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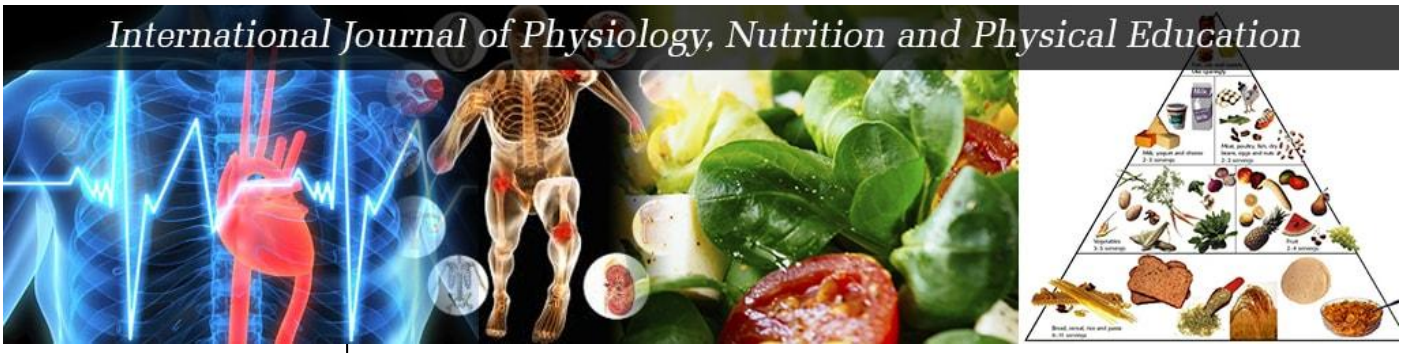

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Effect of isometric quadriceps contraction on the q angle in standing and supine positions among young females

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Abstract
Background: Q angle is an essential parameter which is affected by many factors like age, sex, measurement techniques, pelvis position, foot position, the status of quadriceps and the body position used for measurement and higher Q angle associated with many knee pathologies.
Objective: Objective of this experimental study was to compare the Q angle among females with or without isometric contraction in standing and supine position in both right and left leg.
Materials &Methods: Study Design: Explorative study design; Sampling Technique: Simple random sampling; Sample Size: 50 participants were included in the study with the age group of 18-30 years; Measurement of Q angle: The right and left sided Q angles were measured with subjects barefooted and in both standing and supine position. Q angle were measured using the universal goniometer; Statstics: Data was analyzed using SPSS software 20.0 version and Z test was used to compare the outcome measure
Results: Result of present study showed that there was a significant difference in comparing Q angle with or without contraction of quadriceps in lying and erect body positions but Q angle was more in standing position as compared to supine position and Q angle decreases with the isometric contraction of quadriceps in both body positions. When we compared bilateral variability in standing and supine position result was non-significant.
Conclusion: The present study concluded that there was Q angle decrement with static quadriceps contraction in both standing and supine positions but there was no significant bilateral variability.

Keywords: Q angle, bilateral variability, quadriceps isometric contraction, body position

1. Introduction

Q angle is an essential parameter which is responsible for knee pathologies. Q angle was the first described by Brattstorom as an angle formed between the ligamentum patellae and quadriceps femoris muscle resultant force [1]. Later on the Q angle was measured by taking ASIS as the proximal point. The Q angle provides a relationship between the vector force of the quadriceps femoris muscle and the patellar tendon. Normal Q-angle is 8^0–17^0 in males and 12^0–20^0 in females [2, 3].

A higher Q angle (greater than 20^0) may influence the biomechanics of knee joint and patella femoral articulation is mostly affected by much pathology like anterior knee pain syndrome, chondromalacia patellae, patellar tracking, patella femoral pain syndrome, and patellar instability or patellar subluxation [4, 5]. Patello femoral pain syndrome (PFPS) occurs when the patellar tracking continues and increases the pressure behind the knee resulting in tearing of articular cartilage and degeneration of the articular surfaces [6-8]. Q angle of greater than 20^0-22^0 predisposes to patellar dislocation. There is more risk of PFPS in sitting cross legs and squatting position. So patella femoral problems are seems to be more common among Indians. Increase in contact pressure may cause lateral patellar subluxation or dislocation [9-10].

An exaggerated knee Q angle associated with increased anterior pelvic tilt, femoral ante version, external tibial torsion or a lateral displacement of tibial tubercle [11-14].

There is some disagreement on the reliability and validity of the Q-angle [15-18]. The value of Q angle varies according to sex of subjects [19], the anatomical landmark [20], measurement techniques [21-23], the position of the limb in regarding to the pelvis [24, 25], the status of quadriceps contraction [26-28] and standing or supine position in which measurement is taken [29].

The Q angle does not shows direct relationship with power of quadriceps muscle means as value of Q angle increases, lower the muscle strength of quadriceps muscle. Past studies supported that reduced Q angle associated with maximal voluntary contraction of quadriceps [26-28].

There were some studies which showed that the supine position seems to be more superior to the standing position for analysis of Q angle but there is paucity of literature regarding analysis of Q angle value in different body positions [30]. Hence aim and objective of the present study was to compare the Q angle among females with or without isometric contraction in standing and supine position in both right and left leg.

2. Methodology

Explorative study design of study was chosen. 50 normal female subject's of age group of 18-30 years recruited by simple random sampling from departments of Guru Jambheshwar University of Science & Technology, Hisar. Patients excluded with complaints of knee pain or deformity or any knee pathology.

2.1 Measurement of Q angle: Measurement of both sides Q angles with subjects barefooted and in both body position. Q angles were measured using the universal goniometer (half circle) with two arms-one stationary and lengthened and the other movable arm. Q angle was measured by drawing two imaginary lines. The first line extended from the Anterior Superior Iliac Spine (ASIS) to the centre of patella. The second line extended from the tibial tuberosity to the centre of patella. The angle with these lines intersected was regarded as the Q angle. The point where both lines (one from lateral to medial and other from superior to inferior) intersected was regarded as the midpoint of patella. Then this point of patella was marked with relaxation of quadriceps and contraction of quadriceps in both positions. In both position, the participants faced forward with foot neutral. Measurement was taken in both position with status of quadriceps relaxation and quadriceps contraction in both the right and left leg [31-33].

2.2 Data analysis

Data was analyzed using SPSS software 20.0 version. Descriptive statistics expressed as Mean±SD was calculated for Q angle. Z test was used to compare the outcome measure i.e Q angle with or without quadriceps contractions in both standing and supine position and also compare right and left leg among young females.

3. Results

All females ranged from 18 years to 25 years. Result of present study showed that there was a significant difference in comparing Q angle with or without static contraction of quadriceps in both positions but Q angle was more in standing position as compared to supine position and Q angle decreases with the static quadriceps contraction in both standing and supine positions. When we compared bilateral variability in standing and supine position result was non-significant.

Table 1: Showing comparison of values between quadriceps relaxation and contraction in standing position on right side

Variables	Positions	Mean ±SD	T- value	P-value
Quadriceps relaxation	Standing	13.88±2.86	3.25*	0.0016
Quadriceps contraction	Standing	12.04±2.76		

*, means p values ≤0.05

Table 2: Showing comparison of values between quadriceps relaxation and contraction in supine position on right side

Variables	Positions	Mean ±SD	T- value	P-value
Quadriceps relaxation	Supine	12.76±2.76	3.34*	0.001
Quadriceps contraction	Supine	10.92±2.73		

*, means p values ≤0.05

Table 3: Showing Comparison of values between quadriceps relaxation and contraction in standing position on left side

Variables	Positions	Mean ±SD	T- value	P-value
Quadriceps relaxation	Standing	13.80±2.53	3.38*	0.001
Quadriceps contraction	Standing	12.12±2.42		

*, means p values ≤0.05

Table 4: Showing Comparison of values between quadriceps relaxation and contraction in supine position on left side

Variables	Positions	Mean ±SD	T- value	P-value
Quadriceps relaxation	Supine	12.60±2.50	3.86*	0.0002
Quadriceps contraction	Supine	10.72±2.35		

*, **, *** means p values ≤0.05, ≤0.01, ≤0.001 respectively; Ns non-significant

Table 5: Showing comparisons of both side Q angle values in standing position

Left leg in standing		Right leg in standing		T- value	P-value
Quadriceps relaxation	13.80±2.53	Quadriceps relaxation	13.80±2.86	0.14Ns	0.88
Quadriceps contraction	12.12±2.42	Quadriceps contraction	12.04±2.78	0.15Ns	0.87

*, means p values ≤0.05; Ns non-significant

Table 6: Showing Comparisons of right and left side Q angle values in supine position

Left leg in supine		Right leg in supine		T- value	P-value
Quadriceps relaxation	12.60±2.50	Quadriceps relaxation	12.76±2.76	0.30	0.76
Quadriceps contraction	10.72±2.35	Quadriceps contraction	10.92±2.73	0.39	0.69

*means p values ≤0.05; Ns non-significant

4. Discussion

The Aim of experiment was to compare the Q angle among females with and without isometric quadriceps contraction in both standing and supine position and bilateral variability. Q angle has variability in gender because of anthropometric measure like height and pelvic width (small difference of two to three degree). Study results reported that exaggerated Q angle associated with increased pelvic width to length of femur ratio. Small height persons have larger Q angle as compared to larger height persons so females have higher Q angle as compared to males [34-37]. Our study result was supported by some studies in which it was found that the reduction in Q angle values takes place with isometric quadriceps contraction [26-28].

Many studies have concluded that an increase in Q-angle values was found when a transfer is made from lying to a erect posture and higher Q-angle upon erect position is due to transfer of weight in lower limb from body [26, 29, 30, 38].

Some studies reported bilateral variability in mean Q angle, the reason for this difference is still unclear [39-42] but one reason might be because of higher tone in dominant leg, which would cause a force on the patella displacing it [43] and altered position of tibial tuberosity with respect to midpoint of patella [39].

5. Conclusion

The present study concluded that there was Q angle decrement with static contraction of quadriceps muscle in both standing and supine positions but there was no significant bilateral variability.

6. References

1. Lori A, Livingston. The Quadriceps Angle: A Review of the Literature, JOSPT. 1998; 28(2).
2. Maharjan R, Shrestha BP, GP Khanal BP, Chaudhary P, Karn NK. Quadriceps angle in eastern Nepalese population. Health Renaissance. 2013; 11(2):150-156.
3. Islam Tarawneh, Omar AL-Ajoulin, Abdullah Alkhawaldah, Heba Kalbouneh, Amjad Shatarat, Darwish Badran, Maher Hadidi. Normal values of Quadriceps angle and its correlation with anthropometric measures in a group of Jordanians. Journal of the Royal Medical Services. 2016; 23(2):53-58. DOI: 10.12816 0027106.
4. Powers CM, Ward SR, Fredericson M *et al.* Patello femoral kinematics during weight-bearing and non-weight-bearing knee extension in persons with lateral subluxation of the patella: a preliminary study. J Orthop Sports Phys Ther. 2003; 33:677-685. [PubMed: 14669963]
5. Caylor D, Fites R, Worrell TW. The relationship between quadriceps angle and anterior knee pain syndrome. J Orthop Sports Phys Ther. 1993; 17:11-16.
6. Piva SR, Fitzgerald K, Irrgang JJ *et al.* Reliability of measures of impairments associated with patella femoral pain syndrome. BMC Musculoskelet Disord. 2006; 7:33.
7. Lee Herrington. Does the change in Q angle magnitude in unilateral stance differ when comparing asymptomatic individuals to those with patella femoral pain? Physical Therapy in Sport. 2013; 14:94-97
8. De Oliveira Silva D. *et al.* Q-angle static or dynamic measurements, which is the best choice for patellofemoral pain. Clin. Biomech. 2015, http://dx.doi.org/10.1016/j.clinbiomech.2015.09.002.
9. Sanfridsson J, Arnbjornsson A, Friden T, Ryd L, Svahn G, Jonsson K. Femorotibial rotation and the Q-angle related to the dislocating patella. Acta Radiol 2001; 42:218-224.
10. Cooney D, Kazi Z, Caplan N, Newby M A. St Clair Gibson D. Kader F. The relationship between quadriceps angle and tibial tuberosity-trochlear groove distance in patients with patellar instability. Knee Surg Sports Traumatol Arthrosc. 2012; 20:2399-2404. DOI 10.1007/s00167-012-1907-8
11. Anh-Dung Nguyen, ATC; Sandra J. Shultz, ATC. Identifying Relationships among Lower Extremity Alignment Characteristics. Journal of Athletic Training. 2009; 44(5):511-518.
12. Hvid I, Andersen LI. The quadriceps angle and its relation to femoral torsion. Acta Orthop Scand. 1982; 53:577-579.
13. Herrington L, Nester C. Q-angle undervalued? The relationship between Q-angle and medio-lateral position of the patella. Clin Biomech. 2004; 19:1073.
14. Shultz SJ, Levine B, Nguyen AD. The relationship among lower extremity alignment characteristics and anterior knee joint laxity. Sports Health. 2009; 1(1):966-972.
15. Smith TO, Hunt NJ, Donell ST. The reliability and validity of the Q-angle: a systematic review. Knee Surg Sports Traumatol Arthrosc. 2008; 16(12):1068-1079.
16. Greene CG, Edwards TB, Wade MR, Carson EW. Reliability of the quadriceps angle measurement. Am J Knee Surg. 2001; 14:97-103.
17. Lawrence Weiss, EdD, Bradley DeForest, BS, Kelley Hammond, MS, Brian Schilling, Lucas Ferreira. Reliability of Goniometry-Based Q-Angle. MSPM R. 2013; 5:763-768.
18. Draper CE, Chew KTL, Wang R, Jennings F, Gold GE, Fredericson M. Comparison of quadriceps angle measurements using short-arm and long-arm goniometers: Correlation with MRI. PM R. 2011; 3: 111-116.
19. Nguyen AD, Shultz SJ. Sex differences in clinical measures of lower extremity alignment. J Orthop Sports Phys Ther. 2007; 37:389-398. [PubMed: 17710908]
20. France L, Nester C. Effect of error in the identification of anatomical landmarks on the accuracy of Q angle values. Clin Biomech. 2001; 16(8):710-713.
21. Ando T, Hirose H, Inque M, Shino K, Doi T. A new method using computed tomographic scan to measure the rectus femoris-patellar tendon Q-angle comparison with conventional method. Clin Orthop. 1993; 289:213-219.
22. Fehling PC, Paulson AA, Gilchrist AE. An assessment of quadriceps angle measurement using dual energy X-ray absorptiometry. Med Sci Sports Exerc. 2003; 35:S221.
23. Roush JR, Bustillo K, Low E. Measurement error between a goniometer and the NIH Image J program for measuring quadriceps angle. Internet J Allied Health Sci. Prac. 2008; 6(2).
24. Livingston LA, Spaulding SJ. OPTOTRAK measurement of the quadriceps angle using standardized foot positions. J Athl Training 2002; 37:252-255.
25. Olerud C, Berg P. The variation of Q angle with different positions of the foot. Clin Orthop Relat Res. 1984; 191:162-165.
26. Guerra J, Arnold M, Gajdosik R. Q angle: Effects of isometric quadriceps contraction and body position. J Orthop Sports Phys Ther. 1994; 19:200-4.
27. Lathinghouse LH, Trimble MH. Effects of isometric

quadriceps activation on the Q-angle in women before and after quadriceps exercise. J Orthop Sports Phys Ther. 2000; 30:216.
28. Belchior ACG, Arakaki JC, Bevilaqua-grossi D, Reis FA, Carvalho PTC. Effects in the Q angle measurement with maximal voluntary isometric contraction of the quadriceps muscle. Rev Bras Med Esporte. 2006; 12(1):5-8.
29. Woodland L, Francis R. Parameters and comparisons of the quadriceps angle of college-aged men and women in the supine and standing positions. Am J Sports Med. 1992; 20:208-11.
30. Ann-Katrin Stensdotter, Per-Ivar Andersson, Anders Rydh, Charlotte Ha¨Ger-Ross. Q-angle variations in standing and supine positions and for different measurement methods in women with and without patellofemoral pain. Advances in Physiotherapy. 2009; 11:88-96.
31. Horton M, Hall T. Quadriceps femoris muscle angle: Normal values and relationships with gender and selected skeletal measures. Physical Therapy. 1989; 69:897-901.
32. Byl T, Cole JA, Livingston LA. What determines the magnitude of the Q angle? A preliminary study of selected skeletal and muscular measures.J Sport Rehabil. 2000; 9:26-34.
33. Rauh MJ, Koepsell TD, Rivara FP, Rice SG, Margherita AJ. Quadriceps angle and risk of injury among high school cross country runners. J Orthop Sports Phys Ther. 2007; 37:725-733.
34. Anh-Dung Nguyen, Michelle C. Boling, Beverly Levine, Sandra J. Shultz. Relationships between Lower Extremity Alignment and the Quadriceps Angle. Clin J Sport Med. 2009; 19(3):201-206. doi:10.1097/JSM.0b013e3181a38fb1
35. Shultz SJ, Nguyen AD, Schmitz RJ. Differences in lower extremity anatomical and postural characteristics in males and females between maturation groups. J Orthop Sports Phys Ther. 2008; 38(3):137-149.
36. Raveendranath V, Nachiket S, Sujatha N, Priya R, Rema D. The quadriceps angle (Q angle) in Indian men and women. Eur. J Anat. 2009; 13:105-109.
37. Raveendranath Veeramani, Nachiket Shankar, Sujatha Narayanan, Priya Ranganath, Rema Rajagopalan. Gender differences in the mediolateral placement of the patella and tibial tuberosity: a geometric analysis. Anatomy. 2010; 4:45-50.
38. Rajeev Choudharya, Mudasir Malikb, Ammar Aslamc, Deepak Khuranad, Sangita Chauhane. Effect of various parameters on Quadriceps angle in adult Indian population 2017 (article in press)
39. Raveendranath R, Nachiket S, Sujatha N, Priya R, Rema D. Bilateral Variability of the Quadriceps Angle (Q angle) in an Adult Indian Population. Iran J Basic Med Sci. 2011; 14(5):465-71.
40. Jha A, Raza HKT. Variation in Q-angle according to sex, height, weight and interspinous distance-a survey. Int. J Orthod. 2000; 34:99-101.
41. Tella BA, Ulogo U, Odebiyi DO, Omololu AB. Gender variation of bilateral Q-angle in young adult Nigerians. Nig Q J Hosp Med. 2010; 20(3):114-116.
42. Bayraktar B, Yucesir I, Ozturk A *et al.* Change of quadriceps angle values with age and activity. Saudi Med J 2004; 25:756-760.
43. Livingston LA, Mandigo JL. Bilateral within-subject Q-angle asymmetry in young adult females and males. Biomed Sci. Instrum. 1997; 33:112-117.