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MEASUREMENT OF THE CARRYING ANGLE IN HEALTHY INDIAN POPULATION.

Physiotherapy

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ABSTRACT

Introduction: The intersection of the line along the mid axis of the upper arm and the line along the mid axis of the forearm defines the carrying angle. Considering that carrying angle varies significantly among different ethnicities, this study aimed to study the carrying angle in Indian population.

Methods: Carrying angle was measured using a half circle universal goniometer in standing anatomical in 600 healthy subjects in the age group 21 to 80 years.

Results: The mean carrying angle of males was 10.18o and 9.160 and female 14.20 and 13.090 in dominant and non-dominant arm respectively. Greater carrying angle was noted in female than males. Also, carrying angle was greater in dominant than non-dominant arm.

Conclusion: Evaluation of carrying angle and knowledge of its variations are essential for handling the traumatic lesions of elbow, designing total elbow prosthesisand also for elbow disorders that require reconstruction.

KEYWORDS

Carrying angle, Dominance, Elbow joint

INTRODUCTION

The carrying angle of the elbow is defined as the clinical measurement of varus valgus angulation of the arm with the elbow fully extended and the forearm in a fully supinated position[1].It determines the lateral obliquity of the forearm[2]. The carrying angle can also be described as the angulation formed due to the configuration of the articulation of joint surfaces which produces a natural valgus angulation of the forearm in relation to the humerus[3].The carrying angle can be measured statically by various methods like radiographs, digital electrogoniometerand most simply by a single hinge standard universal goniometer [4].

The carrying angle of the elbow is also considered as a secondary sex characteristic [5].Previous studies in different populations has related the carrying angle with different parameters such as age, sexand handedness [6, 7]. Considering that carrying anglevaries significantly among different ethnicities, this work has been specifically aimed to study the carrying angle inIndian population.

MATERIAL & METHODS

Institutional Ethical Review Committee approval was obtained before starting the study. Six hundred healthy volunteers were selected. Exclusion criteria included any pathology or trauma, fractures, dislocation or deformities in the upper limbs.A written informed consent was taken from the subjects.

Demographic data was obtained from each subject. Carrying angle was measured using a half circle (1800) universal goniometer in standing anatomical position with arm at the side, elbows fully extended and forearm fully supinated[8].The goniometer was placed along the medial aspect of the arm and the forearm. One arm of the goniometer was placed along the medial border of the arm and the other arm placed along the medial border of the forearm and the angle formed was noted. The carrying angle of the elbowwas measured in degree. Three consecutivereadings werenoted and the mean value was recorded.

Data obtained was statistically analysed using the SPSS software version 16.0 (Statistical Package for Social Sciences).Parametric tests were used to find the effect of gender and dominance on carrying angle. Levels of significance was P<.01.

RESULTS:

The present study included 600 subjects, 300 males and 300 females. Right arm dominance was in 520 (86.66%) subjects and left arm dominance in 80 (13.33%) subjects.

Table-1 Mean values of carrying angle in males and females in both dominant and non-dominant side.

Gender	Dominance	Carrying Angle (degree)
		Mean±SD
Male	Dominant side	10.18±1.38
	Non-dominant side	9.16±1.33
Female	Dominant side	14.2±1.48
	Non-dominant side	13.09±1.47

Table-2 Shows comparison of average carrying angle in male and females in different population and the present study.

Study by	Population	Carrying angle – Male (degree)	Carrying angle – Female (degree)
M.J. Emami(9)	Shiraz, Iran	6.4	7.2
Mbagwu(10)	Nigeria	16.9	20.5
Mohammed Z. Allouh(11)	Jordanian	13	16.6
Yilmaz(12)	Turkish	10.47	12.01
Present Study	Indian	10.18	14.2

Dominant and non-dominant side carrying angles of females was found to be higher than carrying angles of males using paired t-test(P <0.01). Also carrying angle was noted to be greater in dominant side than the non-dominant side using unpaired t-test (P <0.01).

DISCUSSION

Knowledge of the carrying angle helps in the management of paediatric elbow injuries, for correction of cubitus varus deformity occurringafter malunited supracondylar fractures of the humerus and for elbow disorders that requires reconstructionor arthroplasties[2, 13]. Itis also important anthropologically for differentiation ofsex in fragmentary skeletal remains [2].

In the present study, carrying angle was found to be greater in females as compared to males in both dominant and non-dominant side. The broad shoulders and narrow hips of the males lets the arm to hang straight downwards, with long axis of the upper arm and forearm approximately in the same straight line. Whereas in females, the narrow shoulders and broader hips leads to splaying out of the forearm axis so that the hanging arms clear the hips [14]. According to Khare GN et al., the carrying angle does not help in keeping the forearm away from the side of the pelvis during walking as while walking the forearm is pronated and carrying angle disappears in pronation of forearm. They also found that carrying angle of the elbow is inversely proportional to the height and length of forearm of a person. Since, the average height and length of forearm in females is lesser than the average height and length of forearm in males, so the average value of

carrying angle is greater in females as compared to males[6].

One study had identified by anthropometric methods the sexually dimorphic features in the bone of elbow joint in a dry bone. The distal end of the humerus & the proximal end of ulna play a major role in the formation of carrying angle. It has been verified that the lower end of humerus does not show any sexual difference but the olecranon – coronoid angle of the ulna showed a clear cut sexual difference. It was reported that Olecranon - Coronoid angle exhibited high sexual dimorphism and is regarded as one of the cause of sexual difference seen in 'Carrying angle' of the elbow. Thus, smaller Olecranon - Coronoid angle of female ulna leads to the projection of olecranon process in females relatively larger than that in males leading to greater carrying angle in females than males[15].We have also found the similar picture in our study that carrying angle is greater in females than males.

In the present study, the carrying angle in dominant arm was found to be greater than non-dominant arm. Ficket al.[16]suggested that the external deviation of the forearm is due to the action of two powerful forearm muscles such as brachioradialis and extensor carpi radialis longus because of their topographical location on the radial side of the forearm which abducts the forearm radially and thus contribute to the formation of the carrying angle of the elbow. This ''muscular theory'' of the carrying angle formation supports the fact that the carrying angle is more obvious on dominant side as compared to non-dominant side. This is because the dominant side of a person has stronger muscles as compared to the non-dominant side. Also, the carrying angle is found to be greater in the dominant limb thanin the non-dominant limb of both sexes, which indicates that natural forces acting on the elbow modify the carrying angle [17].

Difference is also observed in carrying angle with regards to ethnicities[9-12]. It depicts that the difference in the growth, genetic and hormonal factors have influence on the development of carrying angle.

CONCLUSION:

This study has established data on the carrying angle in Indian population. According to the study, the carrying angle of the females ranked higher than males and that of the dominant arm was found to be significantly higher than the non-dominant arm in both sexes. Greater carrying angle in female is considered as secondary sex characteristic. The evaluation of elbow carrying angle and the knowledge of its variations are essential for handling the traumatic lesions that affect the elbow[13].

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