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Original article

ANALYSIS OF Q ANGLE VALUES OF FEMALE ATHLETES FROM DIFFERENT BRANCHES

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Abstract

Aim. The purpose of this study is to examine the Q angle values of female athletes in different branches.

*Methods.*42 female athletes from different branches (Badminton, Rugby, Volleyball, Basketball, Futsal) studying at Ondokuz Mayıs University YaşarDoğu Faculty of Sports Sciences who were actively doing sports participated in the study. The subjects' Q angle, pelvic width and femur length were measuredrespectvely. Care was taken not to include any participants who had any kind of knee injury in the past. SPSS 22.0 package program was used for the statistical analysis of the data. In statistical analysis of the data, One-Way ANOVA and LSD correction test were used in repeated measurements to make comparisons between branches. Pearson correlation analysis was used to analyze the association between variables.

Results. When the findings of our study were examined, it was found that volleyball and basketball players had higher averages of height than other branches and volleyball and futsal players had higher Q angle values when compared with other branches ($p<0.01$). When pelvic widths and femur lengths were examined, it was found that volleyball and futsal players had wider pelvis while volleyball, futsal and basketball players had longer femurs when compared with the players of other branches($p<0.01$).

Conclusions. As a conclusion, it was found that Q angles of female athletes varied in terms of different branches, while some physical parameters such as sports age, femur length and pelvic width were found to have direct or indirect influences on Q angle. It is thought that as the strength of quadriceps muscle, which is used dynamically during regular training and sports, Q angle may be decreased and thus the risks of injury that can result from high Q angle can be reduced.

Keywords: Female, Athlete, Q angle

Introduction

Quadriceps femoris angle, which is also known as Q angle or patellofemoral angle, has been defined as the angle between a line drawn to the center of patella from anterior superior iliac spine (ASIS) and another one drawn from the center of patella to tibial tubercle center (Hahn and Anders,1997). While this angle is thought to be useful in patellofemoral assessment, it is also a skeleton based measurement and it is used in the detection of joint function and lower extremity alignment (Timo et al, 2000; Holmes et al,1998; Schulthies1995). Although it is not a definite result, it is obviously seen in literature that women have higher Q angles than men and it is thought that the basic reason for these results depends on gender differences (Livingston, 1998). The general assumption about this view results from the fact that women have wider gynecoid pelvis (Krivickas,1997; Mellion,1996). While there is no definitive diagnosis for the norm values of Q angle, non-normal values for this angle are thought to be 15 degrees and higher for men and 20 degrees and more for women (Horton and Hall,1989; Woodland,1992). In addition, it is thought that when the Q angle exceeds the limit of 15-20 degrees, this causes disorders in the extensor mechanism of the knee and causes patellofemoral pain with the tendency of patella to slide to the lateral (Timo et al,2000).

In addition to causing knee injuries, Q angle is also reported to be affected by a great number physical factors and postural defects (McConnell and Fulkerson, 1996, Eliöz et al,2015). Although there are studies which have reported increased Q angle in people with short femur lengths, empirical studies have not found a direct significant association between Q angle and pelvic width and femur length (Horton and Hall, 1989). Since patella is located in the quadriceps femoris muscle, the contractions of this muscle tend to decrease and restore Q angle. Thus, quadriceps femoris muscle, which contracts frequently and which is stronger, can cause low Q angle. When these results are taken into consideration, it is thought that Q angles can give positive results directly proportional with the frequency of trainings and the strength of quadriceps femoris muscle; at the same time, Q angle in sports has contributed to necessary surgical interventions for the knee (Aglietti et al,1983;

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Stephen et al,1991)

The purpose of this study is to examine whether the quadriceps muscle used dynamically by female athletes of different branches causes a change in Q angle with regular training, to find out the differences between these and to find out the association between Q angle and femur length and pelvic width.

Methods

42 female athletes from different branches (Badminton, Rugby, Volleyball, Basketball, Futsal) studying at OndokuzMayıs University YaşarDoğu Faculty of Sports Sciences who were actively doing sports participated in the study. The participants of the study had an average age of 22.62±3.49 years, an average height of 166.95±6.05 cm and an average weight of 59.83±7.98 kg. Care was taken not to include any participants who had any kind of knee injury in the past.

All the participants were informed orally about the purpose of the study. Before the measurements, the subjects were asked about whether they had any injury or surgical intervention of the lower extremity in the past and the results were recorded. Pelvic width and femur length were measured when the subject was in prone position by using a tape measure with spaces of 1 millimeter. Pelvic width was found by measuring the distance between both anterior superior iliac spine, while femur length was found by measuring the distance between trochanter major and condylusmedialis. Q angle was measured from the right knee when the subject was in prone position on a horizontal plane and quadriceps muscle was loose in both lower extremities in full extension. The measurements were made with Lafayette digital goniometer. Anterior superior iliac spine, patella center andtibial tubercle were marked and the goniometer was placed with its midpoint on the patella center. One arm of the goniometer was lined on the ASIS point, while the other one was lined on the tibial tubercle point and Q angle was recorded in degrees. SPSS 22.0 program (SPSS Inc, Chicago, Illinois) was used for the statistical analysis of the data. Average and standard deviation were used to find out descriptive values. Before statistical procedures, Shapiro-Wilk test was administered to control normal distribution. Skewness and Kurtosis values were checked for non-normally distributed data set. In statistical analysis of the data, One-Way ANOVA and LSD correction test were used in repeated measurements to make comparisons between branches. Pearson correlation analysis was used to analyze the association between variables.

Results

When the descriptive data of the subjects were examined, it was found that they had an average age of 22,62±3,49 years, average height of 166,95±6,05 cm, average weight of 59,83±7,98 kg, average body mass index of 21,41±1,96 kg/m^2 and average sports age of 8,67±1,97 years

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Table 1. Descriptive Data of the Subjects

Variable	N	Min.	Max.	Ave.	S.D.
Age (years)	42	19,00	37,00	22,62	3,49
Height (cm)	42	157,00	181,00	166,95	6,05
Weight (kg)	42	46,00	82,00	59,83	7,98
BMI (kg/m^2)	42	16,90	26,78	21,41	1,96
Sports age (years)	42	5,00	12,00	8,67	1,97

In Table 2, the subjects' data were compared in terms of sports branches. When the height averages of branches were examined, it was found that height averages of volleyball and basketball players were higher than the other branches, while the Q angle values of volleyball and futsal players were higher when compared with other branches ($p<0,01$). When pelvic width and femur length were examined, it was found that volleyball and futsal players had wider pelvis while volleyball, futsal and basketball players longer femurs when compared with other branches ($p<0,01$).

Table2. Comparison of the subjects' physical, physiological, Q angle, pelvic width and femur length values in terms of their sports branch

Variable	Groups	Average (%)	S.D.	F	p	Significant difference
Age (years)	A. Badminton	23,67	1,15	**5,259**	**0,002**	B-C
	B. Rugby	27,50	3,70			B-D
	C. Volleyball	20,38	1,61			B-E
	D. Basketball	23,62	4,41			C-D
	E. Futsal	21,89	1,17			
Height (cm)	A. Badminton	164,00	1,00	**3,287**	**0,021**	B-C
	B. Rugby	161,00	7,35			B-D
	C. Volleyball	169,54	5,98			E-C
	D. Basketball	169,00	4,91			E-D
	E. Futsal	163,89	5,30			
Weight (kg)	A. Badminton	56,00	6,56	**1,334**	**0,275**	-
	B. Rugby	54,25	6,13			
	C. Volleyball	61,92	9,74			
	D. Basketball	61,92	7,52			
	E. Futsal	57,56	5,75			
BMI (kg/m^2)	A. Badminton	20,83	2,53	**0,162**	**0,956**	-
	B. Rugby	20,89	1,28			
	C. Volleyball	21,48	2,63			
	D. Basketball	21,62	1,59			
	E. Futsal	21,41	1,71			
Sports Age(years)	A. Badminton	6,33	0,58	**1,298**	**0,289**	
	B. Rugby	8,25	2,06			A-D
	C. Volleyball	8,77	1,59			A-E
	D. Basketball	9,00	2,45			
	E. Futsal	9,00	1,73			
Q Angle (degree)	A. Badminton	14,67	3,21	**3,397**	**0,018**	C-A
	B. Rugby	21,50	7,14			C-D
	C. Volleyball	26,54	7,01			E-A
	D. Basketball	19,15	7,29			
	E. Futsal	24,67	5,00			
PelvicWidth(cm)	A. Badminton	28,00	1,00	**4,041**	**0,008**	C-A
	B. Rugby	28,88	4,73			C-B
	C. Volleyball	34,92	4,12			C-D
	D. Basketball	29,50	4,33			E-D
	E. Futsal	33,28	4,65			
Femur Length (cm)	A. Badminton	41,33	1,53	**6,141**	**0,001**	A-C
	B. Rugby	41,25	9,39			A-D
	C. Volleyball	53,96	5,29			A-E
	D. Basketball	50,31	3,90			B-C
	E. Futsal	50,67	6,40			B-D
						B-E

Table 3 examines the association between variables. Moderate significant association was found between age and Q angle and pelvic width; height and femur length; weight and pelvic width and femur length; branch and femur length and pelvic width and femur length ($p<0,05$).

Table3. Analysis of the association between variables

Variables	Value	Q Angle	PelvicWidth	Femur Length
Age (years)	r	-0,367*	-0,415**	-0,268
	p	0,017	0,006	0,086
	n	42	42	42
Height (cm)	r	-0,043	0,284	0,567**
	p	0,787	0,068	0,000
	n	42	42	42
Weight (kg)	r	-0,119	0,361*	0,323*
	p	0,455	0,019	0,037
	n	42	42	42
BMI (kg/m^2)	r	-0,115	0,286	0,017
	p	0,467	0,067	0,912
	n	42	42	42
SportsAge (years)	r	-0,157	-0,126	0,089
	p	0,321	0,425	0,573
	n	42	42	42
Branch	r	0,133	0,134	0,323*
	p	0,400	0,397	0,037
	n	42	42	42
Q Angle(degree)	r	1	0,302	0,268
	p	-	0,052	0,086
	n	42	42	42
PelvicWidth (cm)	r	0,302	1	0,563**
	p	0,052	-	,000
	n	42	42	42
FemurLength (cm)	r	0,268	0,563**	1
	p	0,086	0,000	-
	n	42	42	42

Discussion

Since it is not easy to measure internal forces, scientists have preferred to make use of measurements related with the postural structure of the knee such as quadriceps (Q) angle in order to find out predisposition to injuries (Kishali et al,2004). Q angle is the acute angle on the point where quadriceps femoris axis and patellar tendon axis intersect (Livingston,1998). Besides causing injuries, the changes in Q angle are also associated with a great number of factors and posture defects (McConnell and Fulkerson, 1996). This angle is generally associated with frontal plane movements (Schulthies et al, 1995). When associated with sportive performance, it can be said that this angle

is influenced by factors based on structure, condition, coordinate, personality and branch (Schnabel et al, 2016).

When the literature is reviewed, it can be seen that there are no exact values presented for both genders in terms of sport branches. When examined in general, it was found that males had minimum 8 degrees, maximum 14 degrees of Q angle, while females had between 11 and 22 degrees average values of Q angle (Horton and Hall,1989; Søjbjerg at all, 1987). When results higher than the maximum values for men and women were found, they were considered as non-normal and the rate of predisposition to injuries was thought to be higher (Woodland and Francis, 1992).

In our study we examined Q angles of female athletes who did sports actively and some of the physical parameters that may have an influence on this angle, statistically significant differences were found between branches ($p<0,01$, $p<0,05$). When Q angle values were examined in terms of the variable of branch, it was found that female volleyball and futsal players showed higher degrees when compared with other branches ($p<0,05$). When literature was reviewed, it was reported that the changes in Q angles differed based on the rate and intensity of physical activity and athletes who with more intense training programs showed lower results and it was stated that the results were associated with biomechanical factors such as femur length and pelvic length. At the same time, the increase in the strength of especially the quadriceps muscle group in the knee is said to cause decreases in the values of Q angle and as the Q angle decreases, quadriceps muscle is reported to have a more effective traction (Schulthies et al, 1995; Di Brezzo et al, 1996; Muratlı et al, 2000; Bayraktar et al, 2004; Eliöz et al, 2015). In their study, Hahn and Foldspang (1997) found that as the force applied by quadriceps muscle group increased, Q angle decreased. Based on all these results, it was found that Q angle values found in our study were in line with the literature in all branches except for futsal and volleyball, while these two branches were found to have higher results than literature. It is thought that the athletes in these two branches may have done these sports amateurishly or as a recreation activity and they may have not applied a regular training program.

It was found in our study that femur length showed higher results especially in basketball and volleyball when compared with other branches and a moderate significant association was found between branch and femur length ($r=0,323$). When other studies were examined, the heights of basketball and volleyball players were found to be higher when compared with other branches and thus it is thought to have an influence on femur length (Atan et al, 2012).

According to the results of our study, a slight association ($r=-0,157$) was found between sports age and Q angle ($p<0,01$). This result is thought to have occurred as a result of the high association between quadriceps muscle group used actively during physical activity and Q angle and the results of other studies examined support this finding (Guerra et al,1994;Eliöz et al,2015).

Conclusion

As a conclusion, it was found that Q angle values of female athletes differed in terms of different branches and at the same time some physical parameters such as sports age, femur length and pelvic width were found to have direct or indirect effect on Q angle. It is thought that as the strength of quadriceps muscle, which is used dynamically during regular training and sports increases, Q angle may be reduced and thus risks of injury that may result from high Q angle can be decreased.

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