A study comparing two different pinning techniques in supracondylar fractures of the humerus

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**ABSTRACT**
Various treatment options are available for treating type III supracondylar fractures of the humerus. The most common technique employed is closed manipulative reduction with K wire fixation. This study was performed to compare two different pinning techniques in type III supracondylar fractures of the humerus. This study was done in the time frame between January 2012 to December 2015. The age of the children selected for this study ranged from 3 to 12 years of age. Among 66 children, 6 were lost to follow up and the final number was 60 children. Patients with lateral pin fixation were allotted to Group A (n=29), while patients with cross pin fixation technique were allotted to Group B (n=31). All patients were assessed for loss of fracture reduction and the occurrence of ulnar nerve injury. The two groups were evaluated at regular intervals from the first week to a time frame of 6 months. In both groups of patients, there was no loss of fracture reduction observed. The various parameters pertaining to the study were evaluated and there was no statistical significant difference found between the 2 groups. In group B, 3 of the children had injury to the ulnar nerve. Both groups were comparable in terms of fracture healing duration, loss in the reduction of the fracture and the stability provided by the pin constructs. In conclusion, both fixation constructs are comparable in terms of stability, but there are higher chances of iatrogenic injury to the ulnar nerve by using the crossed pinning technique. Hence, we conclude that the lateral pin construct is safer as compared to the cross pin method.

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**INTRODUCTION**
Among paediatric fractures, supracondylar fractures of the humerus are fairly common injuries which present to the orthopaedic department and they account for around 70% of fractures around the elbow (Herring and Fitch, 2002). Various complications such as vascular and nerve injuries as well as malunion leading to a cubitus varus deformity can be associated with these fractures. (Flynn et al., 1974; Arino et al., 1977; Bloom et al., 2007). Among the 2 types of pinning constructs, the cross pinning method was associated with a high incidence of injury to the ulnar nerve (Chai et al., 2000). The different treatment options available for management are conservative management with closed manipulative reduction and application of an above elbow cast and also various traction modalities can be applied, but the drawback is the fact that they are often associated with a higher complication rate (Wilkins, 1996; Dodge, 1972; Dunlop, 1939;
MATERIALS AND METHODS

This was a prospective study conducted between January 2012 to December 2015. Children with supracondylar fractures of the humerus willing for the procedure and follow up were included in our study, while children with compound injuries, fractures necessitating open reduction and unstable elbow with multiple fractures were excluded.

This study was performed after obtaining clearance from the ethical committee of our hospital.

At the time of admission, the elbow was first immobilized in an arm sling and a thorough neurovascular examination was performed. The children were then subjected to a radiographic evaluation, which included standard radiographs of the elbow, which consisted of anteroposterior and lateral views. CT scans were not taken in any of the patients. The patients were taken up for surgery after pre anaesthetic evaluation was performed.

The children were then allocated into 2 groups by flipping a coin method and children with the lateral pinning technique were in group A while group B consisted of children treated by the cross pinning technique.

Proper informed and written consent were taken from the children’s parents prior to performing the surgical procedures. The procedures were performed under general anaesthesia under fluoroscopic control. Traction was first applied with appropriate counter traction and the fracture length was gained. Any medial or lateral displacement was then corrected by giving a valgus or a varus stress and then the elbow was taken into hyperflexion by placing a finger on the tip of the olecranon in order to correct the posterior displacement and the fracture reduction was assessed under fluoroscopic control. After closed reduction, the fractures were then pinned using the 2 different constructs according to the group the children were allotted in. For the lateral pinning technique either 2 or 3 pins were used in a parallel or a divergent pattern while in the cross pinning technique, 2 pins were used routinely. In the cross, pinning technique care was taken while inserting the medial pin in order to avoid injury to the ulnar nerve and an incision was made at the base of the medial epicondyle and the unlar nerve was isolated and protected before passage of the pin (Figures 1 and 2).

After placement of the pins, the radial pulse was palpated and the elbow was immobilized in arount 70 to 80 degrees of flexion in an above elbow slab. Postoperatively i.v antibiotics were given for 5 days and postop radiographs were taken to evaluate the quality of fracture reduction and the stability of the pinning constructs. The children were then followed up at regular intervals and the pins were removed in the outpatient department at the end of 3 weeks. At the time of follow up, all patients were evaluated clinically and radiologically and all parameters were evaluated and documented in the case records and the Flynn’s criteria was used in the evaluation (Flynn et al., 1974). (Table 1).

The data were collected and were subjected to an evaluation using SPSS software and the mean and standard deviation were evaluated. A P value of less than 0.05 was taken to be statistically significant.

RESULTS AND DISCUSSION

Both groups were comparable in terms of the parameters assessed and there was no statistically significant difference between them. Out of the 66 children included in this study, 6 of them were lost to follow up.

Group A (Lateral pin fixation) comprised of twenty-nine patients among which twenty-one patients (72%) were male. The mean age of the patients was 5.7 years and the most common mode of injury was fall from a height followed by play injuries and road traffic accidents. The left side was more commonly affected as seen in 18 patients. Nerve palsies were seen in 3 patients, which included injury to

Worlock and Colton, 1987; Smith, 1947). In this scenario the most favourable treatment option appears to be closed manipulative reduction of the fracture followed by K wire fixation under fluoroscopic guidance, which are generally associated with good outcomes as widely reported in literature (Mazda et al., 2001; Shannon et al., 2004; Gordon et al., 2001; Skaggs et al., 2004; Fowles and Kassab, 1974). In terms of K wire fixation, the two constructs available are the lateral and the cross pinning technique and it has been a debate as to which construct is the superior one as pertaining to fracture stability and functional outcomes (Belhan et al., 2009; Ramachandran et al., 2006). The cross pinning technique stabilizes the medial as well as the lateral columns of the humerus while the lateral construct engages the central and lateral columns of the humerus. Cross pinning technique was ideally thought to provide more stability to the fracture but was associated with injury to the ulnar nerve. Therefore, this study was conducted in order to compare the 2 pinning techniques available and to evaluate the superiority on one over the other in terms of stability and functional outcomes achieved (Brown and Zinar, 1995; Lyons et al., 1998; Lee et al., 2002).

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Figure 1: A. Pre-op x-ray. B. Immediate post-op x-ray showing cross pin construct. C. Good union at 6 months.

Figure 2: A. Pre-op x-ray. B. Immediate post-op x-ray showing lateral pin construct. C. Good union at 6 months.
Table 1: Modified Flynn's criteria

| Result      | Rating | Carrying angle loss (degrees) | Flexion loss (degrees) | Extension loss (degrees) |
|-------------|--------|-------------------------------|------------------------|-------------------------|
| Satisfactory| Excellent | 0-4.9                         | 0-4.9                  | 0-4.9                   |
|             | Good   | 5-9.9                         | 5-9.9                  | 5.9-9.9                 |
|             | Fair   | 10-14.9                       | 10-14.9                | 10-14.9                 |
| Unsatisfactory| Poor   | ≥15                           | ≥15                    | ≥15                     |

the radial and median nerve while a pulseless viable hand was seen in 4 patients. The most common fracture displacement seen was posteromedial as observed in 23 patients. The capitohumeral angle loss was 6.4, carrying angle loss was 3.84 and the bauman angle loss was 5.50. The average range of motion of the elbow achieved was 0 to 128 degrees. The time taken from arrival in the hospital to treatment was 5.7 hours. Only 1 patient in this group had a minor limitation of function.

Group B (Medial and Lateral pin fixation) comprised of thirty-one patients among which seventeen patients (54.8%) were male. The mean age was 6.4 years. The most common mode of injury was fall from height followed by playtime injuries and road traffic accidents. The left elbow was more commonly affected as seen in 16 patients and 3 patients had a pulseless hand, which was viable. The most common fracture displacement seen was posteromedial as seen in 24 patients. Three cases of ulnar nerve injury were encountered in this group. Tenting of the ulnar nerve was seen in 2 patients while 1 patient had a constriction of the cubital tunnel, which required an immediate reexploration. Only 2 patients in this group had minor limitation of function.

Both groups A and B were comparable in terms of the parameters evaluated and there was no statistical significant difference between them. The only difference was the fact that 3 of the patients in group B had injury to the ulnar nerve, which required intervention. Hence from the evaluation from both clinical and radiological parameters the 2 groups were quite comparable except for the ulnar nerve injuries encountered in group B.

Various treatment modalities are available for the management of supracondylar fractures of the humerus, each associated with its own set of complications. The different treatment options available for management are conservative management with closed manipulative reduction and application of an above elbow cast and also various traction modalities can be applied, but the drawback is the fact that they are often associated with a higher complication rate. In this scenario, the most favourable treatment option appears to be closed manipulative reduction of the fracture followed by K wire fixation under fluoroscopic guidance, which are generally associated with good outcomes as widely reported in literature. In terms of K wire fixation, the two constructs available are the lateral and the cross pinning technique and it has been a debate as to which construct is the superior one as pertaining to fracture stability and functional outcomes.

In Lee et al cadaveric study of these fractures they stated that the cross pinning construct provides greater rigidity and stability as compared to the lateral pinning technique (Zionts et al., 1994; Skaggs et al., 2001). This was based on parameters such as the pattern of pinning as well as the number of pins used in the procedure. A greater strength was seen if the pins were placed in a divergent fashion due to the interaction of the pins with each other providing greater stability of the fracture. In a study by bloom et al stated that both pin constructs were found to be equally stable. The cross pinning technique has found to be associated with a higher risk of injury to the ulnar nerve as reported by various authors in literature (Rasool, 1998; Zaltz et al., 1996; Royce et al., 1991). In a study by Arino et al of 1171 cases of supracondylar fractures treated by the cross pinning technique, they found out that 40 of the patients has an iatrogenic injury to the ulnar nerve which spontaneously recovered in most of the patients with a few patients having permanent injuries (Wind et al., 2002; Brauer et al., 2007; Skaggs et al., 2004). Rasool at all observed that open exploration of the ulnar nerve in case of injuries showed that the mode of injury was direct penetration of the nerve by the pins as well as constriction of the cubital tunnel (Rasool, 1998).
CONCLUSIONS

Through this study, we observed that there was no statistically significant difference between the 2 groups in terms of functional and radiological evaluation, with the only exception being the risk of ulnar injury seen in the cross pinning technique group. Hence the lateral pinning method gives the same stability and functional outcome as the cross pinning technique and avoids iatrogenic injury to the ulnar nerve and is safer to use.

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