SUPRACONDYLAR FRACTURE OF HUMERUS; RADIOLOGICAL ASSESSMENT OF CLOSED REDUCTION BY BAUMANN ANGLE

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ABSTRACT: Objectives: To assess closed reduction by Baumann angle in supracondylar fractures humerus treated by closed reduction and percutaneous pinning. **Material and Methods:** This prospective study of 50 patients who presented with displaced supracondylar fracture of humerus in children between ages 1-12 years were admitted to Orthopedic and Trauma unit of Hayatabad Medical Complex Peshawar over period from January 2008 to July 2009. Closed reduction and percutaneous pinning were performed under general anesthesia and post-operative reduction was assessed by Baumann angle. All patients were followed for one year. **Results:** Mean age of the patients was 7.02 years ± 2.25 SD. Loss of Baumann angle in injured side was range from 2^{o} to 8^{o}. Loss of carrying angle in injured side was range from 3^{o} to 9^{o}. When Baumann angle and carrying angle of both sides were compared the mean Baumann angle loss and carrying angle loss were 5.360 ± 2.22 SD and 4.320 ± 1.52 SD respectively. Using Flynn's criteria 36 (72%) patients out of 50 patients with carrying-angle loss considered to be excellent results and 14(28%) good results. Neither of the patient developed cubitus varus deformit y after one year of follow-up. **Conclusions:** Baumann angle of the humerus is a simple and reliable measurement of closed reduction that can be used to predict final carrying angle in supracondylar humeral fractures in children.

Key words: Supracondylar fractures, percutaneous pinning, Baumann angle.

INTRODUCTION

Supracondylar fractures of the distal humerus are the second commonest fracture in children[1]; these fractures are known to have a high incidence of complications. The most commonly reported is the unsightly deformity of cubitus varus. An accurate and reliable assessment method to prevent this deformity from happening is needed[2].

Clinical assessment of carrying angle after fracture reduction is difficult and inaccurate because of swelling, bulky dressing and plaster. Most people rely on radiographic methods.
Three methods are commonly used;

1) Metaphyseal-diaphyseal angle.
2) Humeral – ulnar angle.
3) Baumann's angle.

Both methods one and two have their limitations clinically and Baumann angle remain a good indicator in an assessment of post reduction alignment[2].

The Baumann angle is often used as a guide to the adequacy of reduction. This is based on the assumption that the Baumann angle has a constant relationship to the carrying angle in a displaced fracture[3]. Baumann angle is not equal to the carrying angle of the elbow in older children. This is consistent angle when both sides are compared[4].

Williamson et al[5] found that an average of 72 degrees (range 64 to 81) could be considered a normal Baumann angle and as long as the angle did not exceed 81°, cubitus varus not occurs.

There was no significant difference between the Baumann angle after reduction and that measured at follow-up; and it is suggested that this angle after reduction can be reliably used to predict accurately the final carrying angle[6]. The present study aims to assess closed reduction by Baumann angle may be used to predict the final carrying angle so that cubitus varus deformity can be prevented.

MATERIAL AND METHODS

This prospective study was conducted from January 2008 to July 2009 with follow up of one year in orthopedic and trauma department of Postgraduate Medical Institute, Hayatabad Medical Complex Peshawar.

The inclusion criteria were children of 1-12 years age and extension type displaced supracondylar fracture of humerus. The exclusion criteria were undisplaced supracondylar fractures and open fracture or fracture with neurovascular compromise.

All patients fulfilling our inclusion criteria was admitted and recruited in our study. Back slab was applied, neurovascular status were analyzed. Informed consent for the study and surgery was taken. Before reduction two standard antero-posterior and lateral X-rays were taken on the injured and the normal elbow and fracture configuration assessed.

Under general anesthesia closed manipulative reduction was performed and the reduction was confirmed with the image intensifier by Baumann angle. When reduction was acceptable, fractures were fixed either with two crossed pins or two lateral pins.

The post reduction X-rays of the affected elbow were taken and adequacy of reduction was assessed by Bauman angle. Patients were discharged on the first or second postoperative day. All the patients were followed at the out-patient department with at interval of 2 weeks, 4 weeks, 12 week, 24 weeks and one year. Back slab removed after 2 weeks and pins were removed at 4th week.

Loss of Baumann angle and loss of carrying angle were assessed by comparing the injured side with uninjured side. Loss of carrying angle was also assessed by Flynn criteria[7]. (Table I)

Table-I. Flynn criteria for reduction assessment

	Loss of carrying angle (in degrees)	Loss of motion (in degrees)
Excellent	0-5	0-5
Good	6-10	6-10
Fair	11-15	11-15
Poor	>15	>15

RESULTS

A total 50 patients were treated with closed reduction and percutaneous pinning. The mean age was 7.02 years ± 2.25 SD with ranged from 1 to12 years. There were 33(66%) male and 17(34%) female. Male to female ratio was 1.9:1. Left side 38(76%) was the most dominant site of fracture as compared to the right side 12 (24%).

The Baumann angle was ranged from 66° to 84° with average of 78° in the injured side while Baumann angle in the uninjured side was 64° to 80° with average of 72°. Loss of Baumann angle in injured side was range from 2° to 8°.When Baumann angle of both sides were compared the mean Baumann angle loss was 5.360 ± 2.22 SD.

The carrying angle was ranged from 8° to 14° with average of 10° in the injured arm while carrying angle in the uninjured arm was 11° to 18° with average of 14°. Loss of carrying angle in injured side was range from 3° to 9°.When carrying angle of both sides was compared the mean Carrying angle loss was 4.32° ± 1.52 SD. At the final follow-up, while using Flynn's criteria 36 (72%) patients out of 50 patients with carrying-angle loss considered to be excellent results and 14 (28%) good results. Neither of the patient have a fair and poor results. Also none of the patients developed cubitus

varus deformity after one year of follow-up.

DISCUSSION

In our study, at final follow up mean Baumann angle loss was 5.36 ± 2.22 SD and, there was no significant difference between the Baumann angle after reduction and that measured at followup; and it is suggested that this angle after reduction can be reliably used to predict accurately the final carrying angle. Mean carrying angle loss was 4.32±1.52 SD, when carrying angle was analyzed according to Flynn's criteria, we found 72% excellent and 28% good results and none of patient have fair or poor results and none of the patient developed cubitus varus.

The outcome of supracondylar humeral fractures in the pediatric population has been commonly assessed by clinical and radiographic parameters, including the Baumann angle of the humerus. Baumann angle of the humerus is a highly reliable measurement, with excellent inter-observer and intra-observer reliability values (r=0.78 and r=0.80, respectively). In most instances, measurements of the Baumann angle of the humerus (by different observers, as well as by a single observer on multiple occasions) were within 7° of each other. Therefore, a difference of up to 7° in the measurement of the Baumann angle (by a single or multiple observers) should be considered to be within the normal error of the measurement[8].

Aronson et al [9] evaluated the quality of reduction by measuring the Baumann angle after reduction; they accepted the reduction if the Baumann angle of the fractured extremity was within 4 degrees of that of the normal extremity. Keenan and Clegg, after examining the radiographs of 577 pediatric elbows, performed an analysis of variance that suggested that neither age, gender, nor side measured affected the Baumann angle of the humerus[10]. Camp et al. showed that the Baumann angle of the humerus varies 6° for every 10° of humeral rotation on the anteroposterior radiograph of the elbow[11].

CONCLUSIONS

Baumann angle of the humerus is a simple and reliable measurement that can be used for the assessment of post-operative closed reduction. Baumann angle of the humerus is used on as a predictor to determine the carrying angle.

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In the truest sense,
freedom cannot be bestowed;
it must be achieved.

Franklin D. Roosevelt (1882 - 1945)