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Comparison of cross pin Vs lateral pin fixation in displaced supracondylar fracture humerus in children

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Abstract
Background: Supracondylar fracture of the humerus are the most common elbow fractures in children most commonly seen in the first decade of life. Most common modality of treatment is closed reduction and percutaneous pinning using k-wires. Two crossed pins [one lateral and one medial] or two lateral pins can be used after fracture reduction.
Objective: To compare the two modalities of treatment in gartland type 2 and gartland type 3 fracture humerus in children.
Materials and method: This was a retrospective study done in K.D. medical college, Mathura and M.G.M. Medical College, Indore between feb 2018 to feb 2019.
Results: Out of the 70 patients, 52 (60.9%) were treated with a medial lateral cross pin and 18(39.1%) were fixed with two lateral parallel pins. The average age of the patients who were fixed with the medial lateral cross pin was 6.5± SD 2.5 years and that of those treated with the lateral two parallel pins was 7.5± SD 3.0 years. 21 (30%) patients had type II and 49 (70%) had type III fractures.
Conclusion: In our study, crossed pin configuration was found to be a superior method of fixation as it gave more stability.

Keywords: supracondylar fracture (SCH), crossed pin, lateral pin, gunstock deformity

Introduction

SCH fractures are the most common elbow fractures in children [1, 2]. The peak age range is 5 to 6 years [3]. They can be classified as flexion type or extension type, depending on the displacement of distal fragment. Extension type is the most common type and account for 97% to 99% of SCH fractures [4] which are usually caused by fall on the outstretched hand with elbow in full extension [5]. The displaced supracondylar fractures were treated by either crossed or parallel lateral k-wires followed by above elbow POP slab application. Some of the known complications of pinning are iatrogenic injury to ulnar-nerve [6], Varus [gunstock] deformity, instability and redisplacement. Gartland type 3 fractures who were treated with cross pin versus lateral pin, crossed pinning was found to be biomechanically more stable [7].

Material and Methods

This is a retrospective study which was conducted in the Orthopaedic Department of K.D. Medical College Mathura and M.G.M. Medical College, Indore. The variables included were age, gender, crossed pin versus lateral pin, and the affected side. The displaced extension type supracondylar fractures were treated by closed reduction and percutaneous pinning.

The exclusion criteriae were open fractures, fractures that required open reduction, fractures with neurovascular compromise and the presence of any concomitant fractures in the ipsilateral limb. Hospital records were reviewed of the study cohort for details which included pre-operative clinical examinations, operative note, postoperative evaluation, duration of the immobilization and the time of the pin removal. A total of 70 children were included in the study, consisting of 54 boys and 16 girls. Their mean age was 6.8 years; 44 were right sided and 26 were left sided. There were 22 Gartland's type II fractures and 48 Gartland's type III fractures. All the children underwent closed reduction and percutaneous pinning. The k-wire diameter was selected according to the age of the child, which was usually 2mm for the younger children and 2.8mm for the older children. The pin configuration was based on the testing post reduction and the fracture stability intraoperatively, with the image intensifier and considering the severity of the elbow swelling. -While placing the medial pins, we followed the flexion-extension cross pinning technique which was described by Eidelman *et al*. [8] The pin ends were bent outside the skin, and an above elbow POP slab was applied, with 40 to 60 degree of elbow flexion and neutral forearm rotation. All the children were discharged on the post-operative day three and were again reviewed 1 week after the surgery, by checking their orthogonal plain radiographs. If these were acceptable, the child was seen again after 3 weeks when the cast was removed and the check-up X-rays were taken. Whenever an acceptable healing was confirmed, the pins were removed at four weeks in the OPD and motion was encouraged. Physiotherapy was rarely indicated. The follow-up was continued until the full range of the motion was regained. The average follow up period was 6.4 months. The clinical and radiological assessments were analyzed at the final visit. The clinical assessment included the range of motion, the carrying angle, neurological and vascular examination and return to the full function. A radiological assessment was made by comparing the Baumann's angle in the initial post-operative and in the final

follow-up radiographs. The analysis was done by using descriptive statistics and the testing of the hypothesis. The Chi-square test was used to examine the association between the different variables. A p-value of < 0.05 (two-tailed) was used to establish the statistical significance.

Results

Out of the 70 patients, 52 (74.28%) were treated with a medial lateral cross pin and 18(25.71%) were fixed with two lateral parallel pins. The average age of the patients who were fixed with the medial lateral cross pin was 6.5± SD 2.5 years and that of those treated with the lateral two parallel pins was 7.5± SD 3.0 years. 21 (30%) patients had type II and 49 (70%) had type III fractures.

Table 1: Genderwise distribution of the patients

Sex	Number	Percentage
Male	54	77.14 %
Female	16	22.86 %

Table 2: According to Side involved

Side	Number	Percentage
Right	44	62.85 %
Left	26	37.15 %

Table 3: Distribution of patients according to type of fracture

Type of fracture	Number	Percentage
Extension type	66	94.28 %
Flexion type	4	5.72 %

Gartland type		
Type 2	22	31.42 %
Type 3	48	68.57 %

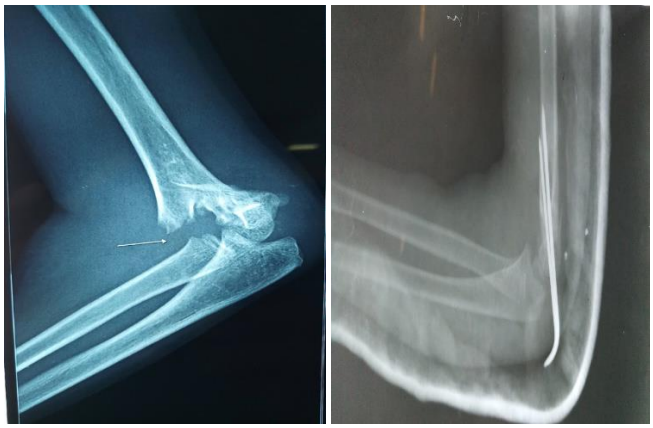
Table 4: According to method of fixation

Approach	Number	Percentage
Cross pinning	52	74.28 %
Lateral pinning	18	25.72 %

Table 5: Distribution according to various complications

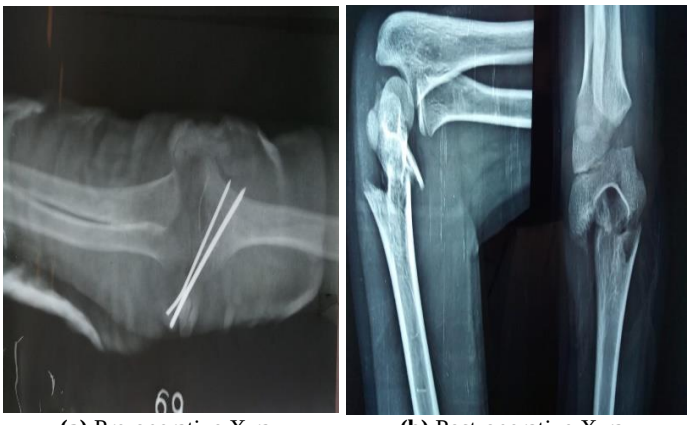
Complications	Number	Percentage
Ulnar nerve injury	6	8.57 %
Radial nerve injury	2	2.85 %
Varus deformity	4	5.71 %
Pin tract infection	10	14.28 %
Stiffness	25	35.71 %

Case 1.



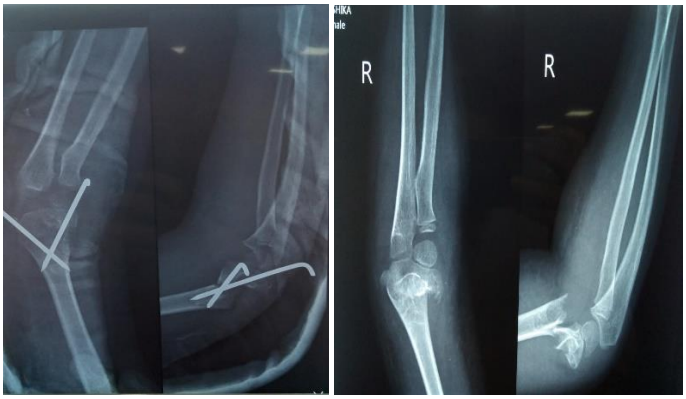
(a) Pre-operative x ray **(b)** Post-operative X ray

Case 2



(a) Pre-operative X ray **(b)** Post-operative X-ray

Case 3.



(a) Pre-operative X-ray **(b)** Pre-operative X-ray

Fig 1: The average immobilisation time in the present study was 3.6 +1.04 (3–6) weeks

Discussion

The success of the treatment of displaced supracondylar fractures of the humerus in children depends on good reduction, maintenance of the reduction until fracture healing with avoidance of complications.

The method of pin fixation is always controversial. It involves the use of two lateral pins which are placed in either a parallel or a divergent pattern. The latter is more biomechanically stable and therefore it is more popular, with a minimal risk of ulnar nerve injury [7].

Some of the synthetic paediatric bone models have suggested that lateral pin fixation is not stable enough against torsional forces [8], and that an additional medial pin must be added whenever necessary, to control rotational instability [7]. Zoints *et al*. showed that the torque which was required to produce 10% rotation was 40% less for two lateral pins than for a two cross pin [7].

Rotational stability was better in gartland type 2 fractures, because of the intact bone or the periosteum, posteriorly. The type III fractures developed rotational instability and the cubitus varus deformity due to tilting. The posterior displacement, coronal tilt and the horizontal rotation of the distal fragment were evaluated radiologically to overcome the cubitus varus deformity.

In our study on a total number of 70 cases, a cross pin was fixed in 52 cases and a lateral pin was fixed in 18 cases. The mode of injury was mostly fall while playing. There were 4 cases (5.71%) of pin tract infection in lateral pinning and 6 cases (8.57%) in cross pinning which were tackled with antibiotics. The pin tract infection was superficial, may be because of poor hygiene and scratching due to post op irritability, which was treated adequately with oral antibiotics and it was resolved completely. So, it was not a problem.

2 cases were reported with radial nerve injury whereas ulnar nerve injury occurred in 6 patients out of 70. Mild cubitus varus deformity (Baumann's angle 5 to 8 degree) was found in 4 cases (5.71%) in cross pinning and in 8 cases (11.42%) in lateral pinning. In cases of severely swollen elbow, we preferred to make a small incision over the medial epicondyle to explore the ulnar nerve, to avoid injury to it.

In lateral two parallel pin fixation, the occurrence of intraoperative instability and redisplacement may not allow the full extension of the elbow. Mild cubitus varus deformities are more and not adequate enough for intraoperative stability for torsional forces. The lateral pins are more close to the epiphysis of the distal humerus and they may disturb the growth plate and may cause mild cubitus varus deformity.

To avoid iatrogenic ulnar nerve damage while inserting the medial pin, a relative extension of the elbow at a maximum of 60 degrees of flexion was done after inserting the lateral pin.

The choice of the pin configuration was based on the intraoperative stability and the severity of the elbow swelling. In the current concept of Bloom *et al*, they reported that three lateral pins were biomechanically equivalent to two cross pins; but that the cross pins provided more stable fixation than the two lateral pins.

Conclusion

In our study, it was found that there was no significant difference in patient outcomes in between cross pins and lateral pin entry. However, the incidence of iatrogenic injury to ulnar nerve was 4.3 times higher in cross pinning compared to lateral pinning.

We recommend two pins in gartland type 2 fractures and 3 pins in gartland type 3.Medial pin can be added if fracture is rotationally unstable after inserting lateral pins. Cross pinning is advised in gartland type 3 as it lacks posterior wall/periosteum

support. When cross pinning is done, lateral pin should be inserted first and then medial pin is inserted after extending the elbow. Bigger the diameter of the pin (2mm to 2.8mm preferable) more rigid is the fixation.

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