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A study to evaluate treatment outcome of conservative management for type IIA supracondylar fractures and operative treatment for type IIB supracondylar fracture of humerus

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Abstract---Background: Supracondylar Humerus fracture is the most common fracture seen in children of 3-12 years' age group. Fracture is divided into 3 types by Gartlands classification. Type I is undisplaced, Type II is displaced but with the posterior cortex being intact, maybe angulated or rotated, Type III is complete displacement with distal fragment going posteromedial or posterolateral. Objective: To study functional outcome of type IIA & IIB supracondylar fracture of humerus at 6 months by Mayo Elbow Performance score. Materials and Methods: The Present Prospective study was done by the Department of orthopedics at JSS Medical College and Hospital from October 2018 to march 2020. A total of 20 Study subjects who met the inclusion criteria were included in the study. All the 20 Patients with type IIA and IIB supracondylar fracture of humerus visiting orthopedic department of JSS hospital, Mysore were included in the

study. Type IIA fractures were treated conservatively with reduction and above elbow cast application under general anesthesia, type IIB were treated operatively with percutaneous cross K-wire fixation. Results: Functional outcome of type IIA and IIB supracondylar fracture humerus at 6 months by Mayo Elbow Performance Score was found to be excellent hence all patients were pain free, had 0-100 degree or more range of motion, no instability and was able to carry out daily functional requirements without hindrance. Conclusion: All type IIA fractures can be managed conservatively without risk of loss of reduction or need for another operative procedure, also percutaneous cross K-wiring for type IIB fractures gives excellent outcome.

Keywords---Children, Fracture, Suprachondylar, K Wire, Conservative, Mayo Elbow.

Introduction

Supracondylar fractures of the humerus being the most frequent fractures affecting the pediatric elbow, most commonly occur in children aged between five and seven years ¹, their correct management is imperative because they can lead to catastrophic long term complications. Supracondylar fractures of the humerus are regarded as the second most common type of fracture in children according to many reputed studies² and also as the most common fracture as per other set of studies. ³ Treatment of these fractures has substantially changed over the past decade with the advent of modern techniques, leading to decreased rates of malunion and compartment syndrome. Despite all the progress made in the field, fractures of the child's elbow can still be challenging to treat. A thorough understanding of the anatomy and adherence to surgical principles, which are at patient's best interest, we can expect better outcomes than before. However, some aspects of treatment still remain controversial till date.

Age is a key factor in the incidence of supracondylar fractures. This is a fracture that occurs more frequently in skeletally immature children than adults. The supracondylar region consists of a weak, thin bone located in the distal humerus. This area is bordered posteriorly by olecranon fossa, anteriorly by coronoid fossa and on both sides by respective supracondylar ridges. The medial and lateral supracondylar ridges end into respective condyles and epicondyles. The trochlea is normally tilted 4° valgus in males and 8° valgus in females (carrying angle). The trochlea is also 3-8° externally rotated, resulting in external rotation of the arm when is flexed to 90°. ^{4,5}

Supracondylar Humerus fracture is the most common fracture seen in children of 3-12 years' age group. Fracture is divided into 3 types by Gartlands classification. Type I is undisplaced, Type II is displaced but with the posterior cortex being intact, maybe angulated or rotated, Type III is complete displacement with distal fragment going posteromedially or posterolaterally. Modified Gartlands classification introduced by Wilkins, sub classified type II supracondylar fracture humerus into type IIA and IIB. Type IIA has intact posterior hinge of humerus

without angulation of the fragment and with Baumann's angle (BA) 5 degrees, LCHA and SCA >18 degrees from uninjured elbow.^{6,7,8}

There is agreement for the conservative treatment of Type I fractures and operative management for type III fractures. The right treatment for type II fractures is controversial and there is no unanimous agreement. Hadlow did a study and makes the point that if all type II fractures are operated, close to 30 percent would have undergone unnecessary operative procedure and also close to 30 percent of patients who underwent conservative treatment would lose reduction and need delayed operative fixation. Hence it proves not all type II fractures can be treated conservatively, and more studies are required to decide which patient benefits with what treatment.^{7,8}

In a study done by Ariyawatkul et al, type IIA patients with BA less than 5 degrees from uninjured side and LCHA or SCA difference from the uninjured side less than 18°, after conservative management showed statistically significant improvement in BA, SCA and LCHA at 12 weeks' follow-up radiograph, thus operative management was proved to be inessential. In the case of type 2B fractures, fixation was advised in all patients because of the unstable reduction from loss of BA, LCHA, and SCA. Ariyawatkul et al. didn't record functional outcome post treatment and the follow up was only for 3 months. Since there is no agreement regarding the treatment for type II fractures, this study would help to throw more light in evaluation of radiographic and functional outcome in management of modified Gartland's type IIA and type IIB supracondylar humerus fractures in children in our population.⁹

Objective

To study functional outcome of type IIA & IIB supracondylar fracture of humerus at 6 months by Mayo Elbow Performance score.

Materials and Methods

The Present Prospective study was done by the Department of orthopedics at JSS Medical College and Hospital from October 2018 to march 2020. A total of 20 Study subjects who met the inclusion criteria were included in the study. All the 20: Patients with type IIA and IIB supracondylar fracture of humerus visiting orthopedic department of JSS hospital, Mysore were included in the study.

Inclusion criteria: • All closed type IIA and IIB modified Gartlands supracondylar humerus fractures in children between 3-12 years. • Patients with normal opposite elbow.

Exclusion criteria: • Children with bilateral supracondylar humerus fractures • Open supracondylar humerus fracture. • Supracondylar humerus fracture with neurovascular injury. • Children with skeletal dysplasias. • Children with flexion type of supracondylar humerus fracture

Patients were divided into 2 groups- the first group (type IIA) consisted of patients with Baumann angle (BA) differing from the uninjured side by 16 less than 5°, LCHA and SCA differing from uninjured side by 18 degrees; the second group

(type IIB) consisted of patients with BA difference greater than or equal to 5° from uninjured side and LCHA and SCA more than 18 degrees from uninjured side. Type IIA fractures were treated conservatively with reduction and above elbow cast application under general anesthesia, type IIB were treated operatively with percutaneous cross K-wire fixation.

K wires were removed at 6 weeks in OPD. • These angles were measured after injury, after reduction/k wire fixation, and in the 2weeks, 6weeks and 12 weeks follow up. • Functional outcome of the elbow joint was measured at 6 months according to Mayo Elbow Performance score.

Results

A total of 20 study subjects were enrolled and analyzed in the study.

Table 1
Social profile of the study subjects

		Frequency	Percentage
Age Group	3-5 Yrs.	5	25
	6-8 Yrs.	4	20
	9-12 Yrs.	11	55
Gender	Male	14	70
	Female	6	30

The study had majority of patients belonging to the age group of 9-12 year, 11(55%) the mean age was found to be 7.95. The current study had majority males 14(70%). The male: female ratio was found to be 2.3:1.

Table 2
Distribution of Study Subjects based on Gartland Classification and Bauman Angle

		Frequency	Percentage
Gartland classification	II A	10	50
	II B	10	50
BA difference from uninjured side (Mean $\pm$ SD)	Pre Op	5.90 $\pm$ 2.40	
	2 Weeks	3.85 $\pm$ 1.34	
	6 Weeks	2.75 $\pm$ 0.96	
	12 Weeks	2.40 $\pm$ 0.75	
	6 Months	2.35 $\pm$ 0.67	

The study had equal number of patients of Gartland type IIA and IIB. The study saw improvement in the mean Baumann angles. There is improvement seen in Baumann angle at preop and at 2 weeks ($p = <0.001$). There is significant improvement seen with the Baumann angle at pre op and at 6 months follow up which indicates progressive improvement. ($p = < 0.001$, $t = 6.51$)

Table 3
Association of Gartland classification and Baumann Angle

Gartland classification	BA difference from uninjured side		
	Mean and SD pre op	Mean and SD at 2 weeks follow up	Mean and SD at 6 month follow up
II A	3.70 ± 0.675	3.00 ± 0.667	2.30 ± 0.48
II B	8.10 ± 0.994	4.70 ± 1.33	2.40 ± 0.84
P Value	<0.001	0.003	0.749

The above table shows mean and standard deviation of Baumann's angle among the 2 groups of Gartland classification. There is significant difference seen in Baumann Angle between type IIA and IIB during preop and at 2 weeks follow up. But the 6 month follow up shows no difference between the 2 groups showing that the recovery in operative and conservative therapy to be same.

Table 4
Association of Gartland classification and Lateral Capitello humeral angle

Gartland classification	Lateral Capitello humeral angle difference from uninjured side		
	Mean and SD pre op	Mean and SD at 2 weeks follow up	Mean and SD at 6 month follow up
II A	15.50 ± 0.972	13.60 ± 1.174	9.60 ± 1.265
II B	20.60 ± 1.35	15.30 ± 2.003	10.0 ± 1.414
P Value	<0.001	0.033	0.514

The above table shows mean and standard deviation of LCHA among the 2 groups of Gartland classification. There is significant difference seen in LCHA between IIA and IIB during preop and at 2 weeks follow up. But the 6 month follow up shows no difference between the 2 groups showing that the recovery in operative and conservative therapy to be same.

Table 5
Association of Gartland classification and Shaft condylar angle

Gartland classification	Shaft condylar angle difference from uninjured side		
	Mean and SD pre op	Mean and SD at 2 weeks follow up	Mean and SD at 6 month follow up
II A	14.0 ± 1.49	11.20 ± 1.87	7.40 ± 1.71
II B	19.5 ± 1.17	14.20 ± 1.87	8.60 ± 1.64
P Value	<0.001	0.002	0.128

The above table shows mean and standard deviation of SCA among the 2 groups of Gartland classification. There is significant difference seen in SCA between IIA and IIB during preop and at 2 weeks follow up. But the 6 month follow up shows no difference between the 2 groups showing that the recovery in operative and conservative therapy to be same.

Discussion

SCHF is the most common fracture affecting the pediatric elbow between five and seven years, their adequate management is imperative because they can lead to catastrophic long term complications. The supracondylar fractures are divided using Gartland's classification into type I, II and III. Type II is further subdivided by Wilkins into Type IIA – stable, posterior cortex intact and no rotation, and type IIB – unstable and increased extension of distal fracture fragment.

The current study has 20 study participants who belong to type II and are further subdivided into type IIA and IIB. Type IIB consisted of patients with difference of BA more than or equal to 5° from uninjured side and LCHA and SCA more than 18 degrees from uninjured side. These patients were treated surgically by closed reduction and percutaneous cross K – wire fixation.

Similar to our study, Ariyawatkul et al suggested classifying fractures into type IIA and IIB to be useful in deciding the most ideal treatment modality. They described Gartland type IIA fractures with less than 18° losses of SCA or LCHA compared with the uninjured side could be treated conservatively. Whereas for type IIB fractures, operative management is important because of loss of BA, LCHA, and SCA.⁹

Hadlow and Parikh did two separate studies on type II SCHF treated conservatively by closed reduction and cast application and concluded that close to 30 percent of the cases lost reduction in subsequent follow ups. This validates our study and stresses on the fact all type II fractures cannot be treated conservatively and pretreatment rotation and extension of fracture fragment must be closely studied before deciding treatment modality.¹⁰

On the contrary The American Academy of Orthopedic Surgeons (AAOS) has developed Appropriate Use Criteria (AUC) for treatment of SCHF and suggested that all type II supracondylar humerus fractures, irrespective of initial angulation, displacement or rotation should undergo percutaneous pinning. However, our study shows excellent results in patients with type IIA SCHF treated conservatively, thus avoiding undue risk of anaesthetic and intra operative complications that can occur. The study by Fitzgibbons explained that not all type II fractures require pinning and that the degree of extension would determine the likelihood of failure of non-operative treatment. Hence in the current study it was found that patients with higher LCHA and SCA, which correlates with the degree of extension of distal fracture fragment, did well with cross K-wiring and for patients with lesser angles, conservative management was sufficient with nil failure rate.¹¹

The study by Balasubramanian et al, explained cross pinning is better for all supracondylar humerus fractures treated operatively compared to lateral pinning as it provides a more stable fixation and lesser chance for loss of reduction. Hence the current study uses cross K wire pinning for type IIB SCHF.¹² The study by Hillard T. Spencer found that there was no significant difference among treatment groups with respect to carrying angles, similar to the current study where both

conservative and surgical treatments patients had good range of motion with no instability or deformity on follow-up.¹³

The metanalysis by Gyoguevara Sol Queiroz Andrade Patriotaa showed better outcomes for patients with Gartland type IIB, III and IV when treated by percutaneous cross K-wire technique as compared to lateral pinning and mini open technique and found loss of reduction was most common with lateral pinning and iatrogenic ulnar nerve injury was most common with cross pinning. In our study all type IIB fractures were treated using cross K wire technique and no patients had loss of reduction or iatrogenic ulnar nerve injury.¹⁴

Skaggs et al.¹⁵ in his study showed better outcome of patients with type II fractures with operative treatment than closed reduction, while the current study subdivided type II into type IIA and IIB and operated on only type IIB fractures which showed good results. There are controversies in management of type II SCHF with extension of distal fracture fragment. Most studies agree operative management with closed reduction and percutaneous K-wire pinning is better than conservative management. To do operative management with percutaneous K-wire pinning, Baumann's angle on AP radiograph is a good indicator. Paediatric fractures remodels very well, but only 20% of growth happens in distal end of humerus, causing slower remodelling. Hyperextension of the distal fracture fragment has been shown to predict failure of conservative management. Greater the degree of distal fracture fragment extension, higher is the risk of failure of cast treatment. Hence in our study such patients got included in type IIB due to increased difference of SCA and LCHA compared to uninjured side due to hyperextension of distal fracture fragment, hence operative management was done. Another advantage of percutaneous K-wire fixation includes avoiding hyper flexion while reducing and casting the patient. Other articles have showed; hyper flexion decreases the vascularity within the brachial artery. In our study we subdivided type II fractures into type IIA and IIB and treated only type IIA fractures with closed reduction and above elbow cast application.

Hence proper patient selection for type II supracondylar fractures is imperative before going ahead with conservative or operative management. As part of our secondary objective Mayo elbow score was evaluated for all patients at 6 months follow up to determine the functional outcome. The Mayo elbow score in the study showed that all the patients had excellent recovery as all scores were in the range of 90-100. There were 25% of patients who had a score of 90 with a mean of 92.05 ± 1.79 .

Hence all patients were pain free, could perform their activities, had no complaints of instability and could flex their elbow above 100 degrees. There were no studies that documented functional outcome of patients after conservative and operative management of type II fractures like our study, however a study done by Nirav S Patel et al. observed that closed reduction and percutaneous cross pinning or lateral pinning for Gartlands type III SCHF gave excellent outcome based on MEPS irrespective of the technique.¹⁶

Conclusion

Conservative management with closed reduction and above elbow cast application for type IIA SCHF's and operative management with percutaneous cross K-wiring for type IIB SCHF's have good radiological outcome in 6 months follow up which is comparable to pretreatment values with respect to BA, LCHA and SCA. No complications were documented peri-operatively and at 6 months follow up like iatrogenic neurovascular injury, pin tract infections or malunion which proves adequate patient selection and technique will give good results. Functional outcome of type IIA and IIB supracondylar fracture humerus at 6 months by Mayo Elbow Performance Score was found to be excellent hence all patients were pain free, had 0-100 degree or more range of motion, no instability and was able to carry out daily functional requirements without hindrance. Thereby, concluding all type IIA fractures can be managed conservatively without risk of loss of reduction or need for another operative procedure, also percutaneous cross K-wiring for type IIB fractures gives excellent outcome.

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