

Carrying angle its relation to height in young adult males and females

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Abstract

Background: Carrying angle of elbow is formed between the axis of a radially deviated forearm and the axis of the humerus. It helps the arms to swing without hitting the hips while walking and the angle varies from person to person. This carrying angle is crucial for most of the activities in our day to day life.

Aim and objectives: The knowledge of the measurement of carrying angle is necessary while evaluating elbow injuries or other elbow disorders. The parameter varies according to the height of an individual. This study reveals the relation between the carrying angle the height of the person.

Methodology: The carrying angle was measured for about 150 students (male and female) within the age group of 17 to 19. The angle is measured using Goniometer.

Results: The mean carrying angle in males on the right side was found to be $6.31^{\circ} \pm 0.36$ and on the left side was $6.31^{\circ} \pm 0.23$; in females on the right side was $12.4^{\circ} \pm 0.57$ and on the left side it was found to be $12.38^{\circ} \pm 0.68$.

Conclusion: The present study shows that the height of the person is inversely related with the carrying angle.

Introduction

The Carrying angle is defined as the acute angle formed by the median axis of the arm and that of an extended and supinated forearm and thus it measures the lateral obliquity of the forearm the role of carrying angle. The role of carrying angle in sex determination and its cause of formation is a long debated issue in Anatomy and Anthropology. According to Mall (Mall F.P-1905) the axis of the elbow joint is set obliquely at nearly 84° of both the humerus and ulna, which is also agreed by Jones (Jones F.W-1953). Langer (Langer-1905) was in the opinion that the obliquity of trochlea to the shaft of the humerus is the cause.

Kapandji (Kapandji I A-1970) explained that the angle is formed as a result of the trochlear groove being vertical and anteriorly but on the posterior aspect, it runs obliquely distal and lateral. This results in the formation of the carrying angle in extension when the posterior aspect of the oblique groove makes contact with the trochlear notch of the ulna and the angle is marked during flexion when the trochlear notch lies on the vertical groove in the anterior aspect.

Last (Last RJ 1978) suggested that a curved ridge joins the prominence of the coronoid and olecranon process which fits the groove in the trochlea of the humerus. The obliquity of the shaft of the ulna to this ridge accounts to most of the carrying angle at the elbow. Decker (Decker Gog 1986) gave the same reason pointing that the inner lip of the trochlea of the humerus is a ridge which is much deeper distally anteriorly so that the ulna is deflected in full extension by the ridge.

William (William A-2005) considered that the medial of the trochlea of the humerus partly responsible as it projects 6mm of the lateral edge and the obliquity of the superior articular surface of the coronoid process which is not set at right angle to the shaft of the ulna.

Most of the studies are focused on the question of formation of the carrying angle, difference in sex and age but little attention has been given to correlate the carrying angle with various parameters. Hence, an effort has been made to find out correlation of carrying angle with height and length of forearm.

Material and Methods

It is a cross-sectional study conducted with a sample size of 150 study subjects, of 17-19 years, among first MBBS students over a period of 2 months. Ethical clearance was obtained from the institution's ethical committee before starting the study. Written informed consent was taken from

the participants was included in the study. The measurement of the carrying angle was done using a goniometer plate. The fixed arm of the goniometer was placed on the median axis of the arm, adjust and place the movable arm on the median axis of the forearm and the angle was read on the goniometer. Bicipital groove, biceps brachii tendon at the insertion of the palmaris longus tendon at the wrist were palpated and marked as anatomical landmarks to demarcate the median axis of the arm and the forearm respectively. Measurement of the carrying angle was taken on the left arm and the right arm to find out the difference on both the sides if any. Stature metre was used to measure the height. Height was measured in erect, anatomical position from vertex to heel with bare foot. A centimetre-millimetre tape was used to measure the length of the forearm. Medial epicondyl and styloid process of the ulna are used as landmark. Distance between these two points is recorded as length of the forearm

The data was collected, tabulated and analysed using the SPSS statistical software.

Observation

GENDER	SIDE	LENGTH OF FOREARM(in cm)		CARRYING ANGLE(°)		HEIGHT (in cm)	
		R	M	R	M	R	M
		A	A	A	A	A	A
		N	N	N	N	N	N
		G	G	G	G	G	G
		E	E	E	E	E	E
MALE	RIG HT	2 1- 2 5	2 3 . 0 2	5- 8	6 . 3 1	1 6 0- 1 6 7	1 6 4 . 4 5
	LEF T	2 1- 2 5	2 3 . 1 5	5- 8	6 . 3 1		
FEMALE	RIG HT	2 0- 2 5	2 2 . 9	1 0- 1 4	1 2 . 4	1 5 8- 1 5 6	1 5 4 . 8 6
	LEF T	2 0- 2 5	2 2 . 8 9	1 0- 1 4	1 2 . 3 8		

Table 1: Collected data

Result

The carrying angle in males on the right side is $6.31^{\circ} \pm 0.36$ and on the left side it $6.31^{\circ} \pm 0.23$. The carrying angle in females on the right side is $12.4^{\circ} \pm 0.57$ and on the left side it was found to $12.38^{\circ} \pm 0.68$. The correlation of the length of the forearm and carrying angle was found to be negative in both male and female. Hence, the carrying angle decreases with increase in length of forearm. the carrying angle decreases with increase in length of forearm.

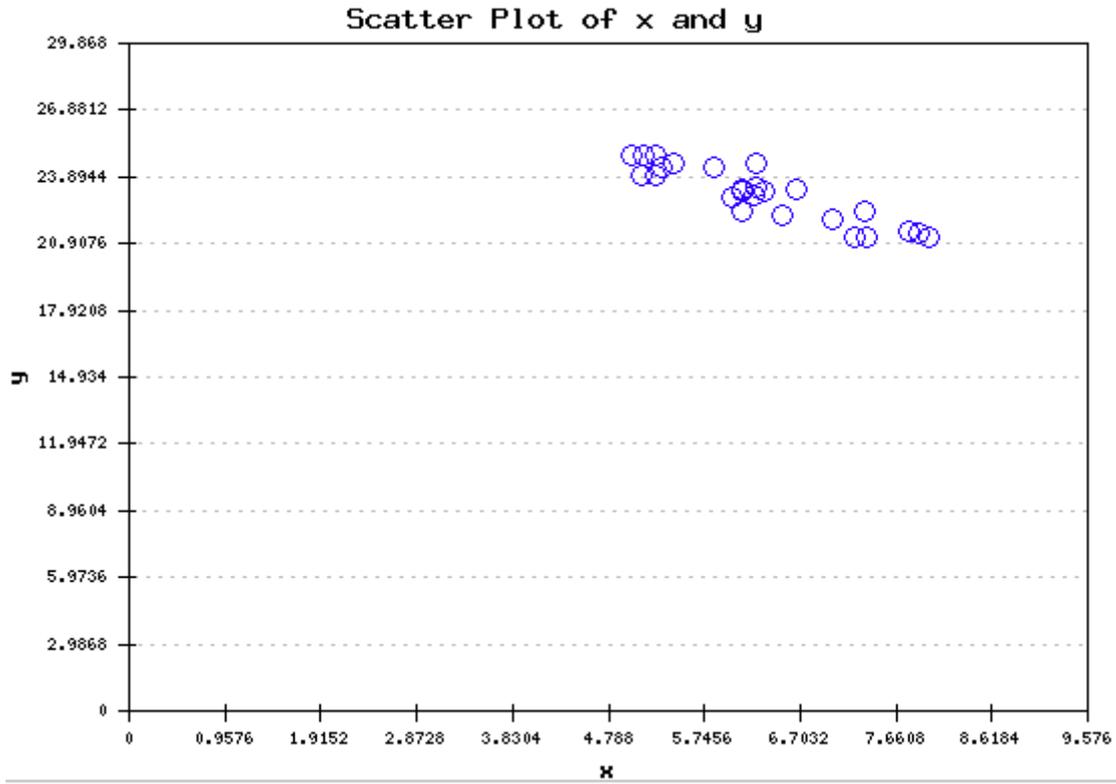


Fig1: forearm on y axis vs carrying angle on x axis (Right in male)

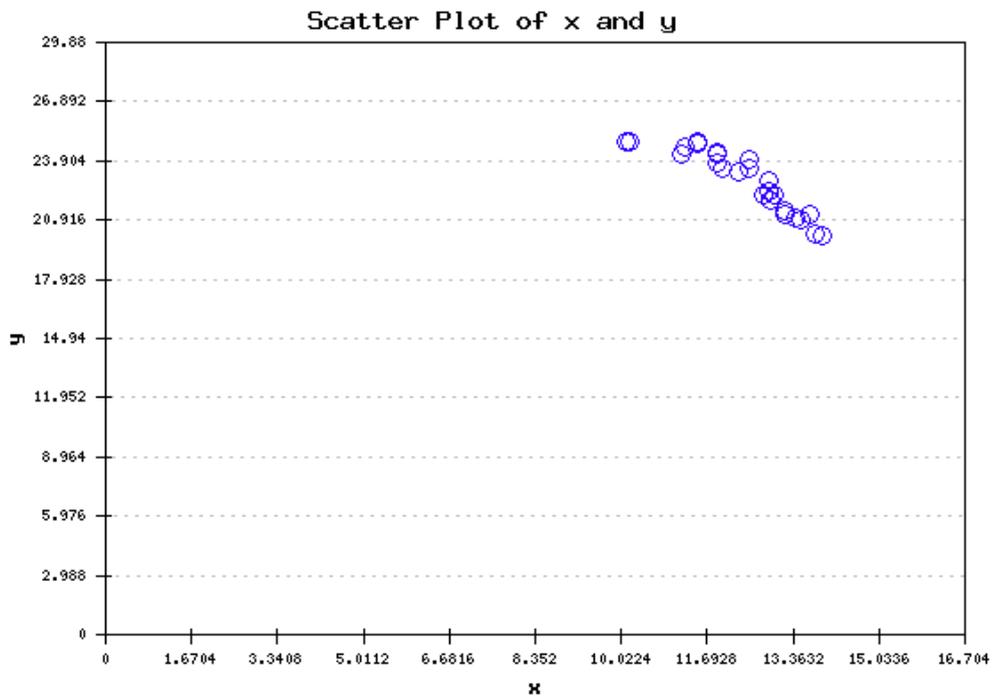


Fig2: length of forearm on y axis vs carrying angle on x axis (Right in female)

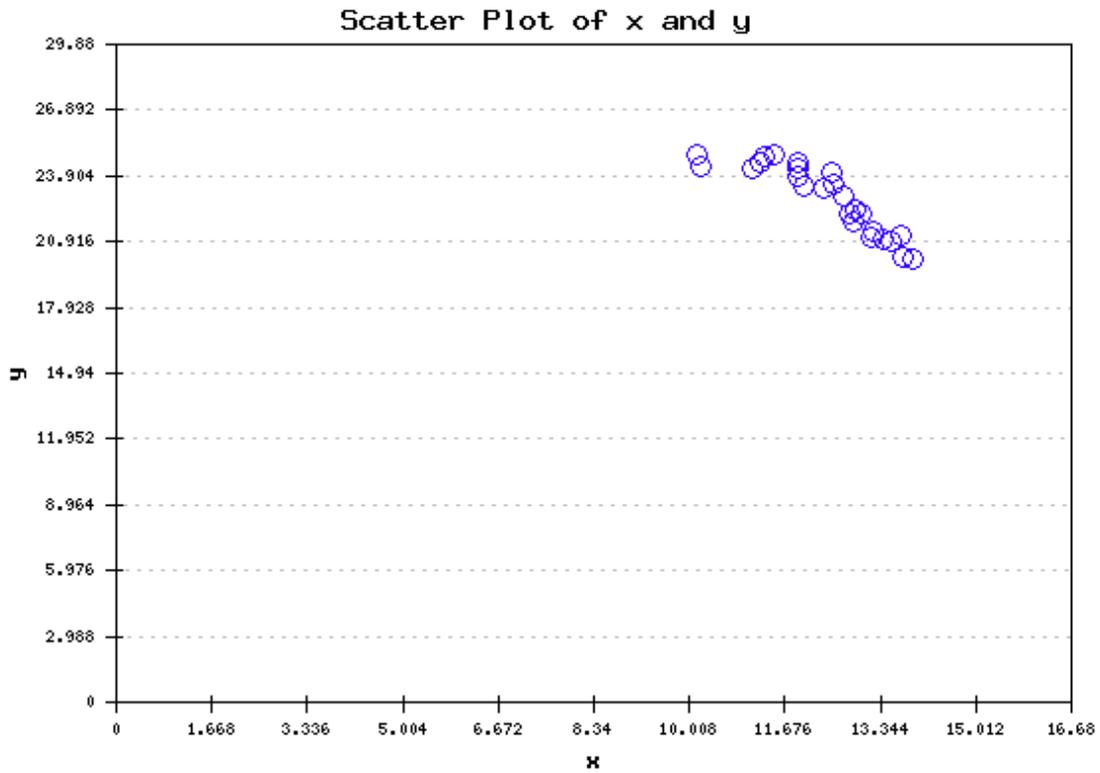


Fig3: length of forearm on y axis vs carrying angle on x axis (left in female)

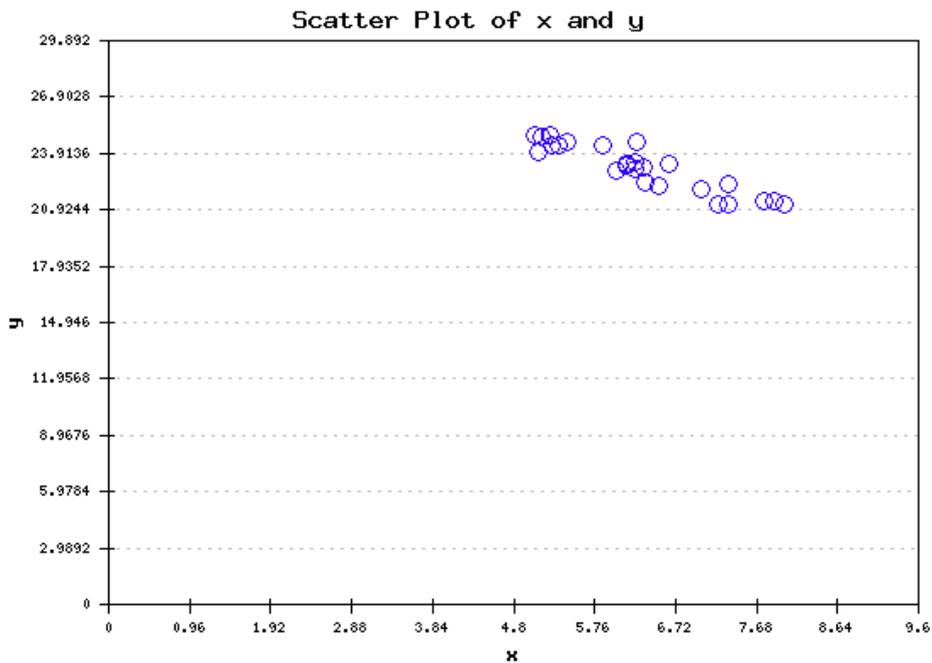


Fig4: length of forearm on y axis vs carrying angle on x axis (left in male)

Difference	5.860
Standard error	0.135
95% CI	5.5889 to 6.1311
t-statistic	43.461
DF	48
Significance level	P < 0.0001

Fig5: comparison between carrying angle in males and females on the right side

Difference	5.800
Standard error	0.144
95% CI	5.5113 to 6.0887
t-statistic	40.399
DF	48
Significance level	P < 0.0001

Fig6: comparison between carrying angle in males and females on the left side

Characteristic	Correlation Coefficient	Inference
Male Rt Arm and Rt Carrying angle	-0.906396	Negative
Male Left Arm and Lt Carrying angle	-0.921147	Negative
Female Rt Arm and Rt Carrying angle	-0.917777	Negative

Table 2: Correlation coefficient

Discussion

Study by	Carrying angle-male (mean)	Carrying angle-female(mean)
Potter(Potter HP-1995)	6.83°	12.0°
Baughman (Baughman-1974)	11.0°	15.0°
J Rai(Rai.J-)	13.26°	17.91°
Keats(Keats T.E-1966)	11.20°	13.0°
G. N. Khare	13.56°	16.92°
Present study	6.31°	12.4°

The present study was conducted to measure the carrying angle in both male and female of similar age group and it's relation with height and length of forearm. It has been documented that carrying angle is greater in female than in male and this difference is considered a secondary sexual characteristic.

The present study is almost similar to the results observed by Potter(Potter HP-1995).From the above study we have observed that the carrying angle in female is greater than that in males. In the present study, 63.3% of the height of the female students ranges from 150cm up to 158cm, with an average of 152cm, whereas 66.6% of the height the male students varies between 160-167cm, with an average of 164.53cm

The average forearm length is 22.9cm on right side and 22.89cm on left side in female, whereas on the left this value is 23.02cm on right and 23.15cm on the left in males. The difference in the length of the forearm of the right and the left is statistically insignificant, whereas the difference in the length of the forearm in the male and female is statistically significant. From the present study, it is observed the height and the length of the forearms are more in males than in females. In contrast to this, the average carrying angle is more in females than males. When the forearm is pronated, the proximal part angulates the medial part of the trochlear olecranon-coronoid angle exhibiting high sexual dimorphism is observed in the carrying angle in the trochlea and the proximal part of the ulna, play a major role in the causation of the carrying angle.

The view that the carrying angle helps in keeping the forearm away from the side of the pelvis when the upper limb swings while walking is wrong .The carrying angle is formed only when the forearm is extended and supinated at the elbow. It disappears in pronation and flexion at the elbow. Therefore the carrying angle is not present and does not help in any way in keeping away from the side of the pelvis while walking. The present study has no data to compare the obtained results. It may be considered as secondary sexual characteristic in females according to some former studies.

There is no difference in the carrying angle in male and female until puberty but in the female it increases after puberty

Conclusion

According to the present study, height of the person is inversely related with the carrying angle. Average height of female is 152cm and in male is 164.53cm. There is significant difference between male and female carrying angles, in males it is 6.42° and in females it is 12.25° . Greater carrying angle in females is considered as secondary sex characteristics. From the present study it is clear that the height and length of the forearm are directly related to each other. Length of the forearm in females is 22.5cm on the right side and 22.4cm on the left side whereas in male the length was found to be 23.8 on the right and 24 on the left which is inversely related to the carrying angle. It may be considered as a secondary sexual characteristic in females because according to some studies it is found that there is no difference in the carrying angle in male and females up to the puberty. But in the female, it is increased after puberty.

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