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A COMPARATIVE STUDY OF CARRYING ANGLE WITH RESPECT TO SEX AND ELBOW DOMINANCE

Anatomy

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ABSTRACT

Carrying angle of the elbow is the acute angle formed between the central axes of arm and forearm, in fully extended and supinated position .In this study total 200 (100 female and 100 male) healthy medical students(between 17-22 years) of N.R.S. Medical College, Kolkata(who are of different regions of India) have been selected. The carrying angle has been measured using the goniometer.The study demonstrated that the carrying angle is greater in females (13.49 +/-1.82 degree) than in males (6.45+/1.53 degree). There is significant difference between male and female carrying angle [P<0.000]. In male the mean carrying angle are 6.87+/-1.53 and 6.02+/1.41 degree on dominant and nondominant side and in female values are 14.55+/-1.13 and 12.42+/-1.75 degree. The differences in dominant and nondominant sides are statistically significant. Carrying angle measurement has excellent intraoperative reliability. This procedure is considered to be suitable for clinical orthopaedics and rehabilitation settings.

KEYWORDS

Carrying angle, male, female, dominance

INTRODUCTION:

Carrying angle (C.A.) of the elbow is the acute angle formed between the central axes of arm and forearm, in fully extended and supinated position of elbow. Anatomists consider the external angle between the central axes of arm and forearm as the carrying angle, when the forearm is fully extended and supinated (Dey et al, 2013)1Clinicians however commonly consider the smaller acute internal angle of deviation of the ulna from the long axis of the humerus to be the carrying angle, also called the "supplementary angle" (Paraskevas et al, 2004)2. C.A. is caused partly by medial trochlear edge, which is 6 mm beyond its lateral edge and partly by obliquity of superior articular surface of coronoid process which is not orthogonal to the shaft of ulna and the C.A. is approximately 163°(Standring et al, 2008)3. Greater carrying angle values usually reported for females than males. In the present study, we have found a greater mean carrying angle in females than in males, and the difference is statistically significant (P<.01).Difference of carrying angles in dominant and nondominant sides are also statistically significant. A detailed knowledge of C.A. is essential in Orthopedics, Forensic Medicine as a basis for sex discrimination, Physical Medicine and Rehabilitation, Sports Medicine, nontrauma-related ulnar neuropathy.

Materials and methods: The materials used are-
Universal Manual Full-circle Goniometer, measuring tape,
Skin marking pencil, pen, eraser, sharpner, consent form, case record form, camera.Subjects were total 200 healthy medical students (100 female and 100 male) between 17-22 years of N.R.S. Medical College, Kolkata.

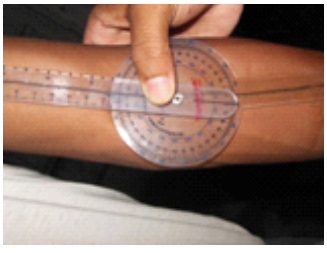

Fig 1: Measurement of Carrying angle using manual full- circle Goniometer

Methods: After receiving approval from the Institutional Ethical Committee written informed consent was obtained from all participants. The right and left elbows in 200 students (100 male and 100 female) were measured (mean age, 19.27 years). All participants were healthy and had no symptoms or signs of relevant pathologies affecting the shoulder, elbow and wrist joints. Arm axis formed by joining points over tip of acromion process of Scapula and midpoint between two epicondyles of Humerus.Forearm axis formed by joining points over midpoint between two epicondyles of Humerus and midpoint between radial and ulnar styloid processes.CA was measured by Universal Manual Full-circle Goniometer. On the body surface of the participants, the anatomic landmarks were identified through palpation and marked with skin pencil. Measurements were made with the forearm fixed, fully extended and supinated. The landmarks were chosen following ISB recommendations (Wu G et al, 2005)4and by Veeger et al (1993)5, Van der Helm and Veeger (1996)6. The carrying angle was modeled as the second rotation in the elbow rotation sequence, following elbow flexion and preceeding pronation-supination (Anglin et al, 2000)7.

Result analysis:

C.A. has been estimated with the help of "Universal Manual Full-circle Goniometer" (in degrees). From the data obtained from 200 students(100 female and 100 male students) mean, standard deviation and range has been calculated. Then "t" value of student t test, degree of freedom (df) and "P" value have been estimated to understand whether the tests are statistically significant or not.

Table 1: Relationship between Carrying angle of male (CA-male) and female (CA-female):

Name of Parameter	Mean	SD	Significant test
CA(male)(degree)	6.445	1.526	T= 29.69 df=198, P=0.000
CA(female)(degree)	13.485	1.815	

Table 2: Relationship between Carrying angle of Dominant side (CA-D) and Non-dominant side (CA-ND)

Name of Parameter	Mean	SD	Significant test
CA-D(degree)	10.71	4.076	T=3.89 Df=398, P=0.000
CA-ND(degree)	9.22	3.577	

According to the present Study, there is significant difference between male & female mean carrying angles. The average carrying angle of male students and female students have been 6.45 +/-1.53 and13.49+/-1.82 degrees respectively. In female, it is 14.55+/-1.13 degree on dominant side and 12.42+/-1.75 degree on non dominant side. In male they are 6.87+/-1.53 degree and 6.02 +/-1.41degree respectively .If all the female and male students are considered together the mean carrying angles have been 10.71+/-4.08 & 9.22+/-3.58 degree on dominant and nondominant side respectively.

Mean carrying angle values being higher in female students.

Difference of the mean carrying angle between female and male students is statistically significant. The mean carrying angle values have been higher on the dominant side. Difference of the mean carrying angle between dominant and nondominant side is statistically significant.

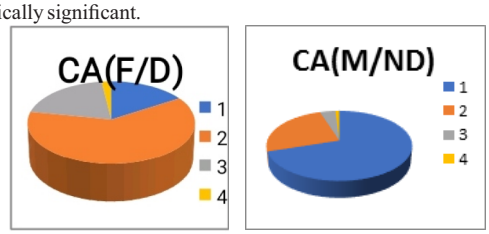

Fig.2. Pie chart showing distribution of CA in dominant side of female students;1:12-13.5^0(16%),2:13.51-15^0(62%),3:15.01-16^0(20%)(grey colour),4:16.01-17^0(2%)(yellow colour) and distribution of CA in nondominant side of female students;1:9-11^0(24%), 2:11.01-12.5^0(29%),3:12.51-14^0(34%),4:14.01-16^0(13%).

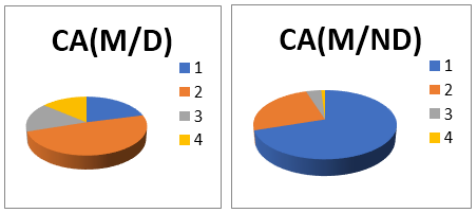

Fig.3. Pie chart showing distribution of CA in dominant side of male students; 1:4-5.5^0(21%), 2:5.51-7^0(49%), 3:7.01-8.5^0(16%), 4:8.51-10^0(14%).and distribution of CA in nondominant side of male students; 1:3-6^0(70%), 2:6.1-8^0(25%),3:8.1-10^0(4%),4:10.1-12^0(1%).

DISCUSSION:

This cross sectional study has described an easy approach to evaluate the carrying angle which has orthopedic and rehabilitative applications and change in carrying angle with changes in certain parameters (gender, elbow dominance). This method consists of the acquisition of anatomic landmarks easily identifiable on the arm and the forearm, and then, measurements have been taken, which have been adopted previously in different experimental models for clinical settings in the lower[(Martelli,2003),8and (Martelli et al,2000),9 and upper arm(Zampagni et al,2006)10. In the present study, we have found a greater mean carrying angle in female than in male, and the difference is statistically significant (P<.01). Potter (1895)11, Purkait & Chardra (2004)12 have stated that the carrying angle is greater in females than in males & this difference has been considered to be a secondary sex characteristics. Udoaka et al (2009)13 have stated the mean value for males is 11.3±1.37 o while that of females is 15.2±0.97 o, this difference being statistically significant (P<0.05)5. DR. Manoranjitham. R.M.S et al (2015)14 found that carrying angle is significantly higher in females than in males and also higher in the dominant right upper limb than nondominant limb.

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