

Radiographic measurement of Lateral Capitellohumeral Angle and Baumann's Angle among Children

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ABSTRACT

Background: Baumann's angle and Lateral capitellohumeral angle measurements are essential to check the degree of reduction in supracondylar fracture of humerus in children. Although the normal values of the angles are available for other populations, there is lack of study in our population for these angles. The objective of the study was to find normal values of these angles in Nepalese children and to compare the findings with studies done elsewhere.

Methods: The study is a prospective observational study conducted at Department of Orthopedics and Trauma Surgery, Tribhuvan University Teaching Hospital. The study was conducted from July 2019 to June 2020. A total of 56 participants were included. Baumann's angle and Lateral Capitellohumeral Angle were measured on X-rays.

Results: The mean(\pm SD) Lateral Capitellohumeral angle in our study was $48.4^\circ(\pm 3.40)$ The mean(\pm SD) Baumann's angle was $71^\circ(\pm 3.20)$. There was no significant difference in Lateral Capitellohumeral angle and Baumann's angle between different genders, age groups and right or left elbow.

Conclusions: The measurements for elbow Baumann's and Lateral Capitellohumeral angles in our study were similar to other studies.

Keywords: Baumann's angle; elbow; lateral capitellohumeral angle; measurement; radiograph

INTRODUCTION

Elbow fractures are common in paediatric populations.^{1,2} Trauma to the child's elbow may result in bony, cartilaginous or soft tissue injury.³ Supracondylar fractures of humerus accounting for 60% among them.⁴ Baumann's angle (BA) and Lateral Capitellohumeral (LCH) angle are useful parameters to study in X-ray for checking degrees of reduction after manipulation of supracondylar fracture of humerus.⁴ There are studies for these angles in European, Indian and Tibetan population, but there are very few studies in Nepal. Since the findings of the studies done in other population may not be applicable in our population, the study was planned to measure these angle in our country.

METHODS

The study was conducted at OPD of Orthopedics department, ward, Trauma and Emergency room of Tribhuvan University Teaching Hospital, Institute of Medicine, Maharajgunj. The study was a prospective observational study. The study was conducted from

July 2019 to June 2020. Study was started after getting the ethical clearance from Institutional Review Committee(IRC), Institute Of Medicine. Informed consent was taken from the parents of the children involved in the study. The measurements were done on AP and lateral views of elbow on the injured side, in children aged between 3 and 13 years, when no fracture is seen in X-ray; and in the cases where contralateral elbow X-rays when taken in cases with elbow trauma, taken for comparison to differentiate between normal physes and fractures. The exclusion criteria were, history of previous fracture of distal humerus and congenital deformity around elbow joint. Sample size of 56 was calculated and consecutive sampling method was followed for recruiting the patients.

The data collection tool for the present study was an interview schedule that has been developed at the department of orthopedics in our hospital. The patient's name, address, age, sex, were all noted as per the proforma through direct interview of the parents of the patients. Examination was done with special references

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to measure LCHA and Baumann angle. Elbow X ray - True anteroposterior and True lateral views were taken from which LCHA and Baumann angle were measured with the help of software and recorded.

For measurement of Baumann's angle, a line was drawn along the longitudinal axis of the humeral shaft and a line along the capitellar physis on the True anteroposterior view of X-ray and the angle formed between these two lines were measured with the help of software. (Konica Minolta, Direct digitizer,S-7, version1.22) (Figure 1).

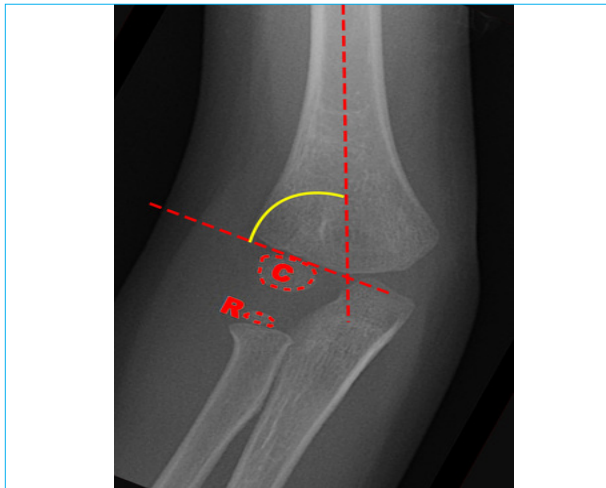


Figure 1. Baumann angle.

For LCH angle, a line was drawn along the anterior border of the distal humeral shaft (anterior humeral line, AHL) and a line along the capitellar physis on the True lateral view of X-ray and the angle formed between these two lines were measured with the help of software. (Konica Minolta, Direct digitizer,S-7, version1.22) (Figure 2).



Figure 2. LCH angle.

Data entry was done with Statistical Package for Social

Sciences (SPSS IBM) version 21.0 and data entry checks were done at regular intervals to ensure valid entries. Analysis of data was done with SPSS IBM version 21.0. Both univariate and bivariate analysis were done. Proportions were calculated for qualitative variables and mean with standard deviation were done for quantitative variables. Independent t test and chi square tests were applied. Significance of *p* value is taken as *p* < 0.05.

RESULTS

In the present study, a total of 56 patients were included. The study population included children aged between 3 -13 years. Among total 56 participants, 38(67.9%) were males and 18(32.1%) were females. The age of the study participants ranged from 3-13 years with mean (\pm SD) age of 6.9 (\pm 2.55) years. 33(58.9%) of the patients were in the age group 6-10 years and 18 patients (32.1 %) were in the age group of 3-5 years . 35(62.5%) right and 21(37.5%) left elbows were studied. The mean (\pm SD) of LCH angle among the study participants is 48.40 (\pm 3.40). The mean(\pm SD) of Baumann's angle among the study participants is 71.0(\pm 3.20). Mean of LCH angle among male and female children were 47(\pm 3.18) and 49(\pm 2.32) respectively. Minimum LCH was 41 and maximum was 56. Minimum and maximum Baumann's angles were 63 and 79 respectively. Mean (+/- SD) of Baumann's angle among male and female children was 70(\pm 3.73) and 72(\pm 1.68) respectively.(Figures 1-4). No statistically significant difference in Baumann's angle and LCH angle was found with respect to age, sex and laterality

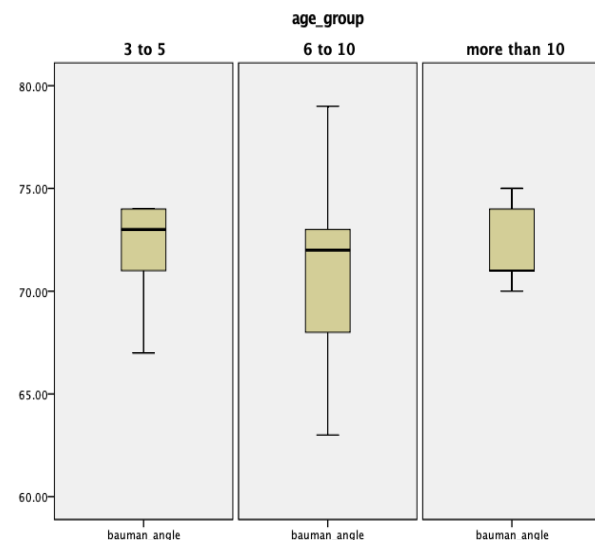


Figure 3. Distribution of Baumann's angle in different age groups.

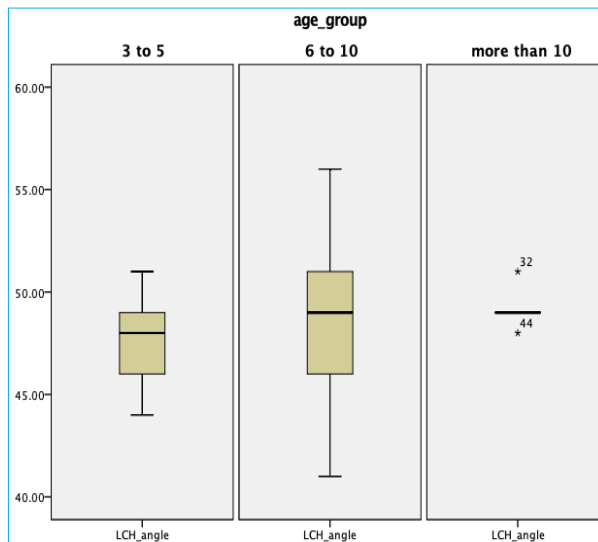


Figure 4. Distribution of LCH angles in different age groups.

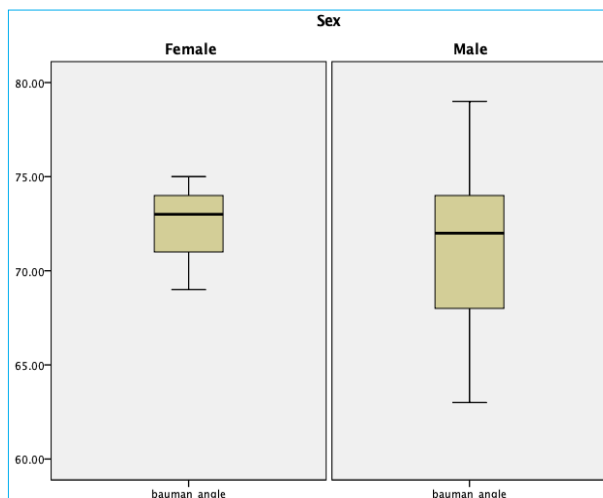


Figure 5. Baumann's angle in boys and girls.

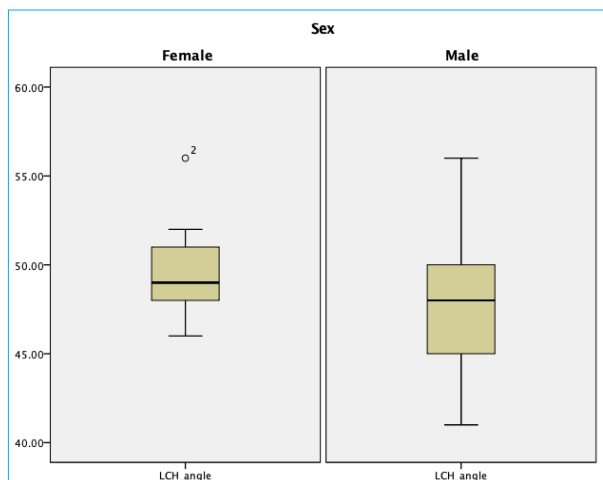


Figure 6. LCH angle in boys and girls.

DISCUSSION

In our study, the age group of the children included was between 3 -13 years with a mean (\pm SD) age was 6.9 (\pm 2.55) years. In a study by Awasthi B et al⁴ a total of 125 children belonging to age group 3-13 years of age were included. Similar age group were studied in a study by Seghal M et al⁵. Another study by Williamson et al.⁶ studied with the same age group. Thus, the age group of our study is matching the previous studies and the study findings can be compared.

In our study, the mean LCH angle among all the study participants was 48.4(\pm 3.4). Mean LCH angle among male and female children was 47(\pm 3.18) and 49(\pm 2.32) respectively. No statistical significant difference was found between the sex, age group and side of elbow.

Simanosky et al.⁷ in their study performed at Jerusalem, Israel found that mean value for a lateral capitello humeral angle in 142 children between the ages of 0 and 15 years was $41.6^\circ \pm 5.6^\circ$ (30° - 70°). In their study the values does not vary with age, side or sex.

A study conducted by Shank et al⁸ at Seattle on 71 elbow radiographs of childrens between the ages of 0 and 12 years, shows that in normal elbows, the mean Lateral capitellohumeral angle was $51^\circ \pm 6$. In their study the values did not vary with age, side or sex.

In a study by Awasthi B et al⁴ found that Mean \pm (SD) for lateral capitellohumeral angle in Indian children from 3 to 13 years of age was $49^\circ \pm 5.75^\circ$. Mean value for lateral capitellohumeral angle in males was $48^\circ \pm 5.50^\circ$ and females was $50^\circ \pm 6.27^\circ$. The difference in males and females is statistically insignificant. The value of this previous Indian study was as similar to our study.

In a study by Sehgal M et al⁵ on Tibetan children, mean lateral capitellohumeral angle in children from 3 to 13 years of age was $45.33^\circ \pm 3.97^\circ$. While the mean value for lateral capitellohumeral angle in males was $45.53^\circ \pm 3.92^\circ$, it was 44 ± 5.65 for females. The difference in males and females was statistically not significant.

Our values lie between the results of the previous western studies placing lateral capitellohumeral angle between 41° and 56° . The SD in our study is also almost the same as western literature. Our findings were similar to those done in Indian and Tibetan children. (Table 1)

Thus, the lateral capitellohumeral angle for Nepalese children was comparable to other children of western and Indian population. In other words, the mean values

of LCH angle is similar in Nepali children compared to children of other countries.

Table 1. Comparison of LCH angle findings of previous literature.

Present study	Awasthi B et al ⁴	Sehgal M et al ⁵	Simanosky et al ⁷	Shank et al ⁸
48.4° ±3.4°	49° ±5.75°	45.33° ±3.97°	41.6° ±5.6°	51° ± 6°

In the present study, the mean (SD) of Baumann's angle among all the study participants was 71(±3.2). Mean (SD) of Baumann's angle among male and female children was 70(±3.73) and 72(±1.68) respectively. No statistical significant difference was found between sex, age groups and side of elbow in the present study.

A study conducted by Shank et al⁸, at Seattle on 71 elbow radiographs of childrens between the ages of 0 and 12 years, shows that in normal elbows, the mean Baumann's angle was 71.5 ± 6°. While the mean value for Baumann's angle in males was 70 ± 6.73°, it was 73 ± 5.22° for females and mean value for Baumann's angle according to laterality was 72 ± 5.72° for left side and 71 ± 6.61° for right side. In their study the values does not vary with age, side or sex.

Williamson et al.⁶ at Melbourne,Australia, in their study conducted on 114 children aged 2-13 years, proposed a mean value of Baumann's angle was 72° with an SD of 4.

An Asian study conducted in this context in Hong Kong, China (Yeung SH et al)⁹ on 105 elbow radiographs of childrens between the ages of 2 - 13 years, concluded that the mean Baumann's angle was 70 ± 5.8°. While the mean value for Baumann's angle in boys was 70.1° with SD of 5.8 and in girls was 69.9 with SD of 5.7°. Sex comparison and findings of our study matches this Asian study.

In a study by Awasthi B et al⁴ found that Mean ± (SD) for Baumann's angle in Indian children from 3 to 13 years of age was 75° ± 4.70°. Mean ± (SD) of Baumann's angle in males was 76°± 4.44° and females was 74° ± 5.37°. The difference in males and females is statistically insignificant. In a study by Sehgal et al⁵ on Tibetan children, mean Baumann's angle in children from 3 to 13 years of age was 72° ± 2.75°. While the mean value for Baumann's angle in male was 72° ± 2.75° and it is 73°± 1.41° for females. The difference in males and females is statistically not significant.

From our analysis, it seems that the mean value of Baumann's angle in Nepali children was less than that

in Indian children. Further, it is comparable to children from the western world and similar to the Chinese population (Table 2).

Table 2. Comparison of Baumann's angle findings of previous literature.

Present study	Awasthi B et al ⁴	Sehgal M et al ⁵	Williamson et al ⁶	Shank et al ⁸	Yeung SH et al ⁹
71° ± 3.2°	75° ±4.70°	72° ±2.75°	72° ±4°	71.5° ±6°	70° ±5.8°

Thus the LCH angle and Baumann's angle values of Nepali children were comparable to other children of the world.

The limitation of the study was that the study included those children who have come to hospital for some elbow related treatment and problems of elbow joint. The measurement of these parameters among children from community would yield better reference values. The measurements were operative dependent so there could be chances of inter-observer variation in measurement of angles- LCH angle and Baumann's angle. The sample size was small, a community based study on LCH and Baumann's angle in normal Nepali children could be done to bring up standard values.

CONCLUSIONS

The anthropometric values for elbow angles - LCH and Baumann's, found out in our study were similar to other published studies.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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