) the anterior humeral line was intact and incomplete. In Group B, 41 patients (41%) had postoperative third week. The difference between the two groups was 2.64 (Chi square test) and P value was 0.10 (Table 6).

Table 6: Comparison of anterior humeral line after 3rd postoperative week in both groups

Anterior humeral line	Group A	Group B
Intact	70(70%)	59(59%)
Non intact	30(30%)	41(41%)

P value = 1.10

Subsequently, at the end of the third postoperative week, 30 patients (30%) in group A had a reduction in fracture, and 70 patients (70%) had no loss with a stable decrease. In Group B, forty-one patients (40%) had a loss of reduction, and 59 patients (59%) had a fixed fracture reduction structure with a P value of 0.10 (Table 7).

Table 7: Comparison of loss of reduction 3 weeks postoperatively in both groups

Loss of reduction	Group A	Group B
Yes	30(30%)	41(41%)
No	70(70%)	59(59%)

P value 0.10

The comparison of the range of motion as excellent results was also made between the groups. While 72 patients (72%) achieved excellent results, 28 patients (28%) did not achieve the desired range of motion with the elbow. In group B, excellent results were obtained in 65 patients (65%), while the desired range of motion was not achieved in 35 patients (35%). The chi-square test was 1.13 and the P value was 0.28 (Table 8).

Table 8: Comparison of excellent outcome (0-5) degree after 12 wks post op. in both groups

Excellent outcome	Group A	Group B
Yes	72(72%)	65(65%)
No	28(28%)	35(35%)

P value 0.28

3 weeks after the comparison of the Baumann angle in the postoperative period and the elimination of the k-wires in group A. The immediate average of Baumann's angle is standard deviation 74.88 ± 6.79 and after 3 weeks, p <0.001 was 77.50 ± 5.09. In the immediate postoperative period, the mean anterior humerus line was 1.30 ± 0.46, and after 3 weeks, the p value was 1.30 ± 0.45 with a p value of 1.0 (Table 9).

Table 9: Comparison of Baumann angle and anterior humeral line in the immediate postoperative period and 3 weeks later at the time of removal of K-wire in group A

Baumann Angle: imm. post op Mean ± SD)	Baumann Angle: after 3 weeks (Mean ± SD)	P value
74.88 ± 6.79	77.50 ± 5.09	<0.001
Ant. Humeral line; imm. Postop	**Ant. Humeral line; after 3 weeks**	
1.30 ± 0.46	1.30 ± 0.45	1.0

In the postoperative period, the mean and standard deviation was 77.60 ± 4 years after the comparison of the Baumann angle and the elimination of the k-wires in group B after 3 weeks. After 40 and 3 weeks, p <0.01 was 77.70 ± 6.30. The mean anterior humeral line was 1.41 ± 0.49 in the immediate postoperative period and 1.41 ± 0.49 p in 3 weeks. (Table 10)

Table 10: Comparison of Baumann angle and anterior humeral line in the immediate postoperative period and 3 weeks later at the time of removal of K-wire in group B

Baumann Angle: imm. post op (Mean ± SD)	Baumann Angle: after 3 weeks (Mean ± SD)	P value
77.60 ± 4.40	77.70 ± 6.30	< 0.01
Ant. Humeral line; imm post op	**Ant. Humeral line; after 3 weeks**	
1.41 ± 0.49	1.41 ± 0.49	1.0

DISCUSSION:

In this study, we compared the results of cross k and lateral entry k wires in the treatment of supracondylar fracture. We examined 200 cases, the majority of cases were Gartland type III fractures in both groups. 80% of the patients were men with dominant upper extremity involvement[10]. In our study, the mean Baumann angle with standard deviation was 74.90 ± 6.85 in cross k wires, 77.60 ± 4.40 in lateral entry k wires, and 0.12 p postoperatively removal of wires, ie healing of fractures. The mean Baumann angle with standard deviation was 77.50 ± 5.09 in cross k wires, 77.70 ± 6.30 in lateral input k wire and p value was 0.037 (Table 5). The Baumann E study, the intraoperative Baumann angle, or immediate postoperative AP radiography was compared to the angle of radiography taken at the time of junction with fracture at approximately three weeks[11-12]. The mean Baumann angle (and standard deviation) was 17.7 ° ± 5.1 ° (range, 16.7 ° - 18.5 °) immediately after surgery, and 17.6 ± 4.9 ° (range, 16.6 ° - 18.4 °) at that time[13]. The mean difference of union was 0.05 ° ± 0.2 ° (p = 0.878). There was no significant difference between type 2 and type 3 fractures according to the Baumann angle during joint. The mean Baumann angle measured immediately after the operation was 17.4 ° ± 5.1 ° (range, 16.2 ° - 18.7 °) and 17.9 ° ± 5.2 ° (range, 16.5 ° to 19.4 °) in patients with type 2 fracture. Type 3 Fracture (p = 0.876). The mean Baumann angle at the time of coupling was 17.4 ° ± 4.9 ° (range, 16.1 ° to 18.5 °) in patients with type 2 fracture and 17.8 ° ± 5.0 ° (range, 16.4 ° to 19.2 °). Type 3 fractures (p = 0.893) the greatest difference between the perioperative and final Baumann angles was 7 °, which was thought to be unrelated due to the effect of the rotation of the elbow on the Baumann angle. In order to evaluate our results, we have revised Flynn's overall rating[14]. This is the most rigorous classification because any ulnar deformity is considered a poor outcome regardless of the function of the elbow. Our treatment protocol gave excellent or good results in 96% of the cases, and 7% of the patients died during the mean follow-up period of 28 months. Comparing the results of our treatment protocol with other published series, we think it is a safe method, even if performed by less experienced surgeons. All type II fractures were classified with excellent or good results. Four missing results, all found in type III fractures, were considered to be the result of technical errors when the guidelines were not followed, ie failure of the first reduction or poor mechanical fixation. This was probably due to the level of experience of primary surgeons; Four mistakes were made in the first six months by six small staff[15]. We did not find one detection technique that confirms the experience of Topping et al. Three and five of the 90 patients treated with the secondary displacement, lateral

percutaneous impact greater than 5 ° at the Baumann angle taken during the removal of the wires by postoperative radiography, all treated with the Open Crusade 26. All had type III fractures. In two secondary displacement cases, poor results were due to technical errors. In the remaining six patients, displacement was less than 10 ° and had no clinical significance.

CONCLUSION:

The mechanical stability of the lateral fixation of the k wire and the cross k is the same, but the lateral fixation of the k wire is technically more difficult. Decrease loss is not the only factor responsible for loss of range of motion. Proper positioning of the pins and healthy surgical skills can prevent ulnar nerve injury in fixing the cross wires.

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