

Are Radiographs Necessary Before Kirschner Wire Removal in Supracondylar Fracture of Humerus in Children Who Have Undergone Operative Procedure?

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Abstract

Background: To assess the need for radiograph one day prior to Kirschner wires removal in supracondylar humerus fracture patients, who had undergone percutaneous wire fixation.

Methods: In this prospective cohort study 100 patients with supracondylar humerus fracture were included. Patients were divided into two groups. Group A was the one in which the radiographs (AP and lateral view) were obtained one day prior to k-wire removal, whereas no prior x-rays were obtained before k-wire removal in group B. All patients were operated by percutaneous k-wiring, position and angles of k-wires confirmed under fluoroscope. The operated limb was immobilized in a back slab after k-wire fixation. Postoperative radiographs (AP and lateral view) obtained for all patients before being discharged. First follow-up was after 2 weeks of surgery for Stitch removal. Second follow-up, 3 weeks after surgery to remove the back slab. Third follow up at almost 4 weeks of surgery for k-wire removal. Baumann's angle was calculated and compared from radiographic evaluation that was done during surgery and the final follow up X-ray.

Results. Out of the 100 patients, 57 were male while 33 were females. Supracondylar humerus fractures were classified into flexion and extension type. Patients in group A (n=50) had a mean age 5.38 ± 1.308 whereas in group B (n=50) it was 5.24 ± 1.271 . In group A, the mean number of post-operative days prior to k-wire removal was 27.16 ± 2.881 while for group B it was 27.30 ± 3.046 (p-value 0.814). Patients in group A had a mean difference in Baumann's angle of 2.324 ± 0.041 while in group B 2.329 ± 0.023 (p-value 0.452). K-wires were not retained in any of the patients who underwent radiography one day before the expected day of their removal

Conclusion: X-rays are not a requisite before Kirschner wire removal in supracondylar fracture of humerus in children. This not only saves the child and the family from anxiety but also prevents

unnecessary radiation exposure, which may harm the child in long run.

Key Words: Kirschner wire, Percutaneous, Baumann's angle.

Introduction

Supracondylar fractures which are usually seen in the first decade of life are regarded as the widespread fractures of upper limb.¹ These fractures have more predominance in boys than girls.² Its onset is maximum at age of 8 years. The incidence descends with increasing age.³ Pediatric supracondylar fracture is categorized into flexion and extension type. Of the two mentioned, latter is more prevalent (97.7%). The underlying mechanism of injury is falling on an extended arm (elbow in hyperextension).^{4,5} Gartland classification system is widely accepted for these fractures.⁶ This system is applied to extension type fractures and is categorized into three grades.⁷ In Grade 1 fracture is not displaced, in Grade 2 fracture is partially displaced with intact posterior cortex, and in Grade 3 complete displacement of bone segment is present. Treatment plan will depend upon degree of displacement⁸. Grade 1 fractures are treated with conservative management whereas grade 2, 3 are treated with surgical intervention i.e. closed reduction and percutaneous kirschner wire (k-wire) fixation.⁹ When closed reduction fails to reduce the fracture segments properly, then open reduction is treatment of choice.¹⁰ The percutaneous wiring is carried out by implanting sterilized wires which immobilize and stabilize the fracture after reduction. K-wires stick out of skin beneath the plaster, so that when healing of bone has been achieved around 3-6 weeks, they can be pulled out with ease.^{11,12} Patients with medial wire implantation are more vulnerable to the ulnar nerve complications in comparison to those with lateral fixation¹³ Expectancy of K-wire removal during clinical session can trigger anxiety in pediatric patient and their parents, this leads to significant negative effect on a patient's overall experience during clinical session.

Patients and Methods

This prospective cohort study was conducted in the department of orthopaedics, Benazir Bhutto hospital, Rawalpindi from April 2015 to April 2016. We divided the patients into 2 groups; A and B. Group A was the one in which the radiographs (AP and lateral view) were obtained one day prior to K-wire removal, whereas no prior x-rays were obtained before K-wire removal in group B. All patients were operated in elective orthopaedic operation theatre under fluoroscopic control and those who did a complete post-operative follow up were included in the study.

Patients of supracondylar humerus fractures were operated by percutaneous K-wiring, position and angles of k-wires confirmed under fluoroscope (AP and lateral view). The operated limb immobilized in a back slab after k-wire fixation. Postoperative radiographs (AP and lateral view) obtained for all patients before being discharged and they were informed regarding follow-up. First follow-up after 2 weeks of surgery for Stitch removal.

Second follow-up, 3 weeks after surgery to remove the back slab, assess movements of fingers and enquire about any new history of trauma/fall. Third follow up was at almost 4 weeks of surgery for K-wire removal. Baumann's angle was calculated and compared from radiographic evaluation that was done during surgery and the final follow up x-ray. There was one specific person who calculated this angle for each patient to prevent variation which can result due to human error (parallax error). Baumann's angle was calculated by drawing a line parallel to long axis of humerus which intersects with a straight line passing through the open capitellarphysis (Figure-1). For each calculated angle, three readings were taken on x-ray and then their mean was calculated which was taken as final value.

Results

During the 1-year study period, a total of 103 patients were included in the study. 3 patients were lost to follow-up. Hence they were excluded from the study. Out of the 100, 57 were male while 43 were female. Male patients had a mean age of 5.35 ± 1.217 while female patients had a mean age 5.26 ± 1.382 . Of the total, 63 patients had left upper limb involvement while 37 had involvement of the right upper limb. Supracondylar humerus fractures were classified into flexion and extension variety. Out of the total, 7 patients had a fracture of flexion type while 93 with extension variety (Table 1). Patients were divided into 2 groups; A and



Fig-1: Calculation of Baumann's angle

B. 50 patients were placed in group A and 50 in group B (Table 2). Twelve patients had a Gartland type-II fracture while 88 had type-III injury. Patients in group A had 3 post-operative radiographs prior to k-wire removal whereas those in group B had 2 post-operative radiographs. For patients in group A, the mean number of post-operative days before k-wire removal was 27.16 ± 2.881 while for those in group B was 27.30 ± 3.046 (Table 3). Difference in the mean values of two groups was not significant. Variations in final post-operative radiographic follow-up were seen, with an average mean number of days 64.34 ± 12.040 (Table-4). As $p\text{-value} = 0.458$, so the difference in the means of two groups was insignificant. For each patient included in study, Baumann's angle was measured immediately after surgery and at final radiographic follow-up, and difference in angle calculated. Patients in group A had a mean difference in Baumann's angle of 2.324 ± 0.041 while in group B 2.329 ± 0.023 (Table 5). None of the patient presented with retained k-wires at final radiographic follow-up. None had to undergo a revision surgery or re-application of cast.

Table 1: Age distribution according to fracture type

Type of Fracture	Mean Age	Standard Deviation (SD)
Flexion type (n=7)	5.14	2.116
Extension type (n=93)	5.32	1.217

Table 2: Patient distribution according to gender

Group	Gender		Total (n=100)
	Male	Female	
A	30	20	50
B	27	23	50

Table 3: Group distribution of mean number of post-operative days prior to k-wire removal

Group	Mean No. of post-operative days before k-wire removal	Standard Deviation (SD)	p-value
A	27.16	2.881	0.814
B	27.30	3.046	0.814

Table 4: Group distribution of number of days of final radiographic follow-up

Group	Mean No. of days of final radiographic follow-up	Standard Deviation (SD)	p-value
A	63.44	12.380	0.458
B	65.24	11.745	0.458

Table 5: Group distribution of difference in Baumann’s angle

Group	Mean difference in Baumann’s angle	Standard Deviation (SD)	p-value
A	2.324	0.041	0.452
B	2.329	0.023	0.452

p-value of 0.452 showed that the mean difference of Baumann’s angle in two groups was not significant.

Discussion

Laxity of the ligaments and structure of humerus predispose children to supracondylar fractures making them one of the most common fractures among children as compared to adults.¹⁴In addition to these inevitable risk factors; increased activity of the children, their risk taking behavior to learn new things as well as decreased supervision makes them more liable to injury.¹⁵

The neurovascular complications associated with this fracture include injury to brachial artery, anterior interosseous nerve, median, ulnar and radial nerve which result not only in motor weakness but sensory deficit is also found to some extent.¹⁶Nerve dysfunction secondary to operative management has also been reported but its incidence is low. Other complications include inadequate reduction, infection of percutaneous pin site, Volkmann's contracture and ischemia of forearm.¹⁷

Among these supracondylar fractures, extension type make up majority of the fractures and can be attributed to fall on the outstretched arm.⁴ Our study showed 93% of the fractures to be of extension variety where as the flexion type only constituted 7% of the supracondylar fractures. These results can be compared with a study carried out by Dawood et al

who found the incidence of extension type supracondylar fractures to be 97.7% and that of flexion type 2.3%.⁴

Over a period of one year, 100 patients were studied and the male to female supracondylar fracture incidence ratio was found to be 57:43. These statistics are comparable to a similar study done by Sahu RL et al in which the male incidence was also found to be greater than that of female children with male to female ratio of 57.05: 42.95 .¹¹

Right upper extremity was affected in 63 patients while 37 patients suffered from left upper extremity supracondylar fracture. In the comparative studies carried out by Dost AK et al found that 49(62%) out of total 79 patients studied had left arm supracondylar fracture as compared to the 30(38%) patients who had right upper extremity trauma.¹⁸

Gartland’s classification was used to further divide the extension type of fractures depending upon the displacement of distal segment. In our study, 12 patients had Gartland type II fracture where the posterior cortex was intact despite displacement and 88 patients were treated for type III fracture with the displacement either posterolateral or posteromedial.

Our study showed the mean age to be 5.14 years(+2.116) in the case of flexion type of fractures and 5.32 years(+1.217) where the extension type of supracondylar fractures were concerned. This result was similar to the result of Mitchelson et al who reported a peak incidence between 5 to 6 years of age with mean of 5.05 years. ¹⁵

Percutaneous Kirschner wires (k-wires) are used to stabilize the site of fracture. Previous studies lack the data regarding removal of k-wires. It was believed that admitting children and removing k-wires under general anesthesia saved the subjects from any traumatic outcomes.Symons S et al contradicted this, showing that this minor procedure when done in clinical settings not only reduced anxiety of patients and their parents associated with hospital admission but also the complications of general anesthesia could be avoided. Lest to say that it also favored the parents from any extra financial burdens associated with this stay in pediatric ward.¹⁹ K-wires can be removed without giving anesthesia or under local anesthesia in the outpatient department. If these wires are buried deep inside the skin, then general anesthesia is required at times. But in our study, no wires were deeply buried in any of the subjects therefore they were removed under local anesthesia with little pain. K-wires were removed after a mean of 27.16 days post operatively in group A patients where as a mean of

27.30 days was found before their removal in group B patients. A similar study showed mean number of days before removal of k-wires to be 26.1 days for group A patients as compared to 27.2 days for group B.¹

Final radiographic follow-up varied from patient to patient with mean number of days of final radiographic follow-up post operatively 63.44 days for group A and 64.26 days in group B patients. John A. Schlecter & Michael Dempewolf showed similar results with an average of 59.7 days post operatively for radiographic follow up in group A as compared to a mean of 70.4 days in group B patients. These variations in follow-up of all patients could be attributed to a number of reasons. Few children completely failed to follow up due to change in location(city) when inquired upon and a few went to bone setters resulting in short follow up or no follow up at all. In some patients, operating surgeon demanded a longer follow up or the patients presented with new history of trauma thus leading to a longer follow up period. Parents' concern about the post operative limited range of motion of affected elbow joint when compared to the opposite joint sought for a longer follow up. A number of these cases showed limited range of motion post-operatively because of a delay in seeking proper medical attention causing a delay of average 7-15 days before the fracture was managed in a tertiary care hospital. In our region, most of the population is concentrated in rural areas. Lack of awareness results in patients approaching quacks. When no improvement is seen, they present to hospital with much delay and functional or cosmetic compromise.

Baumann angle and carrying angle were found to be correlated²⁰ therefore we measured the difference in Baumann's angle of the two groups A and B immediately after reduction and at the final follow-up of the patient. The mean difference in Baumann's angle was found to be 2.324° in group A patients whereas in group B patients, it was 2.329°. This mean of difference was observed to be 2.33° between the two groups studied by Antonie De Gheldere and Damien Bellan.²¹ In group A patients, 3 radiographs were done before k-wire removal. The final x-ray was taken one day prior to their removal whereas in group B patients no x-ray was done just before the k-wires were removed. It was seen that k-wires were not retained in any group after removal, so both groups were comparable. This raised a question about the necessity of x-rays done before removing k-wires in supracondylar fracture of humerus in children.

To justify the necessity of these x-rays is of utmost importance in children due to the risks associated with radiation exposure so as to keep the number of radiographs limited in children. Children and parents are anxious about the healing of the bone and more so when x-ray is done prior to wire removal. In the follow-up, they will demand repeated radiographic investigations assuming it to be a part of necessary management and thus increasing the unnecessary exposure. Children maybe petrified if x-ray is taken without cast when they see the exposed pins therefore to reduce the unease of the patient, x-rays can be done with the casts on. But a compromise has to be done on the quality of x-ray as the overlying cast obscures the bony structures and progress cannot be assessed correctly.¹ Also it is easier to determine Baumann's angle without cast. These repeated visits to the hospital are not without a burden on the parents of the patients who not only at times have to travel far from their home but their routine work is also affected with the expenses contributing to their worries. Therefore if proper post-operative follow up has been done then there is no need for x-ray one day prior to k-wire removal.

Postoperatively patients can be discharged the next day after surgery as longer hospital stay is not required and it also contributes to anxiety of the patients and their attendants. First follow-up can be done 2 weeks after surgery for the removal of sutures. Antibiotics are given prophylactically to avoid any complications that can arise due to presence of these wires. On average, cast and the wires are removed 4 weeks postoperatively.²² Limited range of motion was observed when k-wires were removed and it was advised that immobility should not be continued beyond 3-4 weeks.²³ The efficacy of physiotherapy after surgical management has not been established yet. Initially better range of motion is seen in the patients undergoing physiotherapy as compared to those who did not opt for it but studies carried out by Keppler et al showed no difference between these two groups after 1 year of follow-up.²³ In a study carried out by Ponce BA et al, no association between late follow up and complications were found and it was reported that radiographic evaluation could be delayed until after the removal of K wires.²⁴

Conclusion

No difference was recorded in the clinical outcomes if x-rays were obtained one day prior to k-wire removal as compared to those in whom radiography was done after removing the wires. If operative procedure is not followed by any undesirable event, then it is deemed

safe to remove these wires at the time of removal of cast so no extra visit to the hospital is required. It not only helps ease the patient and his family but also saves the children from excessive radiation exposure.

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