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Original Research Article

CHANGES IN QUADRICEPS ANGLE (Q-ANGLE) WITH REGARD TO GENDER AND DIFFERENT ANTHROPOMETRIC PARAMETERS

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ABSTRACT

Introduction: The Q-angle is defined as the acute angle formed by the vectors for combined pull of the quadriceps femoris muscle and the patellar tendon. It has a great clinical and biomechanics significance. The present study was planned so as to study Q-angle in healthy young adult individuals and establish its relationship with different anthropometric parameters.

Material and methods: The subjects for the study were normal healthy young adult medical students from A.C.S. medical college, Chennai, India.148 subjects (80 girls and 68 boys)were studied. Males and females between the age of 18-20 years were included in the study. Q-angle was measured using standard goniometer. The Q-angle in degree was measured on both sides.

These Q-angles were correlated with various anthropometric parameters (height, weight, BMI, WHR, pelvic width, femur length).

Results: The mean Q-angle in males on left side was 8.1±1.83and that on right side was 8.6 ±2.20

The mean Q-angle in females on left side was 8.8± 2.33 and that on right side was 8.9 ± 2.52. There were no significant bilateral differences The Q-angle (Left) and Q-angle (Right) are significantly correlated with Weight (Kg), Waist (cm) and Hip (cm). However, these angles are not correlated with Weight for height or Waist for Hip ratio, pelvic width and femur length in females.In case of males, height, BMI, Pelvic width measurements were found to be correlated with Q-Left and Q-Right angle. Femur length was correlated only with Q-Left angle while there was no correlation with Q-Right angle.

Conclusion: No significant differences in both gender was also noted, No significant bilateral differences were seen. According to our study Q-angle does not vary with the age. Several anthropometric measures on correlating with Q-angle signify that irrespective of gender higher Q-angles are seen with those having high BMI, increased waist and hip-circumference.

KEY WORDS: Q-angle, goniometer, anthropometric measurements.

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INTRODUCTION

The Q-angle was first defined by Brattstrom. He described the angle with its apex at the patella, and formed between the ligamentum patellae and the extension of line formed by quadriceps muscle resultant force.It was later measured

using the the anterior superior iliac spine as the proximal landmark [1].

The Q-angle is defined as the acute angle formed by the vectors for combined pull of the quadriceps femoris muscle and the patellar tendon [2]. When measured with the knee in extension in the frontal plane, it provides a reasonable estimate of the resultant force vector between the quadriceps muscle group and the patellar tendon.

The American orthopaedic association considers 10 degree to be normal and 15 to 20 degree to be abnormal.Some authors consider a Q- angle greater than 15 degree for men and 20 degree for women to be abnormal [2,3].

Studies have reported a greater Q-angles in individuals who are suffering with pathological conditions of patellofemoral joint.

It has a great clinical and biomechanics significance. It is useful during planning and identifying candidates for surgery and assessing probable outcome that require patellar re-alignment surgery.

The present study was planned so as to study Q-angle in healthy young adult individuals and establish its relationship with different anthropometric parameters.

The aim of this study was (1)to know a normal value among the healthy young adults (2) to correlate Q-angle with anthropometric measures (body height, weight, BMI, pelvic width, waist to hip ratio, femur length) (3) to assess the difference between the two genders as well as(4)if there is any bilateral asymmetry between the two limbs.

MATERIALS AND METHODS

The subjects for the study were normal healthy young adult medical students from A.C.S. medical college, Chennai, India.

The procedure was explained to the subjects and a verbal consent was taken. Ethical clearance for the study was obtained from the ethical committee of the college. A total of 148 subjects (80 girls and 68 boys)were studied.Males and females between the age of 18-20 years were included in the study.

The subjects were normal asymptomatic adults as examined by a thorough clinical examination.

Following were the exclusion criteria-

- Subjects with prior orthopaedic surgery at lower extremities
- Subjects with previous lower extremity fractures
- Subjects with previous history of lower limb, spinal or neurological injury

We recorded the age and gender of the subject.

Measurement Of Q-Angle: Q-angle was measured using standard goniometer.The right and left side angles were measured with subject in standing position [4]. They were instructed not to flex their thighs.We palpated the anterior superior iliac spine and proximal end of a string was taped to it.The borders of the patella were palpated and its centre was identified. We taped the distal end of the string to the centre of the patella after making it taut.

The fulcrum of the goniometer was placed on the centre of the patella. The short arm was directed towards tibial tuberosity. The long arm was directed along the anterior superior iliac spine. The Q-angle in degree was thus measured on both sides.

These Q-angles were correlated with various anthropometric parameters.

DATA AND STATISTICAL ANALYSIS

B**aseline data** including age, gender, height, and weight were recorded for all volunteers.

BMI was calculated by the following formula: BMI = weight ([kg])/height (m square)

Interspinous distance (cm) between the ASIS's was also measured as an indicator of pelvic width.

Waist circumference (cm) was measured at the level of the umbilicus with the subject in mid-expiratory position. Hip circumference was recorded at the widest point over the greater trochanters, and the waist-to-hip ratio (WHR) was calculated. In obese participants (BMI >30), the waist-hip ratio (>0.9 for men and >0.85 for women) was used as a measure of central obesity, while waist-hip ratio (<0.9 for men and <0.85 for women) was used as a measure of lower body obesity.

Femur length: A non stretchable tape was used to measure the distance between the greater

trochanter and lateral condyle of the femur.

Greater trochanter: is about hand breadth (12.5cm) below tubercle of iliac crest.

Tubercle of iliac crest is about 5cm behind anterior superior iliac spine.

The mean and standard deviation for age, weight, height, BMI, W/H ratio, femur length and pelvic width were determined. Comparison of parameters were performed with the one way analysis of variance (ANOVA). Karl Pearson correlation coefficient (r) was determined between parameters (age ,weight, height, waist/hip,BMI femur length ,pelvic width and Q-angles).To compare between right and left side variation in Q-angle paired-T test was used.

RESULTS

The mean age of male candidates is 18.8 years and that of females is 18.30 years.

The average weight of males is 77.2 kg and that of females is 59.1 kg.

The average height of males is 170.5 cm and that of females is 155.38 cm.

The average BMI of the male group is 26.53 kg/m square and that of female group is 24.0kg/m square .

The average waist of males is 80.5 cm and that of females is 80.11cm.The average hip diameter of males is 84.92cm and that of females is 96.7cm.Average waist/Hip ratio of males is 0.942 and for females is 0.82. The average femur length in males is 43.75cm and that of females is 43.68cm. The average pelvic width in males is 32.0cm and that in females is 41.86cm.

Right and left side Q-angles does not vary significantly with regards to age of the female candidates. (Table1)

The mean differences in Q-angles by three selected age groups of females were seen. ANOVA carried out to see the possible significant differences between Q-angles. The result suggested no significant differences in Q-angles by age. (Table 1)

The possible significant bilateral differences between Q-angles were attempted by paired t-test. The results suggested that there are no significant differences between Q-left and Q-right angle amongst female candidates. (Table 2)

The possible significant bilateral differences between Q-angles were attempted by paired T-test.The results suggested that there are no significant differences between Q-angles among male candidates.

ANOVA carried out to test the possible significant differences in Q-angle amongst the gender, suggested that Left side Q-angle was varying significantly while Q-right angle was found to be comparable. (Table 6)

The Q-angle (Left) and Q-angle (Right) are significantly correlated with Weight (Kg), Waist (cm) and Hip (cm). However, these angles are not correlated with Weight for height or Waist for Hip ratio, pelvic width and femur length in females. (Table 3)

Right and left side Q-angles do not vary significantly with regards to age of the male candidates. (Table 4)

ANOVA suggested no significant correlation between Q-angles and age.

In case of males, height, BMI, Pelvic width measurements were found to be correlated with Q-Left and Q-Right angle. Femur length was correlated only with Q-Left angle while there was no correlation with Q-Right angle.(Table 5)

The mean Q-angle in males on left side was 8.1±1.83and that on right side was 8.6 ±2.20

The mean Q-angle in females on left side was 8.8± 2.33 and that on right side was 8.9 ± 2.52. (Table 7)

Table 1: Analysis of Variance by age and right and left sides Q-angle in females.

Q-Angle Type	Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Q-Angle (Left)	Between Groups	15.19	2	7.595	1.459	0.239
	Within Groups	374.73	72	5.205		
	Total	389.92	74			
Q-Angle (Right)	Between Groups	23.008	2	11.504	1.857	0.164
	Within Groups	445.979	72	6.194		
	Total	468.987	74			

Table 2: Paired T-test to show correlation between right and left side Q-angle in females.

Angle	Mean	SD	t-pair	P-value
Q-Left	8.8	2.3	-1.22	0.228
Q-Right	9	2.51		

Table 3: Correlation (r) of Q-angle with Weight, waist , weight for height and waist to hip ratio for female candidates.

Anthropometric measurements	Q-Angle (Left)		Q-Angle (Right)	
	r	P-value	r	P-value
Weight(Kg)	0.31	< 0.01	0.35	< 0.01
Waist(Cm)	0.32	< 0.01	0.36	< 0.01
Hip(Cm)	0.34	< 0.01	0.38	< 0.01
W/H	0.09	NS	0.09	NS
Waist/Hip ratio	0.08	NS	0.09	NS

Table 4: Comparison of left and right Q-angle in male candidates.

Angle	Mean	SD	t-pair	P-value
Q-Left	8.2	1.79	-2.24	0.028
Q-Right	8.7	2.18		

Table 5: Q-angle and its correlation (r) with selected anthropometric measurements in male candidates

Anthropometric measurement	Q-Angle (Left)		Q-Angle (Right)	
	r	P- value	r	P-value
Height(Cm)	-0.481	P < 0.01	-0.336	P < 0.01
BMI (Kg/m^2)	0.285	P < 0.05	0.259	P < 0.05
Femur Length(Cm)	-0.266	P < 0.05	-0.14	NS
Pelvic Width(Cm)	0.296	P < 0.05	0.296	P < 0.05

Table 6: ANOVA carried out to test the possible significant differences in Q-angle in male candidates.

		Sum of Squares	df	Mean Square	F	Sig.
Q-Angle (Left)	Between Groups	17.706	1	17.706	3.955	0.049
	Within Groups	644.685	144	4.477		
	Total	662.39	145			
Q-Angle (Right)	Between Groups	3.771	1	3.771	0.666	0.416
	Within Groups	815.469	144	5.663		
	Total	819.24	145			

Table 7: Average and SD of Q-angles of male and female candidates

Sex	Statistics	Q-Angle (Left)	Q-Angle (Right)
Male	Mean	8.1	8.6
	SD	1.83	2.2
	N	67	67
Female	Mean	8.8	8.9
	SD	2.33	2.52
	N	79	79

DISCUSSION

The aim of the study was to provide the clinicians with normal Q-angle value and its correlation with gender and other anthropometric measurements.

Our study was not without limitations.The location of landmarks tibial tuberosity, anterior superior iliac spine might be sometimes associated with errors but still it was located, positioned and taped with string by the trained doctor single handedly.Differences in hip width may be obscured by differences in thickness of overlying soft tissue or by the angle of the femoral neck.

The study of a normal Q-angle in this group of subjects (young adult healthy individuals) have helped us to understand the correlation between the angle and different anthropometric parameters.It has also helped us in establishing a whether there's a difference between the Q-angle between the two genders.

The angle was measured by keeping the subject in standing position. Though most of the authors prefer supine position. No particular position has been suggested by the authors previously.Turkmen et al calculated the Q-angles in three different positions supine, standing and sitting positions.According to Turkmen, Q-angle measurement in standing position reflects more physiological basis [5]. Guerra et al believed that the standing position depicts the functional position of the lower limb more appropriately than the supine position [6].

The mean Q-angle in males on left side was 8.1±1.83 degrees and that on right side was 8.6 ±2.20 degrees.

The mean Q-angle in females on left side was 8.8± 2.33 degrees and that on right side was 8.9 ± 2.52 degrees.(Table 7)

There were significant differences in Q-angle of left side between the two genders. There was not significant difference in Q-angle on right side between the two. This difference on one side and not on the other could not be explained. The study conducted by Bade et al established Q-angles of as much as 14.5° as the upper limit of normal for adult Nigerian men and 27.5° as the upper limit of normal for adult Nigerian women [2].

High Q-angle has been related to be as an assessor of a patellofemoral pain syndrome by Kaya et al . [7] Horton et al concluded in their study concluded that female have higher Q-angle but could not explain anatomical basis [8].

As compare to previous studies ,which have concluded significant higher Q-angle in females

due to wider pelvis and short femur length.

The present study did not show any correlation between the Q-angle and age of the individual. Our study found right and left side Q-angles does not vary significantly with regards to age of the female as well as male candidates.There's a negative correlation between age and Q-angles. Bhalara et al concluded that with increase in age Q-angle increases [3].

According to Schultz et al, decrease in quadriceps angles and anterior knee laxity were greater in males compared to females, and females were observed to have a more inwardly rotated hip and valgus knee posture, compared to males [9].

No significant differences were found in right and left Q-angles of both male and females. Similar studies were conducted by Veeramani et al and bilateral variations were attributed to an alteration of relative placement of tibial tuberosity with respect to centre of the patella. In his study, mean right Q-angle was more than the left [1].

The minor bilateral differences can be attributed to errors in measurement. In present study q-angle showed a negative correlation with height. Jha and Raza in their study reported that Q angle had negative correlation with height, length of lower limb and length of femur [10]. In present study, in relation to other anthropometric measurements, Q-angle is positively correlated with weight, waist and hip circumference in females. The high values of Q-angle in females with increased weight, waist and hip circumference can be due to high body fat in lower body area. In addition, variations in the body fat for the same BMI might also be caused by variations of physical activity, diet and ethnicity.

In case of males, in the same study Q-angle is positively correlated with height, BMI and pelvic width. Femur length was significantly correlated with left Q-angle.

BMI of these young adults are falling in the category of peripheral obesity i.e. accumulation fat along thighs, hips due to sedentary lifestyle and lack of physical activity.

CONCLUSION

This study gave us the Q-angle values in young healthy adults of the age group 17-20 years. The mean Q-angle in males on left side was 8.1±1.83and that on right side was 8.6 ±2.20. The mean Q-angle in females on left side was 8.8± 2.33 and that on right side was 8.9 ± 2.52. No significant differences in both gender was also noted. No significant bilateral differences were seen. According to our study Q-angle does not vary with the age. Several anthropometric measures on correlating with Q-angle signify that irrespective of gender higher Q-angles are seen with those having high BMI, increased waist and hip-circumference.

The data collected is important because it can provide clinicians with better definitions of normal because it defines the difference between the Q angles of males and females.

ABBREVIATIONS

BMI - body mass index,

WHR - waist for hip ratio

Conflicts of Interests: None

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