

Article

The correlation of quadriceps angle with respect to bicondylar distance of femur and body height measurement in north indian adult human population

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Abstract: Background: Before taking the dimension, the persons were positioned such that the hips and knees were in extension, the quadriceps muscles were relaxed, and the legs and ankles were neutral. Following mark-ing, one of the arms of the manual goniometric was placed such that the ASIS and the patellar middle point were combined, and the other arm was placed so that the tuberosa of tibia and the patellar centre were collective. The dimension value was recorded after the manual goniometry was positioned. **Aim and Objective:** The objective of the study is to find out the bilateral variation in the mean Q- angle (Quadriceps angle) values in both male and female. This study is to determine the correlation between Q- angle (quadriceps angle) values, Bicondylar distance and body height measurement. **Material and Method:** The present study was done on 500 adult human subjects (300 male and 200 female) of north Indian origin. The Q angle is precise with a full circle universal manual goniometry which is made of clear steel with the subject standing in the upright weight-bearing position. **Result:** The dimension of Quadriceps angle values in males from right side (mean 13.25) and from left side (mean 13.41) , the Q- angle values in females from right side (mean 16.97) and from left side (mean 16.35) ($P < 0.0001$). The effect shows that the Q-angle was more prominent in females than in males. The difference of Q-angle with dominant side revealed that left side of Q- angle value (both males and females) was more often higher than right side. **Conclusion and Discussion:** The Quadriceps angle values of both males and females decreases with increases in body height which shows a positive correlation with body height and condylar distance. Positive correlation exists between Quadriceps angle and Body height.

Keywords: Q-angle values; Body height; Bicondylar distance; Age and gender.

1. Introduction

The Q-angle is defined as the acute angle formed by the vectors for the combination of the pull of the quadriceps femoral muscle and the patellar tendon. The reasons for high angles among females are enhanced pelvic width, shorter femur length, or due to more laterally placed tibial tuberoses. [1-4] The Q-angle measurement is broadly used to indicate patella femoral dysfunction. Q angles were measured bilaterally by experienced physiotherapists while the participants were standing and in the supine position. [5-7] Before taking the measurement, the individuals were positioned such that the hips and knees were in extension, the quadriceps muscles were relaxed, and the legs and ankles were neutral. Thus, the quadriceps femoral muscle, which contracts frequently and is stronger, can cause a low Q angle. [8,9] This act translated the patella laterally and increased the retro patellar pressure. In addition, this increase in contact pressure may increase the likelihood of lateral patellar sublimation or dislocation. [12] Q-angle has become accepted as an important factor in assessing knee joint function and determining knee health in individuals suffering from anterior knee pain. [10-12] An excessive Q angle indicates a tendency for added biomechanical stress during repetitive activities using the knee because it interferes with the smooth movement of the patella in the femoral groove. [13] People who perform regular sports may have a more uniform body posture and appearance than

sedentary people; increased Q angle may have a negative effect. [14–16] The Q angle, an indicator of normal alignment in the lower extremity and biomechanical function, simultaneously provides important data on the athlete's lower extremity functional capacity. [17] In biomechanics and anthropometry, many methods have been developed to measure lower extremity alignment using various anatomical variables. [5,18,19] Serious problems are also observed with the correlation of static and dynamic Q-angle with the lower limb's biomechanical behavior and its correlation with various clinical manifestations. [20,21] Anterior knee pain is the most common knee complaint in adolescents and young adults. The rate is around 9% in young active adults and as high as a quarter of all knee problems treated at a sports injury clinic. [22,23] An improvement was obtained, however, after realignment surgery of the extensor mechanism. [24]

2. Material and methods

The present study on Quadriceps angle is done on 500 adult volunteers (300 male and 200 female) aged between 18 and 45 years of North Indian origin. The study was conducted in the Department of Anatomy, Malwanchal University, Indore (Madhya Pradesh).

2.1. Inclusion criteria and Exclusion Criteria:

Normal and Healthy Subjects and Subjects of North Indian Origin are the Inclusion criteria. Subjects with a history of disorders or any anomalies and affected limbs are the Exclusion criterion.

2.2. Materials and Methods:

The present study was precise on 500 adult subjects (300 male and 200 female) aged 18 to 45 years of north Indian origin. The study was calculated in the Department of Anatomy, Malwanchal University, Indore (Madhya Pradesh). The Q angle is considered with a full circle universal manual Goniometry made of clear steel with the subject standing in the erect weight-bearing position. The anterior superior iliac spine (ASIS), the midpoint of the patella, and the tibial tuberosity are replaced and firm. [11,14,16] The hinge of the Goniometer is located at the midpoint of the patella; the goniometer arms are adjusted to become positioned to the line joining the ASIS and the line joining the tibial tuberosity, then the small angle on the Goniometer is read as the Q angle. Both sides are measured for each individual, and the mean values of the Q-angle are calculated. (Figure 1) Stadiometer does height, and the subject standing in an anatomical position, on their heels together, buttocks, shoulder, and head touched the walls of the Stadiometer. [12,22,25] The subjects are taken a deep breath and hold it. The head of the Stadiometer was placed on their head and wall to decide the maximum height, then told to extend and step away from the wall. Measurement is taken from the vertex to the heel. (Figure 2)

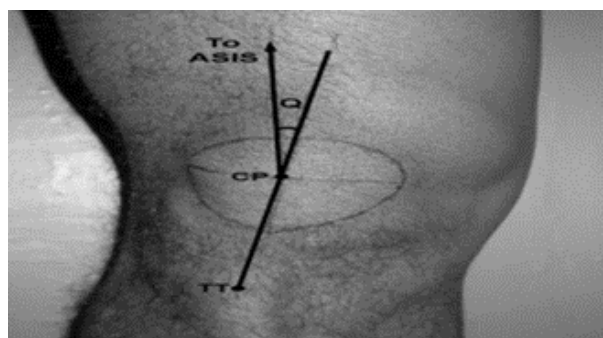


Figure 1. Measurement of Q- angle



Figure 2. Body Height Measurement

A manual vernier calliper, scaled from 0 cm to 20 cm and with a marginal error of $\pm 1mm$, is used to measure the condylar distance of the femur for both sides of each volunteer. [18,26] The subject is sitting on a chair with the feet facing forward, and the leg is flexed to 90° with the result that the femoral condyles became prominent and easily palpable at that position. After the fixed arm of the caliper is placed on the lateral condyle and the movable arm is adjusted to the medial condyle, the condylar distance measurement for each side is determined and recorded on the participant's investigation sheet. [6] (Figure 3)

For the purpose of study, the total number of subjects has been divided into five groups according to the age:

- Group I - 18 to 24 years
- Group II - 25 to 29 years
- Group III- 30 to 34 years
- Group I V - 35 to 39 years
- Group V - 40 to 45 years



Figure 3. Measurement of condylar distance of Femur

3. Results

Age group (18 to 24), the Measurement of Quadriceps angle values in males from the right side (mean 13.25) and from the left side (mean 13.41), the Q- angle values in females from the right side (mean 16.97) and from the left side (mean 16.35). Age group (25-29) the Q-angle values in males from the right side (mean 13.25) and from the left side (mean 13.37), the Q-angle values in females from the right side (mean 15.87) and from the left side (16.0). Age group (30-34), the Q-angle values in males from the right side (mean 13.21) and from the left side (mean 13.23), the Q-angle values in females from the right side (mean of 16.15) and from the left side (mean of 15.85). Age group (35-39) the Q-angle values in males from the right side (mean 12.88) and from the left side (mean 13.40), the Q-angle values in females from the right side (mean 15.45) and from the left side (mean 15.72). Age group (40-45) the Q-angle values in males from the right side (mean 13.26) and from the left side (mean 15.94), the Q-angle values in females from the right side (mean 13.43) and from the left side (mean 16.07). The Q-angle values on both sides were significantly ($P < 0.0001$) greater in females than males. The result shows that the Q-angle was more prominent in females than males. The variation of the Q-angle of the Q-angle (both males and females) was more often greater than the right side. (Table 1)

3.1. Regression formulae for estimating the Quadriceps angle of a subject using body height

Male:

$$Y = 13.812 + 0.0095x$$

$$R^2 = 0.0028$$

Female:

$$Y_1 = 23.914 + 0.0557x_1$$

$$R^2 = 0.0504$$

x, x_1 is the body height of male and female

y, y_1 is the quadriceps value of male and female

3.2. Regression formulae for estimating the Condylar distance of a subject using body height

Male:

$$Y = 25.757 + 0.3447x$$

$$R^2 = 0.0782$$

Female:

$$Y_1 = 66.947 + 0.0904x_1$$

$$R^2 = 0.0089$$

x, x_1 is the body height of male and female

y, y_1 is the condylar distance value of male and female

Table 1. Measurement of Q-angle according to age

Age Group	N (%)	Mean \pm S.D (Right)	Mean \pm S.D (Left)	P-Value
18-24	Total-100%	14.58 \pm 2.12	14.59 \pm 1.93	0.0001
	Male-60%	13.25 \pm 1.10	13.41 \pm 1.18	
	Female-40%	16.57 \pm 1.68	16.35 \pm 1.44	
25-29	Total-100%	14.32 \pm 1.63	14.45 \pm 1.66	0.0001
	Male-60%	13.25 \pm 0.83	13.37 \pm 0.66	
	Female-40%	15.87 \pm 1.22	16 \pm 1.45	
30-34	Total-100%	14.39 \pm 1.69	14.40 \pm 1.81	0.0001
	Male-60%	13.21 \pm 0.83	13.23 \pm 1.03	
	Female-40%	16.15 \pm 0.98	16.15 \pm 1.23	
35-39	Total-100%	13.91 \pm 1.61	14.33 \pm 1.53	0.0001
	Male-60%	12.88 \pm 0.79	13.40 \pm 0.91	
	Female-40%	15.45 \pm 0.80	15.72 \pm 1.61	
40-45	Total-100%	14.32 \pm 1.61	14.47 \pm 1.69	0.0001
	Male-60%	13.26 \pm 0.74	13.43 \pm 0.86	
	Female-40%	15.94 \pm 1.17	16.07 \pm 1.38	

Measurement of Quadriceps angle values of both males and females from the right side (mean 16.10) and from the left side (mean 16.18) according to body height range (140-150). Q-angle values of both males and females from the right side (mean 14.90) and from the left side (mean 15.0) according to body height range (151-160). Q-angle values of both males and females from the right side (mean 13.61) and from the left side (mean 13.82) according to body height range (161-170). Q-angle values of both males and females from the right side (mean 13.53) and from the left side (mean 13.65) according to body height range (171-180). The Quadriceps angle value of both males and females decreases with increased body height, which shows a positive correlation with body height. (Table 2)

Table 2. Measurement of Quadriceps Angle (According to Body Height) of both Male and Female

Body Height(Range)	(N)	Right(Mean \pm S.D)	Left(Mean \pm S.D)
140-150	74	16.10 \pm 1.49	16.18 \pm 1.33
151-160	128	14.90 \pm 1.73	15 \pm 1.81
161-170	221	13.61 \pm 1.36	13.82 \pm 1.37
171-180	78	13.53 \pm 1.18	13.65 \pm 1.31

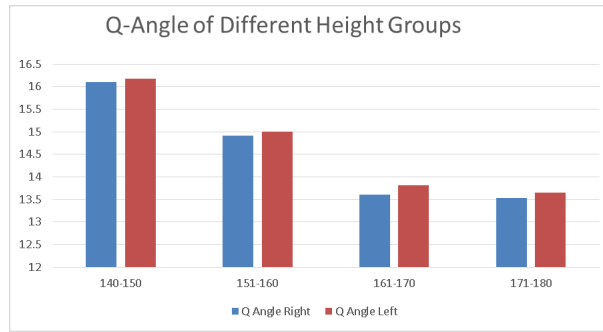


Figure 4. Comparison of Q- angle values from Height Measurement.

Table 3. Measurement of Condylar Distance (According to Age Group)

Age Group	N (%)	Mean ± S.D (Right)	Mean ± S.D (Left)	P- Value
18-24	Total- 100%	79.97 ± 8.63	79.87 ± 8.73	0.0001
	Male- 60%	78.54 ± 9.80	78.42 ± 9.95	
	Female- 40%	82.12 ± 5.88	82.04 ± 5.85	
25-29	Total- 100%	82.87 ± 5.86	82.86 ± 5.73	0.0001
	Male- 60%	84.49 ± 5.35	84.46 ± 5.26	
	Female- 40%	80.36 ± 5.13	80.36 ± 5.53	
30-34	Total- 100%	82.55 ± 8.11	82.49 ± 8.02	0.0001
	Male- 60%	85.99 ± 5.95	85.88 ± 5.72	
	Female- 40%	77.39 ± 8.19	77.39 ± 8.27	
35-39	Total- 100%	81.73 ± 6.90	81.65 ± 6.63	0.0001
	Male- 60%	85.35 ± 5.78	85.15 ± 5.40	
	Female- 40%	76.3 ± 4.44	76.40 ± 4.48	
40-45	Total- 100%	81.30 ± 6.54	81.30 ± 6.45	0.0001
	Male- 60%	84.29 ± 5.42	84.43 ± 5.21	
	Female- 40%	76.71 ± 5.35	76.98 ± 5.48	

Table 4. Correlation between Condylar Distance and Quadriceps Angle According to Height

Body Height	Condylar Distance		Q Angle	
	Right	Left	Right	Left
140-150	79.15	79.05	16.11	16.18
151-160	79.03	79.14	14.91	15.01
161-170	82.49	82.48	13.61	13.82
171-180	86.22	81.61	13.53	13.65

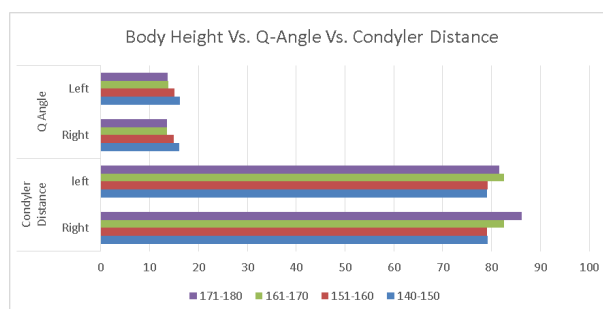


Figure 5. Comparison between Condylar Distance and Q- angle with respect to Height of both male and female

4. Discussion

Allouh MZ. et al. (2019)-Performed their Study on Q-angle on 500 subjects from 19 to 25 years. The mean and standard value of q-angle were 17.35 ± 0.225 in females, 14.1 ± 0.21 in males, 16.7 ± 0.43 on the right side and 16.4 ± 0.12 on the left side, and p-value was <0.01 . The Study shows that the Q-angle was female more often greater than the male, and the Q-angle value was greater on the right side than the left side-Supriya A. et al. (2018)- Conducted their Study on the Q-angle on 100 volunteers. The mean and standard value of Q-angle was 12.45 ± 1.22 in males from the right side, 11.77 ± 0.92 from the left side, 17.64 ± 1.87 in females from the right side, 16.46 ± 1.71 from the left side and p-value of both males and females was <0.001 . The result of the Study was that q-angle values were greater in females than in males. Maharjan R. et al. (2013) - Conducted their Study on Q-angle measurement on 1200 volunteers; the mean and standard values of q-angle were 13.89 ± 1.74 in males from the right side and 13.76 ± 1.66 from left side, 13.94 ± 1.74 in females from right side and 13.90 ± 1.61 from left side and p-value was >0.05 . The Study shows that the mean values of females were higher than those of males. Chaudhary M. et al. (2019) Concluded their Study on Q-angle on 100 subjects; the mean and standard values of q-angle were 15.60 ± 4.56 in males from the right side and 14.04 ± 4.25 from left side, 16.80 ± 4.23 in females from right side and 16.20 ± 4.20 from left side and p-value was 0.080 in male and 0.482 in female. The Study revealed that the mean values of females were higher than those of males. Allouh MZ. et al. (2019) Conducted their Study on Q-angle 500 subjects. This shows that the q-angle and the condylar distance were directly proportional; the q-angle increased significantly as the condylar distance increased. Chauhan R. et al. (2017) Performed their Study on condylar distance on 100 dry femora. The condylar width of the femur was 73.11 ± 6.14 from the right side and 72.16 ± 6.58 from the left side. The study found that the right side of the condylar distance was more often greater than the left side. **In the present Study**, the mean and standard value of Q- angle is 13.25 ± 1.10 in males from the right side, 13.41 ± 1.18 from the left side, and q-angle value is 16.57 ± 1.68 on females from right side, 16.35 ± 1.44 from the left side. The Study found that the mean q-angle of females is greater than that of males. The Study shows that the Right condylar distance value was often greater than the left side. The age group 40-45, the condylar distance was increased on the left side.

5. Conclusion

Positive correlation exists between Quadriceps angle and Body height. The result shows that the Q- angle was more prominent in females than in males. The variation of Q-angle with dominant side revealed that left side of Q- angle (both males and females) was more often greater than right side.

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Conflicts of Interest: The authors declare that they do not have any conflict of interests.

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