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Original Research Article

CORRELATION OF CARRYING ANGLE OF ELBOW WITH LENGTH OF FOREARM AND HEIGHT OF BODY

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ABSTRACT

Background: The angle between the median axis of arm and that of the fully extended and supinated forearm is known as Carrying angle. In females the carrying angle is greater and in the dominant upper limb. To identify deformities of elbow Carrying angle knowledge is important. In the sex determination the role of carrying angle is important. In this study find out correlation of carrying angle with height and length of forearm. **Material & Method:** In this present study total 266 (146 female & 120 male) asymptomatic, healthy students of RajShree Medical Research Institute Bareilly were selected. There ages ranged 17 to 22 years. Carrying angle is measured by Goniometer. The carrying angle is inversely related with height and length of forearm of person. Greater carrying angle In female is considered as secondary sex characteristic. **Conclusion:** it is clear that the height & length of the forearm are directly related to each other. Length of the forearm in female is 24.9 cm on right side and 24.8 cm on left side where as in male this value is 27.8 cm on right side and 26.6 cm on left side which is inversely related to the carrying angle. It may be considered as secondary sex characteristics in female.

key words: Carrying angle, height, goniometer, length of forearm, puberty, secondary sex characteristic

INTRODUCTION

The angle between the median axis of arm and that of the fully extended and supinated forearm is known as Carrying angle. The acute angle made by the median axis of the arm and that of fully extended & supinated forearm is known as carrying angle & thus it measures the lateral obliquity of the forearm. Carrying angle role is important in the sex determination. The carrying angle value is approximately 10º in men and 13º in women **(1, 2)**. In the evaluation of deformities of distal humerus fractures it is important to know the carrying angles of both elbows **(3)**. The study also aims to evaluate the relation of the carrying angle with heights of the individual and length of forearm. Decker3 gave the reason pointing out that the inner lip of trochlea of humerus is a ridge (groove) which is much deeper distally anteriorly so that ulna (with the forearm) is deflected in full extension by this ridge. The ulna a curved ridge joins the prominence of the coronoid & olecranon process which fits the groove in the trochlea of the humerus suggested by Last4. William et al5 considered the medial edge of trochlea of humerus party responsible as it projects nearly 6 mm below the lateral edge & the obliquity of the superior articular surface of the coronoid process which is not set at right angle to the shaft of ulna. Increased carrying angle is also a risk factor for non-traumatic ulnar neuropathy at the elbow **(6)**. In this study has been made to find out correlation of carrying angle with Height, and length of forearm.

MATERIAL & METHODS

In present study total 266 (146 female & 120 male) asymptomatic, healthy students of Raj Shree Medical Research Institute Bareilly belonging to various regions of Uttar Pradesh were selected. There ages ranged between 17 to 22 years. Medical students of this age group were selected as subject because of easy availability. Carrying angle is

measured by Goniometer. The one arm (fixed) of that can be placed on the median axis of the arm of person, the movable arm adjusted as to lie on the median axis of forearm of person & the angle read on the goniometer. Carrying angle Measurement was taken on the both side to find out difference. Stature meter is used to measure the height. Standing, erect, anatomical position from vertex to hill with bare foot was measured as Height. The length of forearm is measured by the Vernier calliper. Medial epicondyle & styloid process of the ulna are used as landmark **(6)**. Length of forearm Distance between these two points is recorded.

All the measurements were recorded, tabulated and statistically analyzed. Mean and standard deviation for each of the parameters was calculated True Epl-state. The Chi square test was used as the test of statistical significance to calculate the 'p' value. 'P' value less than 0.001 was taken to be statistically significant. All the parameters were measured in centimetres and the carrying angle was measured in degree. Three consecutive readings were taken and also the mean was recorded.

RESULTS

The mean Carrying Angle in Males on the Right upper limb was 11.5ºand in females was 14.4º and the mean carrying angle in Males on the Left upper limb was 10.70 and in females was 13.3º. Carrying angle of Females is more (13.850) when compared to Males (11.10). The difference of carrying angle is 2.75º. There was significant negative correlation between height, length of forearm and Carrying Angle. In this study 266 healthy students were taken and study was conducted at of Raj Shree Medical Research Institute Bareilly. Out of them 146 students are female & 120 students are male. Obtained data are shown in Table-1 and 2 and 3

Table-1,2,3 shows values in range, mean and standard deviation of the carrying angle, length of forearm and height The average carrying angle of male is 11.1° and of female is 13.85° in present study.

Table 1. Carrying angle in right and left upper limb of both sex:

Sex	Carrying angle on right upper limb in degree	Carrying angle on left upper limb in degree
Female	14.4	13.3
Male	11.5	10.7

Table 2. Study of Carrying Angle in Sex Ratio (Male: Female) (120 Males: 146 Females)

Method of Measurement	Carrying angle in females (mean in degrees)	Carrying angle in males (mean in degrees)	Differences in Carrying Angle in Degree
Foot-Rule	13.85	11.1	2.75

Table 3. Comparison of Height, Upper Limb measurements to Carrying Angle:

Sex	Mean of Height in cm	Right forearm length in cm	Left forearm length in cm	Carrying angle in right upper limb in degree	Carrying angle in left upper limb in degree
Female	155.5±8.22	24.9±1.69	24.8±1.5	14.4±4.39	13.3±4.02
Male	170.3±5.60	27.8±2.30	26.6±2.30	11.5±3.70	10.7±3.1
	P<0.0000 1	P<0.0000 001	P<0.000000 1	P<0.0000 01	P<0.0000 001

DISCUSSION

Table-4 Shows comparison of average carrying angle in male and female by other workers and present study

Study by	Carrying angle – Male	Carrying angle – Female
Potter[7]	6.83°	12.65°
Baughman et al[8]	11.0°	15.0°
J Rai et al[9]	13.26°	17.91°
Keats et al[10]	11.0°	13.0°
G. N. Khare[11]	13.56°	16.92°
Ruparelia S et al[12]	6.9°	11.8°
Present Study	11.1°	13.85°

Results obtained in present study are quiet comparable with results of other workers study (Table no.4).

Results obtained by Keats et al10 and present study are almost similar. From the above study we have observed that the carrying angle in female is greater than male. In the present study 65 percent of female height ranges between 150–160cm, average 155.5

cm, whereas major population among male students (60.8%) height vary form 160 – 173 cm, average 170.3 cm.

Average Right forearm length is 24.9 cm in female and 27.80 cm in male whereas on the left side this value is 24.8 cm in female and 26.60 cm in male. Difference of the length of forearm in the male and female is statistically significant. From the present study, it is observed that the height and forearm length both are more in males than females. In contrast to this average carrying angle is more in females than males

Carrying angle of Females is more (13.850) when compared to Males (11.10). The difference of carrying angle is 2.75º. There was significant negative correlation between height, length of forearm and Carrying Angle.

If the height of a person & therefore length of ulna is lesser, then because of shorter lever arm, the proximal end has to angulate more in order to bring the hand in pronated position for routine work. Therefore in a shorter person the medial part of trochlear notch of ulna goes more away from the medial flange of trochlea which can now grow more than in a person with longer forearm, leading to greater carrying angle.

The carrying angle develops in response to the pronation & is dependent on the length of the forearm bones greater the length of the forearm bone lesser is the angulation of proximal articulation of proximal articular surface, therefore lesser is the carrying angle. Distal part of the humerus particularly trochlea & proximal part of the ulna play major role in the causation of carrying angle.

CONCLUSION

According to the present Study, Height of the person is inversely related with the carrying angle. Average height of female is 155.5 cm and in male it is 170.3 cm. There is significant difference between male & female carrying angle, in female it is 13.85 degree and in male it is 11.1 degree. Greater carrying angle in female is considered as secondary sex characteristic. From the present study it is clear that the height & length of the forearm are directly related to each other. Length of the forearm in female is 24.9 cm on right side and 24.8 cm on left side where as in male this value is 27.8 cm on right side and 26.6 cm on left side which is inversely related to the carrying angle. It may be considered as secondary sex characteristics in female because according to the study of some workers there is no difference in the carrying angle in male & female up to the puberty. But in the female, it is increased after puberty.

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