Correlation between Degree of Carrying Angle with Dominant Arm Among Medical Students

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ABSTRACT

Objective

The objective of this study was to obtain gender specific data in variations of carrying angle on full extension of the elbow and its correlation with dominant arm.

Methodology

One hundred and eighty healthy volunteers participated in the study with equal number of males (n=90) and females (n=90). The average age of both ranged from 18 to 22 years. All individuals with normal and healthy architecture with no history of arm or forearm fracture or surgery involving the elbow, no history of neural defects or congenital variance were included in the study. Carrying angles of elbows of both dominant and non-dominant sides were measured in case of each volunteer with the help of Goniometer.

Results

The results showed that the carrying angle was found to be greater in females (14.75±1.2) as compared to males (12.96±1.4). Also, the dominant arm of both males and females displayed an increased value of carrying angle than the non-dominant one which was statistically significant (*p*=.001)

Conclusion

Hence in this study it was found the carrying angle at elbow is greater in females and is associated significantly with the dominance of the arm.

Key words: Carrying angle, Goniometer, Dominant and Non-dominant arm

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INTRODUCTION

Carrying angle lies between the long axis of humerus and ulna.[1,2] This angle can only be visualized when the supine arm is in fully extended position and cannot be seen in the flexed position of the arm. In fully extended position, the ante brachium can be seen lying at an angle with brachium.[3] There is variation in degree of angulation in either genders. Females have been seen to be having greater degree of carrying angle than males due to differences in secondary sexual features in females.[4] One of the cause for this noticeable gender disparity may be due to increased slackness in females allowing increased degree of extension.[3] Variations in carrying angle have been observed in various age groups, races, genders, dominant upper limb, anthropometric features like height and intertrochanteric distance.[5] Higher degree of carrying angle has been observed in females.

The carrying angle was also found to be inversely proportional to the height of the individual i.e., lesser the height greater the angle.[1,5,6] As the females are lesser in heights as compared to males so the angle is large in females.[7] The general stature of males and females also leads to variation of this angle in either sex. The males have commonly wide shoulders and tapered hips. Hence this facilitates the arms to stay straight with long axis of both upper and lower arm to be in a straight line. On the contrary the slim shoulders and wide lower segment of females leads to splaying out of the forearm axis.[4,8] Another reason for a greater carrying angle in females is that angle between olecranon and coronoid processes of ulna is larger in females.[9] Also it was found in a study that the angle is greater in dominant arm than the non-dominant one.[4] Hence the angle is more in highly used and operational arm making the elbow more stronger and subsequently holds the forearm away from the body while walking.[3,4,9] The anomalous variations in values of this angle helps in detection of certain deformities of elbow and also in diagnosing a variety of diseases of medial and lateral epicondyles. The angle increases by a certain degree each year and the pace of augmentation for males and females is 0.42 and 0.60 per year, accordingly.[6] There are certain conditions related to increased

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carrying angle e.g., unstable elbow joint, painful elbow during exercise and if a person with increased carrying angle falls on an outstretched hand, he may suffer from dislocation of elbow and fracture of humerus. In addtion, the understanding of carrying angle is significant anthropologically for discrimination of sex in fragmentary leftovers of human body during autopsy. Various diseases of medial and lateral epicondyles may be diagnosed with the help of carrying angle.[10-12]

The objective of this study was to obtain gender specific data in variations of carrying angle on full extension of the elbow and its correlation with dominant arm.

METHODOLOGY

The study was conducted at Khyber Medical College, Peshawar after taking ethical approval from Institutional Review Board. A total of 180 healthy volunteers among college students participated in the study. Both males and females participated in an equal number of 90 each. The age of both genders ranged from 18 to 22 years. An informed written consent was obtained from all volunteering students. The inclusion criteria were all students with normal and healthy architecture and with no history of fracture of arm or forearm involving the elbow, neuropathies, any congenital variance and history of any surgery involving the elbow.

Carrying angles of both dominant and non-dominant sides were measured in all the participants. Carrying angles of elbows of both arms were measured with the help of Goniometer. Before taking the reading, the volunteer was asked to stand in the anatomical position with arms fully extended in supine position. The goniometer was placed on the supinated upper arm along the mid-axis of humerus and forearm with the arm in fully extended position. The measurement plate of goniometer was placed on the cubital fossa of the individual. The fixed arm of goniometer was positioned along the long axis of upper arm while the movable arm was placed along the long axis of forearm and the arrow pointed towards the angle to be noted. Carrying angles of elbows of both the arms were noted three times each side and the mean value of each was taken and all readings were transferred to the data sheet after which mean value of the whole data set was calculated and one sample t test was applied to calculate the p value.[4,7,9]

RESULTS

Of the 180 individuals who participated in the study, half were females (90) while half were males (90). The results obtained showed significantly greater degrees of carrying angle in female subjects as compared to males. The carrying angle was significantly more in females (14.75±1.2) as compared to males (12.96±1.4). Also, the dominant arm of both males and females displayed increased value of carrying angle than the non-dominant one which was statistically significant (p=.001).

The mean values of carrying angles of dominant arm of females and those of males are mentioned in table 1. The *p* value for dominant arm shows that carrying angle of dominant arm of females is significantly greater than dominant arm of males (*p*=.001). Hence the results show that females have significantly greater values of Carrying angle and also the dominant arms of both genders have greater Carrying angle.

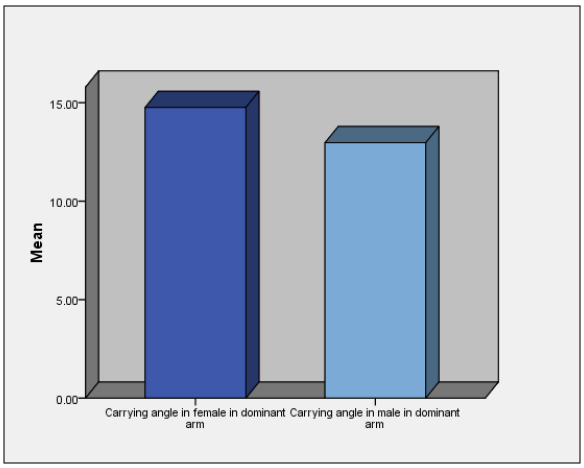

Figure 1 showing the mean values for carrying angles in both the genders

CA	Dominant arm	P value for Dominant arm	Non-dominant arm
Female	14.75±1.2	0.001	11.68±0.9
Male	12.96±1.4		10.51±1.2

Table 1 Mean values of carrying angles of dominant arm of females and males

DISCUSSION

The joint formed by alignment between humerus in upper arm and radius and ulna in forearm is called elbow joint. The arm in full extension can be seen deviated laterally as the bones forming elbow joint are not united. An angle can be seen between upper and forearm called carrying angle. This angle is slightly greater in females and the reason may be laxity of the ligaments and broader pelvis of females. This may lead to deviation of the forearm from the long axis of upper arm.[1,13] The humerus trochlea is pulley shaped and its medial projection exceeds its lateral, hence projects to an inferior level and as a result the level facade of elbow joint is about 2cm below the inter-epicondylar line. The arm and the forearm are not in a straight line in humans but the elbow joint level is situated 2cm below the line joining the humerus epicondyles. The deviation is measured by the carrying angle. The internal trochlear rim of humerus is a crest which is deep towards the distal point than the anterior side. This leads to deviation of ulna in full extension of arm

and causes formation of carrying angle. The current study is conducted on males and females of same age group, to find the difference between this angle as it has been recognized that this angle is bigger in females than in males. The angle increases with advancing age and becomes permanent at 15 years of age.[14] Anthropologically, this angle is very helpful in sex determination of skeletal relics.[11] Hence this angle may be well thought-out as secondary sexual feature. The angle is seen to be larger in dominant arm as compared to the non-dominant one in either genders from which we can conclude that the angle is modified by natural forces acting on the elbow joint.[13] The current study was conducted on adults of either sex in the age group of 18-22 years and was found to be greater in females. The carrying angle was also found to be inversely proportional to the height of the individual i.e., lesser the height greater the angle. As the females are lesser in heights as compared to males so the angle is large in females.[7] The general stature of males and females also leads to variation of this angle in either sex. The males have commonly wide shoulders and tapered hips which facilitates the arms to stay straight.

On the contrary the slim shoulders and wide lower segment of females leads to splaying out of the forearm axis.[4,7] Another reason for a greater carrying angle in females is that angle between olecranon and coronoid processes of ulna is larger in females.[15] Also it was found in this study that the angle is greater in dominant arm than the non-dominant one. Hence the angle is more in highly used and operational arm making the elbow more strong and subsequently holds the forearm away from the body while walking.[2]

CONCLUSION

Hence in this study it was found the carrying angle is greater in females and its values correlate with the dominance of the arm. That's why the study is of significant importance for forensic experts, anatomists and anthropologists with further importance in medico-legal issues.

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