

Relevance of baumann's angle with complications after management of supracondylar fractures of humerus in children

Vikas^{1,*}, Jaspal Singh², Partap Singh Verka³

¹Junior Resident, ^{2,3}Associate Professor, Dept. of Orthopaedics, Govt. Medical College, Amritsar

***Corresponding Author:**

Email: vicky.gandhi8419@gmail.com

Abstract

A prospective study of 30 patients with supracondylar fractures of humerus of both sexes and below 15 years of age managed by different ways i.e. close reduction with pop cast application, close reduction with kirschner wire fixations and open reduction with kirschner wire fixation with aim of finding relevance of Baumann's angle in assessing the malalignment of supracondylar humerus fracture, comparison the Baumann's angle after different ways of managing supracondylar fractures humerus in children and to find complications between different techniques. Patients were followed up over a period of 6 months, evaluated both clinically and radio logically. Result of study shows the negative correlation between the Baumann's angle and carrying angle. Baumann's angle at last follow up in CR/POP SPLINT group was 76.5 ± 2.121 (mean and standard deviation), In CRIF group was (74.4 ± 4.5) mean and standard deviation and in ORIF group was (76.6 ± 4.40) mean and standard deviation (p value 0.201) not significant, and in our study of 30 patients, 2 cases of pin tract infection observed in CRIF group (13%) and 3 cases of pin tract infections in ORIF group(23%) (chi square 0.905, p value 0.636 not significant), no case of anterior ledge formation observed in CR/POP SPLINT group and CRIF group but one case in ORIF group(7.6%) chi square 1.35, p value 0.508(non significant), no case of cubitus varus observed in CR/POP SPLINT group, 2 cases cubitus varus observed in CRIF group(13.33%) and 2 cases in ORIF group(15.38%) chi square 0.355, p value 0.837(not significant). So the result of our study showed negative correlation between the Baumann's angle with carrying angle and no significant difference on Baumann's angle and in complications at last follow up by different ways of treatment in supracondylar humerus fractures in children.

Keywords: Baumann's angle, CRIF, ORIF, CR/POP SPLINT, Cubitus varus

Introduction

The supracondylar fracture of humerus is very common fracture seen above the elbow in children.^(1,2) The peak age of occurrence of supracondylar fracture of humerus is 5-7 years^(3,4) and the boys have high frequency of this fracture than in girls predominating in left⁴ arm in majority of studies. The most common nerve involved in supracondylar fracture of humerus is anterior interosseous nerve^(5,6,7,8) (branch of median nerve) as more common displacement is posterolateral extension type, radial nerve involvement is commonly seen in posteromedial extension type with ulnar nerve commonly involved in flexion type fracture pattern. The change in displacement pattern of fractures changes the nerve involvement pattern. In this study we discuss the relationship of Baumann's angle with carrying angle and the comparison of Baumann's angle and complications between different ways of managing supracondylar fractures of humerus in children.

By definition Supracondylar fracture of the humerus is a fracture in which the fracture line crosses the supracondylar area of the distal humerus just above the condyles and fracture line may be transverse, jagged (zigzag) or may run across obliquely upwards and backwards. Almost all the cases of supracondylar fracture of humerus are caused by trauma rather than abuse.

Materials

A prospective study of thirty cases of supracondylar fracture of the humerus (extension type) in children under 15 years of age, who were admitted in emergency/OPD of Orthopaedics department of Guru Nanak Dev Hospital / Govt. Medical college, Amritsar. The approval of institutional ethical committee was taken and patient were included in the study after taking informed consent from the parents/guardian. Classified according to modified gartland criteria into type I to IV. All cases of open fractures, complex elbow fractures, dislocation of elbow, children above 15 years were excluded from the study. Patients were followed up for 6 months and various clinical and radiological parameters were recorded.

Aim

To study the relevance of Baumann's angle in assessing the malalignment of supracondylar humerus fracture, comparison the Baumann's angle after different ways of managing supracondylar fractures humerus in children and to find out complications between different techniques.

Inclusion criteria: patients under 15 years of either sexes with closed supracondylar fractures of humerus (extension type).

Exclusion criteria: patients who were more than 15 years of age and having open fractures, flexion type fractures, elbow dislocations and complex elbow fractures were excluded from study.

Method of data collection: Immediately after admission, case history was taken in detail. Clinical examination was done. Any tight splintage was removed immediately. Blister if present was punctured and aseptic dressing was done with betadine if required. Otherwise temporary immobilization with crammer wire splint was done. X ray of the elbow AP/Lat. view was taken and any other associated injury was looked after. Patients were investigated to get fitness for anesthesia purpose. All the procedures were done under short duration general anesthesia.

Fracture were classified according to GARTLAND classification⁽⁹⁾ and managed accordingly.

Type 1: Undisplaced type fracture

Type 2: Displaced with an intact posterior cortex
2(a) extended but with no rotation abnormality or fragment translation.

2(b) extended but with rotation abnormality or fragment translation.

Type 3: Displaced with intact periosteal hinge

a. Posteromedial

b. Posterolateral

Type 4: Displaced with no contact

Management of extension type supracondylar fractures;

Type 1: Management of Type 1 supracondylar fracture was done with POP CAST for 3 to 4 week with elbow flexed in 90-100 degree and forearm held in neutral rotation. (Fig. 1-3)

X-Rays of patient treated with close reduction and pop splint



Fig. 1: Pre-op X-Ray

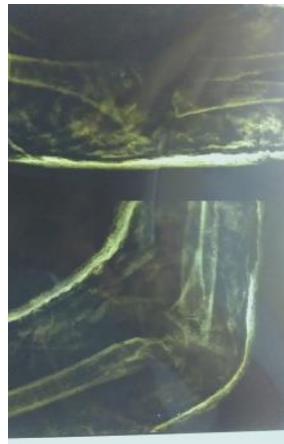


Fig. 2: X-Ray after reduction

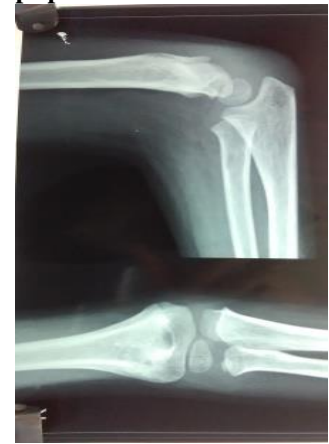


Fig. 3: X-Ray at union

Type 2: Management of type 2 supracondylar fracture was done with Closed Reduction and POP cast application. Patient with type 2 (A) fracture were successfully treated with closed reduction and splint. However patient with type 2 (B) fracture were managed with closed reduction and percutaneous K- wire fixation under C-ARM(Fig. 7-9).

Type 3: Management of type 3 supracondylar fracture were done with Closed reduction and POP cast or percutaneous pinning, in closed reduction procedure, 2 attempts were made in same sitting, if reduction is not satisfactory ORIF with Kirschner wire fixation were done. At conclusion of procedure the arm were splinted in 60 to 80 degree of flexion with radial pulse check. At 1st week post operatively, radiograph were taken to confirm maintenance of reduction. When reduction is satisfactory, same was continued. The kirschner wire s were removed in the office 3 to 4 week post operatively, and the arm were kept in sling for 1 to 2 weeks.

Type 4: Management of type 4 as they were unstable in both flexion and extension fracture is managed with ORIF with Kirschner wire fixation.(Fig. 4-6)

Post operative evaluation: patients were evaluated by clinical and radiological assessment. Exercises were started after removal of Kirschner wires.

Follow up: During follow up at 3 weeks, 6 weeks and last follow up elbow range of motion, carrying angle, Baumann's angle, radiological union were recorded.

X-Rays of patient treated with open reduction and Kirschner wire fixation



Fig. 4: Pre-op X-Ray



Fig. 5: X-Ray after reduction



Fig. 6: X-Ray at union

X-Rays of patient treated with close reduction and Kirschner wire fixation



Fig. 7: Pre-op X-Ray



Fig. 8: X-Ray after reduction



Fig. 9: X-Ray at union

Results

Shows the negative correlation between the Baumann's angle and carrying angle. Baumann's angle (Table 2) at last follow up in CR/POP SPLINT group was 76.5 ± 2.121 (mean and standard deviation), in CRIF group was (74.4 ± 4.5) mean and standard deviation and in ORIF group was (76.6 ± 4.40) mean and standard deviation (p value 0.201) not significant, and In our study of 30 patients (Table 1), 2 cases of pin tract infection observed in CRIF group (13%) and 3 cases of pin tract infections in ORIF group (23%) (chi square 0.905, p value 0.636 not significant), no case of anterior ledge formation observed in CR/POP SPLINT group and CRIF group but one case in ORIF group (7.6%) chi square 1.35, p value 0.508 (non significant), no case of cubitus varus observed in CR/POP SPLINT group, 2 cases cubitus varus observed in CRIF group (13.33%) and 2 cases in ORIF group (15.38%) chi square 0.355, p value 0.837 (not significant).

Table 1

Complications	Close Red/POP splint		CRIF Group		ORIF Group		CHI ²	P Value	Result	Total	
	No. of cases	%Age	No. of cases	%Age	No. of cases	%Age				-	-
Pin tract infection	0	0	2	13	3	23	0.905	0.636	Not Significant	5	17
Ledge formation	0	0	0	0	1	7.6	1.35	0.508	Not Significant	1	3
Cubitus varus	0	0	2	13.33	2	15.38	0.355	0.837	Not Significant	4	13

Table 2

Treatment Types Group	Mean Baumann's Angle	Standard Deviation
CR	76.5	2.121
CRIF	74.4	4.50
ORIF	76.61	4.40

Discussion

Supracondylar fracture of humerus are very common in children, with different ways of managing the fractures like close reduction/ pop splint, close reduction with kirschner wire fixation and open reduction with kirschner wire fixation.

In our study of 30 cases, 9 patients(30%) had Baumann's angle up-to 69-73 degrees, 16 patients(53%) had Baumann's angle up to 74-78 degrees, 5 patients(17%) had Baumann's angle up to 79-83 degrees at last follow-up. Average Baumann's angle in our study is degrees 75.5 at last follow up, similarly Gheldre AD, Bellan D (2010)⁽¹¹⁾ also reported in their series of 74 cases average Baumann's angle of 72 degrees in Gartland type II fracture and 73.8 degrees of Baumann's angle in Gartland type III fractures at last follow up which matches with our study.

Correlation between Baumann's Angle and Carrying Angle

Baumann's angle correlates well with the carrying angle and can be used as an indicator of the potential occurrence of cosmetic complications, in our study there is negative correlation with Baumann's angle and carrying angle similarly in (2013)⁽¹⁰⁾ Smajic N, Smajic J, Sadic S, Jasarevic M, Ahmetovic-Djug J, Hodzic R. observed negative correlation between Baumann's angle and carrying angle.

Effect of different ways of management on Baumann's Angle

In this study Baumann's angle at last follow up in CR/SPLINT group was 76.5±2.121 (mean and standard deviation), In CRIF group was (74.4±4.5) mean and standard deviation and in ORIF group was (76.6±4.40) mean and standard deviation (p value 0.201) which was insignificant, this result matched with the study of Yaokreh JB, Gicquel P, Schneider L, Stanchina C, Karger C, Saliba E, Ossenou O, Clavert JM in 2012⁽¹²⁾ which at last follow-up reported, mean Baumann's angle was 73.9±5.75° in CRIF group and 74.76±4.08° in ORIF group (non-significant: P = 0.5123, t test)

Complications

In our study of 30 patients, 2 cases of pin tract infection observed in CRIF group (13%) similar results reported in the study conducted by El-Adl W.A., El-Said M.A, Boghdady G.W, Ali A.-S.M⁽¹³⁾ in 2008 and 3 cases of pin tract infections in ORIF group(23%) similar results were observed by Shakir H, Malik F.A, Khalid

W⁽¹⁴⁾ in their study in 2010 (chi square 0.905, p value 0.636 not significant), no case of anterior ledge formation observed in CR/POP SPLINT group and CRIF group but one case was reported in ORIF group(7.6%) chi square 1.35, p value 0.508(non significant), no case of cubitus varus observed in CR/POP SPLINT group, 2 cases cubitus varus observed in CRIF group(13.33%) and 2 cases in ORIF group(15.38%) chi square 0.355, p value 0.837(not significant) Yaokreh et al.⁽¹²⁾ also reported no significant difference between cubitus varus complication between two group.

So in our study we found negative correlation between the Baumann's angle and carrying angle⁽¹⁰⁾ and no significant difference in Baumann's angle⁽¹¹⁾ and in complications^(12,13,14) by different ways of managing the fracture.

Conclusion

We conclude that there is negative co relationship of the Baumann's angle to the carrying angle. The measurement of this angle in a supracondylar fracture after reduction can be reliably used to predict the final carrying angle of the arm and there is no significant difference between Baumann's angle, postoperative complications like cubitus varus, pin track infection and anterior ledge formation between different ways of managing supracondylar fractures of humerus in children.

References

1. HOYER A. Treatment of supracondylar fracture of the humerus by skeletal traction in an abduction splint. *J Bone Joint Surg Am.* 1952 Jul 1;34(3):623-37.
2. Piggot J, Graham HK, McCoy GF. Supracondylar fractures of the humerus in children. Treatment by straight lateral traction. *Bone & Joint Journal.* 1986 Aug 1;68(4):577-83.
3. Henrikson B. Supracondylar fracture of the humerus in children. A late review of end-results with special reference to the cause of deformity, disability and complications. *Acta Chir Scand Suppl.* 1966;369:1-72.
4. Cheng JC, Lam TP and Maffuli N. Epidemiological features of supracondylar fractures of humerus in Chinese children. *J Pediatr Orthop B.* 2001;10(1):63-67
5. Cramer KE, Green NE, Devito DP. Incidence of anterior interosseous nerve palsy in supracondylar humerus fractures in children. *Journal of Pediatric Orthopaedics.* 1993 Jul 1;13(4):502-5.
6. Dormans JP, Squillante R, Sharf H. Acute neurovascular complications with supracondylar humerus fractures in children. *The Journal of hand surgery.* 1995 Jan 31;20(1):1-4.
7. McGraw JJ, Akbarnia BA, Hanel DP, Keppler L, Burdge RE. Neurological complications resulting from supracondylar fractures of the humerus in children. *Journal of Pediatric Orthopaedics.* 1986 Nov 1;6(6):647-50.
8. Ramachandran M, Birch R, Eastwood DM. Clinical outcome of nerve injuries associated with supracondylar fractures of the humerus in children. *Bone & Joint Journal.* 2006 Jan 1;88(1):90-4.
9. Hartigan, B. J., and L. S. Benson. "Myositis ossificans after a supracondylar fracture of the humerus in a

- child." *American journal of orthopedics (Belle Mead, NJ)* 30.2 (2001): 152-154
10. Smajic N, Smajic J, Sadic S, Jasarevic M, Ahmetovic-Djug J, Hodzic R. Correlation between Bauman's and carrying angle in children with supracondylar fracture of humerus. *Medical Archives*. 2013 May;67(3):195.
 11. Gheldere A, Bellan D. Outcome of Gartland type II and type III supracondylar fractures treated by Blount's technique. *Indian journal of orthopaedics*. 2010 Jan 1;44(1):89.
 12. Yaokreh JB, Gicquel P, Schneider L, Stanchina C, Karger C, Saliba E, Ossenou O, Clavert JM. Compared outcomes after percutaneous pinning versus open reduction in paediatric supracondylar elbow fractures. *Orthopaedics & Traumatology: Surgery & Research*. 2012 Oct 31;98(6):645-51.
 13. El-Adl W.A., El-Said M.A, Boghdady G.W, Ali A.-S.M. Results of treatment of displaced supracondylar humeral fractures in children by percutaneous lateral cross-wiring technique. 2008 Apr;3(1):1-7.
 14. Shakir H, Malik F.A, Khalid W. Displaced supracondylar fractures of humerus in children treated with open reduction and cross K-wire fixation. *JPMI*. 2010;24:301-6.