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Evaluation of carrying angle in 1st yr. Medical students of SVS medical college, Mahabubnagar

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Abstract

Background: The carrying angle is defined as the acute angle made by the median axis of the upper arm with that of the fully extended and supinated forearm, and thus it measures the lateral obliquity of the forearm. Aim of this study is to evaluate the elbow carrying angle by clinical measurement to check if there is a statistically significant difference among carrying angles of males and females of same age group and to study variation in age, sex, and also special reference to side dominance and to know variation of carrying angle in females considering weight & hip circumference.

Materials and methods: 147 students of 1st yr. mbbs students of svs medical college were selected for the study. Out of which 94 were females and 53 were males. Carrying angle was calculated in both males and females for both upper limbs in standing position with forearm supinated and elbow extended by using goniometer. Materials: goniometer, measuring tape, weighing machine.

Results: Data was analyzed by Graph Pad Prism 6.01 version. All p-values less than 0.05 were considered as statistically significant. Carrying angle is more in females than in males. i.e median carrying angle in females is 16 on right side, 9 on left side. In males mean carrying angle is 10 on right side, 6 on left side.

Conclusion: From the study we conducted there is significant difference in carrying angle among males and females of same age group. Dominant side carrying angle more than non-dominant side. *There is no significant relationship between carrying angle and hip circumference in our study in females.* There is no significant relationship between carrying angle and weight in our study in females.

Keywords: Carrying angle, elbow, supination, extension

Introduction

The carrying angle is defined as the angle made by the median axis of arm and forearm in full extension and supination [1]. The angle is neutralized when forearm is flexed or pronated from extended or supinated position [2]. It permits forearm to clear the hips during walking and is important when carrying objects. angle is formed by long axis of arm to long axis of forearm [3]. The average angle in males is 5 degrees whereas in females it is about 10 degrees. It is formed because trochlear groove is vertically oriented anteriorly and obliquely oriented posteriorly. The trochlea is not a simple pulley as its medial flange more than its lateral, projecting to a lower level so that plane of joint is 2cm distal to inter-epicondylarline. In humans, however arm and forearm are not positioned in a straight line. this parameter varies according to age [4], gender [5, 6], hyperextension of the elbow [7], dominant upper limb [8] anthropometric characteristics such as height [9] and can be measured by simple clinical and radiographic technique [5]. Apparent difference in gender may be due to more joint laxity in female permitting greater degree of extension. This study attempts to determine the carrying angle of elbow in subjects of same age group and different genders and between dominant and non-dominant hand. This angle plays important role in walking, swinging, and carrying objects. The angle is more on the dominant side than on the non-dominant side. The knowledge of its variations is important especially for the handling of traumatic lesions that affect the pediatric elbow [5].

This information will be of help in studying the biomechanics of the elbow joint.

Aims and Objectives

1. To evaluate the elbow carrying angle by clinical measurement among 1st yr. mbbs students of svs medical college and also to check if there is a statistically significant difference among carrying angles of males and females of same age group
2. Objective is to study variation in age, sex, and also special reference to side dominance
3. To know variation of carrying angle in females considering weight & hip circumference

Materials and Methods

Subjects: 147 students of 1st yr. mbbs students of svs medical college, mahabubnagar were selected for the study. Out of which 94 were girls and 53 were boys

Exclusion Criteria

No previous fractures of the upper limb
No skeletal deformities

Methodology: after taking due consent from the students and permission from ethical committee the study was conducted. The subjects are asked to stand in anatomical position (Fig 1&2) (stand up straight, roll his/her shoulders back and elbow was fully extended and the forearm fully supinated) The carrying angle was measured using goniometer. The arms of the goniometer (fig 3) are kept into a straight line and the goniometer's measurement plate placed at the fulcrum of one elbow. One arm of the goniometer is aligned along the middle of the person's upper arm. The goniometer's other arm is moved along until it lined up along the middle of the person's forearm. The angle is recorded from the read out on the measurement plate. The process was repeated for the other elbow



Fig 3: The arms of the goniometer

Observations were tabulated

Study design: observational study

Study place: svs medical college mahabubnagar

Sample: 147 students

Sampling technique: randomized sampling

Duration: 2months

Observation and Results

Statistical Analysis: Data was analyzed by Graph Pad Prism 6.01 version. The comparison between two groups for score data was done by Mann Whitney test/ Wilcoxon Rank Sum Test. The data was summarized by Median \pm IQR (Inter Quartile Range). All p-values less than 0.05 were considered as statistically significant.

Table 1: The comparison between male and female for the parameter age (in years)

Groups	Parameter	N	Range	Median (IQR)	P-Value
Male	Age (in years)	53	17 - 21	18 (17 - 19)	0.327
Female		94	17 - 19	18 (17 - 18)	

Conclusion: There is no significant difference between male and female for the parameter age (in years). That means both groups are same.

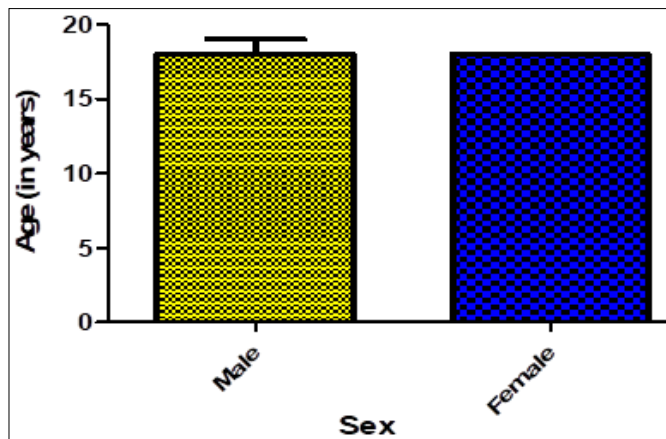


Fig 4: Median with IQR bar diagram for the comparison between male and female for the parameter age (in years)

Table 2: The comparison between male and female for the parameter Carrying angle (in degrees) for Right upper limb

Groups	Parameter	N	Range	Median (IQR)	P-Value
Male	Carrying angle (in degrees) for Right upper limb	53	4 - 18	10 (8 - 11.5)	0.000
Female		94	5 - 22	16 (14 - 19)	

Conclusion: There is significant difference between male and female for the parameter carrying angle (in degrees) for right upper limb.



Fig 1: The subjects are asked to stand in anatomical position



Fig 2: Stand up straight, roll his/her shoulders back and elbow was fully extended and the forearm fully supinated

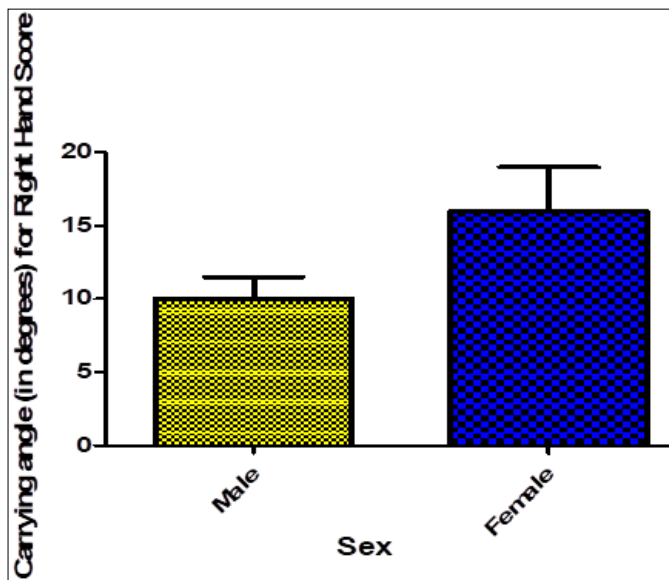


Fig 5: Median with IQR bar diagram for the comparison between male and female for the parameter Carrying angle (in degrees) for Right upper limb

Table 3: The comparison between male and female for the parameter Carrying angle (in degrees) for Left upper limb

Groups	Parameter	N	Range	Median (IQR)	P-Value
Male	Carrying angle (in degrees)	53	4 - 14	6 (5 - 9)	0.0002
Female	for Left upper limb	94	4 - 20	9 (6 - 12)	

Conclusion: There is significant difference between male and female for the parameter carrying angle (in degrees) for left upper limb.

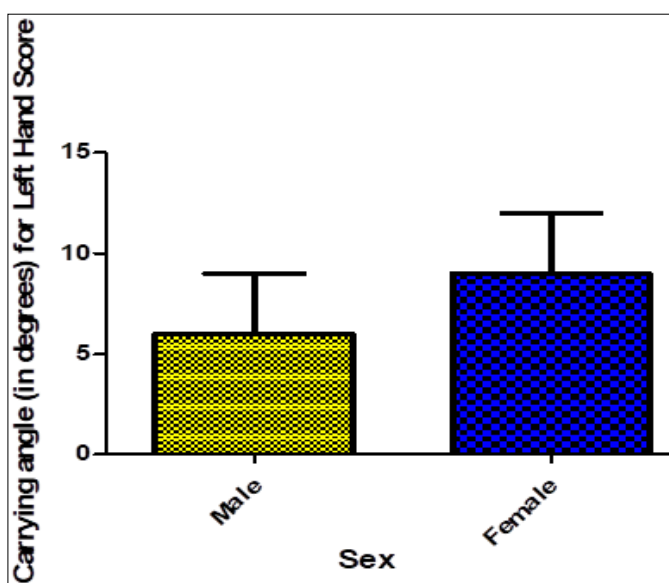


Fig 6: Median with IQR bar diagram for the comparison between male and female for the parameter Carrying angle (in degrees) for Left upper limb

Table 4: The comparison between Carrying angle (in degrees) score for Left upper limb and Right upper limb for the group female

Groups	Parameter	N	Range	Median (IQR)	P-Value
Right upper limb	Carrying angle (in degrees)	94	5 - 22	16 (14 - 19)	0.000
Left upper limb	degrees) Score	94	4 - 20	9 (6 - 12)	

Conclusion: There is significant difference between left upper limb and right upper limb in carrying angle (in degrees) scores for female group.

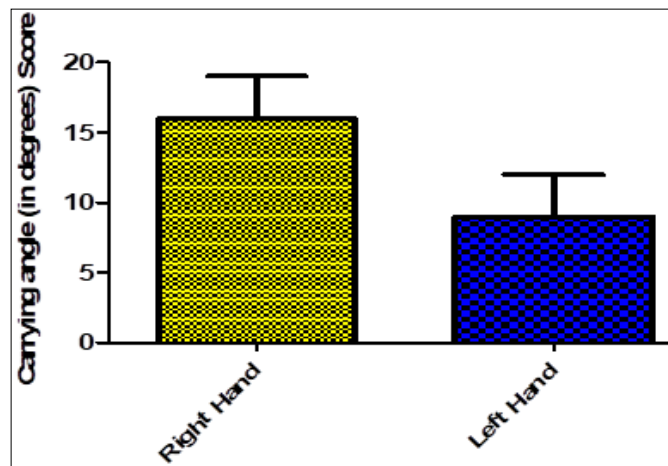


Fig 7: Median with IQR bar diagram for the comparison between Carrying angle (in degrees) score for Left upper limb and Right upper limb for the group female

Table 5: The comparison between Carrying angle (in degrees) score for Left upper limb and Right upper limb for the group male

Groups	Parameter	N	Range	Median (IQR)	P-Value
Right upper limb	Carrying angle (in degrees)	53	4 - 18	10 (8 - 11.5)	0.000
Left upper limb	degrees) Score	53	4 - 14	6 (5 - 9)	

Conclusion: There is significant difference between left and right upper limb in carrying angle (in degrees) scores for male group.

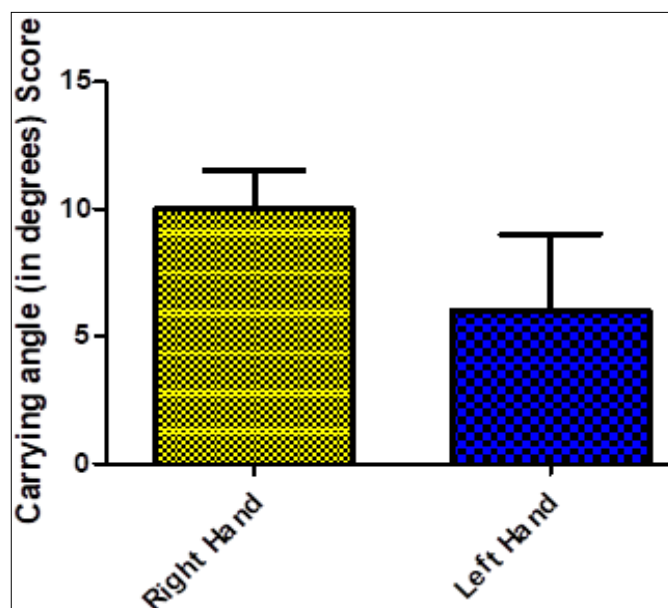


Fig 8: Median with IQR bar diagram for the comparison between Carrying angle (in degrees) score for Left upper limb and Right upper limb for the group male

Table 6: The correlation between dominant Hand Carrying Angle (In Degrees) and HIP circumference in female

Parameter	Mean	SD	N	r-value	P-value	Inference
Right Hand Carrying Angle (In Degrees)	15.96	3.50	94	0.015	0.993	Not Significant
HIP circumference	35.61	2.51	94			

Conclusion: There is no significant relationship between dominant hand carrying angle and hip circumference

Table 7: The correlation between dominant Hand Carrying Angle (In Degrees) and Weight (in kg)

Parameter	Mean	SD	N	r-value	P-value	Inference
Right Hand Carrying Angle (In Degrees)	16.07	3.44	94	-0.039	0.776	Not Significant
Weight (in kg)	52.48	7.47	94			

Conclusion: There is no significant relationship between dominant hand carrying angle and weight

Discussion

Most of study by different researchers proven that carrying angle of females is greater than that of males which also support our study however some researchers found there is no significant difference in carrying angle of males and females of any age group [4, 10, 11]. The long axis of the arm and forearm are not in alignment due to obliquity of the forearm. This is measured as carrying angle- an angle made by the median axis of the fully extended and supinated forearm thus measuring the lateral obliquity of the forearm [9].

The carrying angle is caused partly by projection of the medial trochlear edge 6mm beyond its lateral edge and partly by obliquity of the coronoid's superior articular surface, which is not orthogonal to the ulna's shaft [12]. The shaft of the ulna is angled slightly laterally from the line of the trochlear notch to form the carrying angle [13]. When the forearm is pronated, the proximal part of ulna angulates. The medial part of the trochlear notch moves more away from the humeral articular surface than the lateral part. Therefore the medial flange of trochlea is not compressed and grows more than the lateral flange. The carrying angle develops in response to the pronation and is dependent on the length of the radius and ulna (the lever). Greater the length of radius and ulna lesser is the angulation of proximal articular surface in pronation and therefore lesser is the carrying angle and Therefore the carrying angle is inversely related to the height of a person. Because the average height of females is lesser (156.8 cm) than the average height of males (169.9 cm), so the average carrying angle is greater in females than in males. greater carrying angle develops in response to broader pelvis in females, and carrying angle helps in keeping the forearm away from the side of the pelvis when the upper limbs move during walking. Apparent difference in gender is due to increased joint laxity in females so there is greater degree of extension and angulation

Decker has given a similar reason saying that, in the inner lip of trochlea of humerus is a ridge (groove) which is much deeper distally anteriorly so that ulna (with the forearm) is deviated in full extension by this ridge [14].

Kapandji said that the angle is formed as a result of trochlear groove is vertically oriented anteriorly but on the posterior side it is oriented obliquely distally and laterally [15]. This results in formation of angle in extension when posterior aspect of oblique groove makes contact with the trochlear notch of ulna and the angle is masked during flexion when trochlear notch lies on vertical groove in the anterior aspect. It has been found that the carrying angle of the elbow changes from infancy to adulthood. Difference between the carrying angles of the right and left sides suggests ligamentous laxity at the medial elbow or asymmetrical bone growth.

Jyothinath Kothapalli, Pradeep Kumar, Murudkar, Lalithadevi: explained carrying angle increases with age and greater in females than males because olecranon –coronoid angle exhibits high sexual dimorphism is one of the causes

and it is also considered as secondary sexual characteristic. carrying angle measurement helpful in reconstruction of elbow disorders observed after treatment of distal humerus fractures and evaluating traumatic elbow injuries. Greater carrying angle in female is considered as secondary sexual characteristic because according to some workers there is no difference in carrying angle in males and females up to puberty but in females it is increased after puberty. Even though changes in the carrying angle have only cosmetic value, an evaluation of the same can help the medical practitioner in the management of certain elbow disorders. An increase in the carrying angle is abnormal, particularly if it occurs unilaterally. If the angle is increased beyond the average, it is called cubitus valgus. The present study depicts the existence of sexual dimorphism where females have carrying angle more than males. This supports the fact that the carrying angle is a secondary sexual characteristic. Also, this study reveals that right carrying angles are greater than the left ones. The result of the study is useful in the management of elbow fractures, epicondylar disease and surgical planning for elbow reconstruction.

Conclusion: Our study confirms variation in carrying angle which is greater in females than in males of same age group, and it is greater on dominant side than non-dominant side, we have 4 subjects with left hand dominant side they have carrying angle more on left than on right side. *There is no significant relationship between carrying angle and hip circumference in our study in females.* There is no significant relationship between carrying angle and weight in our study in females. We have not considered parameters like height, BMI, they may have some influence on development of carrying angle

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Conflicts of interest: Nil

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