Research Article

Sexual dimorphism of carrying angle

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Abstract

Aims and Objectives: The angle formed in between the long axis of the arm and that of forearm with fully extended and supinated forearm. The present study is aimed at measurement and correlation of carrying angle in both sexes and on both sides and also relation of carrying angle with other parameters. **Materials and Methods:** This study was undertaken in 140 MBBS students of BRIMS between ages of 18-25 years out of which 80 were females and 60 were males. carrying angle measured with Goniometer. **Observations and Results:** Observations were documented and analysed statistically. It was found that not only the carrying angle was greater in females than males, but also it was found greater on the dominant side. **Conclusion:** Greater carrying angle in females is considered as a secondary sexual character.

Keywords: Carrying Angle, Goniometer, elbow Joint.

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INTRODUCTION

Carrying angle is used as a secondary sexual characteristic. It is formed by the lower end of humerus and upper end of ulna[1]. It is formed due to the fact that trochlear grove is vertically oriented anteriorly and obliquely oriented posteriorly[2]. The average angle in men is about 5° whereas in women it is about 10° to 15° (170° in males and 163° -167° laterally)[3]. This angle is important in walking, swinging, and carrying objects[4]. The angle is greater on the dominant side than on the non-dominant side[5]. The carrying angle permits the arm to swing without contacting the hips[6]. The measurement of carrying angle is helpful in orthopedics in correction of cubitus varus deformity occurring after malunited supracondylar fracture of humerus. It is also useful in the construction of elbow prosthesis.

MATERIALS AND METHODS

Subjects: 140 MBBS students of BRIMS were selected for the study. Out of which 80 were females and 60 were males in the age group of 18-25 years. Clearance of institutional ethical committee was obtained before starting the work.

Exclusion Criteria

No fractures of the upper limb
No skeletal deformities
No nutritional disorders.

Methodology

The subjects were asked to stand in anatomical position (stand up straight, roll his/her shoulders back and the elbow was fully extended and the forearm fully supinated). The carrying angle was measured using goniometer. figures 1 and 2). The arms of the goniometer were kept into a straight line and the goniometer's measurement plate placed at the fulcrum of one elbow. One arm of the goniometer was aligned along the middle of the person's upper arm. The goniometer's other arm was swung/moved along until it lined up along the middle of the person's forearm. The angle was recorded from the readout on the measurement plate. The process was repeated for the other elbow. Observations were tabulated. Chi Square test was done

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Figure 1

Figure 2

OBSERVATIONS AND RESULTS

The measurements and comparison of results according to genders who participated in the study are shown in the above tables, where the dimensions were higher in females as compared to the male subjects. Also, in both male and female subjects the right carrying angles are larger than the left ones which are statistically significant ($P < 0.001$)

Table 1

Range of carrying angle (Degrees)	Males		Females	
	Frequency	Percentage	Frequency	Percentage
9-10	19	32	-	-
11-12	29	45	-	-
13-14	12	23	12	15
15-16	-	-	68	85

Males: Mean = 11.29°; Standard deviation =1.46 Females: Mean = 15.20°; Standard deviation = 0.71, P < 0.001

Table 2: Comparison of carrying angle in different studies

Study	Mean Carrying Angle in Male(Degrees)	Mean Carrying Angle in Male(Degrees)
Rai J *et al*[13]	13.26	17.91
Khare GN[7]	13.56	16.92
Keats *et al*[14]	11.00	13.00
Paraskevas *et al*[15]	12.88	15.07
Present study	11.29	15.20

DISCUSSION

The long axis of the arm and forearm are not in alignment due to obliquity of the elbow joint. This deviation is measured as carrying angle- an acute angle made by the median axis of the fully extended and supinated forearm thus measuring the lateral obliquity of the forearm[7]. The carrying angle is caused partly by projection of the medial trochlear edge about 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[8]. The shaft of the ulna is angled slightly laterally from the line of the trochlear notch to form the carrying angle[9]. Decker[10] gave a similar reason pointing out 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 deflected in full extension by this ridge. Kapandji[11] explained that the angle is formed as a result of trochlear groove being vertical anteriorly but on the posterior aspect it runs obliquely distally and laterally. This results in formation of carrying 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 in a predictable manner. Difference between the carrying angles of the right and left sides may suggest ligamentous laxity at the medial elbow or asymmetrical bone growth. Thirty percent of professional baseball pitchers have a valgus elbow deformity- an increased carrying in the dominant elbow (10-15 degrees), which can be taken as a bony remodeling to adapt to stress[12]. Since the subjects were normal individuals in this series, such discrepancies are not noticed. 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. The present study depicts the existence of sexual dimorphism were females have a larger carrying angle 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 could be useful in the management of elbow displacement, fractures, epicondylar disease and surgical planning for elbow reconstruction.

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