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Effects of isometric quadriceps contraction on the Q-angle among university female students in standing and supine position

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Abstract

Title: Effects of Isometric Quadriceps Contraction on the Q angle among university female students in standing and supine position.

Objective: The purposed of this study was to analyze the effects of isometric quadriceps contraction on Q – angle among university female students in standing and supine position.

Background: Young active females have consistently been diagnosed with anterior knee pain or patella femoral pain disorder. Excess in Q angle potentiates patella femoral pain which in turn leads to patellar sub luxation. Previous studies supports that there is a reduction in the Q angle during maximal voluntary contraction of quadriceps. Less study is done to analyze the Q angle value both in standing and supine.

Design: An Explorative Study

Subjects: A 30 subjects (females) participated in this study with aged group between 20-30 years.

Methods: The Q angle measurements were taken in standing and supine position with knee in full extension. All 30 participants were measured on the right leg with knee relax and during isometric contraction.

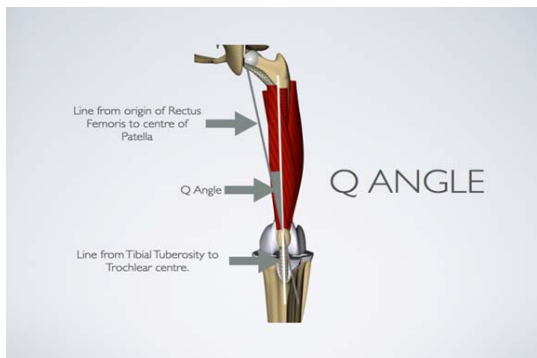
Result: From the paired t-test, it is showed that $p < 0.05 = t(29) = 14.44$ and the 2 tailed significance is .000 which indicates there is significant difference between relax status of the knee and contraction of knee.

Conclusion and Discussion: This study concluded that there was a reduction in the value of Q angle during isometric quadriceps contraction and the magnitude of this decrease is corresponding to the magnitude of the Q angle before the isometric contraction. But there is no difference in the Q angle value in standing and supine.

Keywords: Q – angle value, Goniometry, Knee joint etc.

Introduction

The quadriceps femoris muscle angle is a measurement of the Q angle between the quadriceps muscle and patella tendon. It provides useful information about the patellofemoral function and disorder. By drawing an imaginary line from the anterior superior iliac spine and from the centre of patella to the middle of tibial tuberosity forms an acute angle thus read off as the Q angle. [5] These landmarks for measuring the Q angle have been standardized. In the previous studies, the normal Q angle with knees in full extension for women is 11.3 – 20.3, and for men is 8.2 – 14.2. The patella lies within the tendon of quadriceps femoris complex. The magnitude of Q angle varies with strength and muscle tone of the knee. Livingstone LA *et al* demonstrated that though the 3 skeletal landmarks define the Q angle yet the location of the patella within the quadriceps tendon leads to alteration in the magnitude of the angle when the characteristics of the quadriceps musculature changes. Emami *et al* justified the fact that patients with patellofemoral pain are associated with patellar misalignment and quadriceps weakness which are seen more commonly seen in women. H Huberti proved that tendofemoral contact of Q angle at higher angles of flexion carries the significant fraction of the total contact force of the patella. Both increase and decrease in Q angle lead to more non uniform pressure distribution with higher peak stresses and unloading of other areas. [8] Thus the aim of this present study was to analyze the difference between the quadriceps angle in two different examination situations, having the quadriceps relaxed and in isometric contraction both in standing and supine. Clinically we can implement this study in subjects with high risk of.



Materials and Method

Study Design

This research is conducted as an exploratory study where participants will be in standing and supine lying position to measure their Quadriceps angle during quadriceps relaxed and isometric quadriceps contraction.

Study Setting

The study was conducted at the physiotherapy lab owned by Asia Metropolitan University.

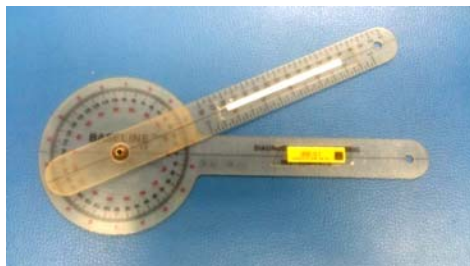
Study Duration

Total duration: 6 months.

Subjects

Female participants were taken from the general population of Asia Metropolitan University (AMU) with the age between 20 - 30 years old and free from knee pain and knee disorder.

Operational Tool



Goniometer

Outcome Measure

Q-angle value

Criteria for Selection

Inclusion Criteria

- Women
- Age group between 20 – 30 years
- Free from knee pain

Exclusion Criteria

- Complaint of knee pain
- Prior history of knee pathological conditions
- Traumatic/surgical records
- Knee deformity

Procedures: This study were conducted with 30 female university students of Asia Metropolitan University, aged between 20–30 years, were conveniently selected. The Q angle measurement will be taken in standing and supine with having the knee in relax and contract. Data collection was lasting for

15-20 minutes per subject. Small markers or tape were applied to the right ASIS, midpoint of patella and the middle of right tibial tubercle. The midline of patella was determined by the intersection of the line from medial to lateral patella and a line from the inferior to superior patella. The midpoint of patella was first marked with the quadriceps relaxed and then with the quadriceps contracted, thus making 2 marks. The midpoint of patella was rechecked between test conditions. All participants will be measure on the right leg. The longitudinal axis of the foot was placed in the parasagittal plane for all measurements because foot positions have been shown to affect the Q angle. In the standing position, the subjects faced forward and aligned the longitudinal axis of the foot (from the midheel through the second metatarsal and digit) with a line of tape placed on the floor perpendicular to the coronal plane of the body. In the supine position, the same points of reference of the foot were aligned with a ruler fixed on the edge of the plinth perpendicular to the horizontal surface. Measurement is taken in standing and supine with quadriceps relaxed and during isometric quadriceps contraction.



The position of the foot in standing.



The position of the foot in supine.



The Q-angle measurement in standing. The goniometry with a lengthened stationary arm was aligned with adhesive stickers over the right anterior superior iliac spine, the midpoint of the patella, and the tibial tuberosity.



The Q-angle measurement in supine.

Data Analysis and Interpretation

Data Analysis: Data analysis is the method by which the validity of a research study is evaluated. It requires a number of closely related operations such as establishment of categories to raw data through coding, tabulation and then drawing statistical inferences.

Data Interpretation: A total of 30 female participants within the age group of 20–30 years were included in this study. This study is analyzed by using paired T-test to compare the outcomes between standing and supine lying, and to compare the value between the quadriceps relaxed and during isometric quadriceps contraction.

Quadriceps Relaxed in Standing and during Quadriceps Contraction results

Quadriceps Relaxed and During Isometric Quadriceps Contraction in Standing

no	Variables	mean	SD	T value	Sig (2-tailed)
1.	Quadriceps relaxed	14.43	1.03	19.9	.000
2.	Quadriceps Contraction	10.66			

Quadriceps Relaxed and During Isometric Quadriceps Contraction in Standing

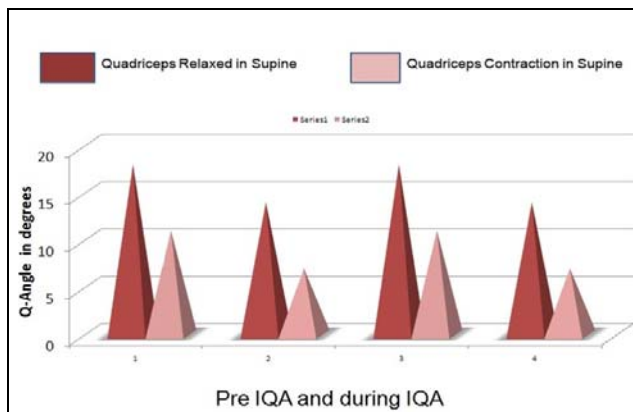
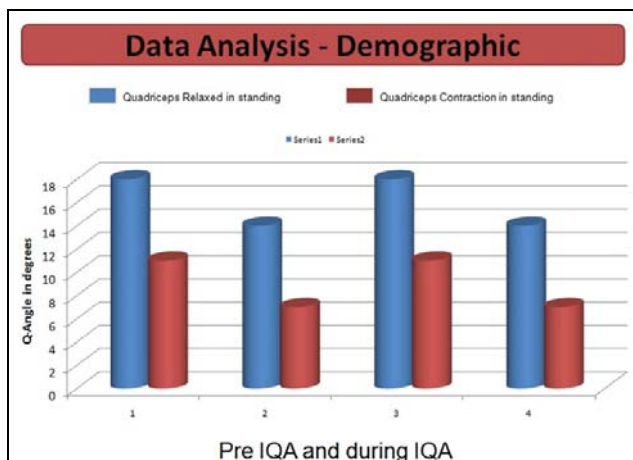
no	Variables	mean	SD	T value	Sig (2-tailed)
1.	Quadriceps relaxed	14.43	1.11	17.69	.000
2.	Quadriceps Contraction	10.81			

Interpretation: From the data analysis, it is showing that Mean ± SD is 14.43 ± 1.54 and 10.66 ± 1.53 in standing, 14.43 ± 1.54 and 10.81 ± 1.53 in supine respectively which shows that there is decrease in mean value of the Q-angle when compared the Isometric Quadriceps Contraction and Quadriceps Relaxed in standing and supine position. From the paired sample T-test. It is showing that at $P < 0.05 = t(29) = 14.44$ and the 2-tailed significance is .000 which shows that it is significant so alternative hypothesis is accepted.

Paired t-test: Comparison of Q-angle value in standing and supine during Isometric Quadriceps contraction.

No	variables	mean	Mean difference	SD	T value	Sig (2-tailed)
1.	Standing	10.66	-.150	.457	-	1.795
2.	Supine	10.81				

Data interpretation: The paired T-test showed no significant difference of Q angle value between standing and supine position.



Discussion

The results of this study shows that the Q angle decreases with Isometric quadriceps contraction is presented in figure 1 which supported the earlier findings. When there is an excessive lateral displacement of patella during isometric quadriceps contraction, it could be due to weak quadriceps muscle that increases the risk of patella tracking disorder which also could be hypothesized as a potential cause of patellofemoral pain. Patellofemoral pain is commonly seen in women, it is described as pain and discomfort that associated with patellar malalignment and quadriceps muscle weakness. By analyzing the maximal contraction of vastus medialis oblique(VMO) and vastus lateralis(VL) muscles using isometric quadriceps exercise with the knee in total extension, we can justified the reduction in Q angle during isometric quadriceps contraction. Factors such as the strength of quadriceps muscle, the depth of intertrochlear groove, the shape of the patella, the presence of patella alta may explain why individual with high Q angle shows little difference during isometric quadriceps contraction and individual with normal Q angle shows considerable decrease during isometric quadriceps contraction. An increase in the Q angle may influences biomechanics of knee joint and patellofemoral articulation by creating an abnormally high valgus angle. It may also cause an increase in pressure between the patella and the underlying lateral femoral condyle during quadriceps contraction. High Q angle causing the patella exerts a laterally directed force and rotates it medially which leading to patella tracking error and increasing pressure on the patellofemoral and results in anterior knee pain. Emami *et al* substantiates the fact that individual with anterior knee pain have higher Q angles than healthy individuals. Quadriceps femoris muscles will exerts a laterally directed pull force on patella when there is increased in the Q angle which

leads to patellofemoral disorder. In the patellofemoral disorder rehabilitation, SLR or Straight leg raised is a way of treatment to strengthen the knee. Based on this study, we believe that if it associated to the quadriceps exercises, it can minimize the excess value of Q angle. Aparna Sarkar *et al* emphasize the strengthening of the hip abductor muscle due to kinematical imbalance of lower limbs. It is also wise to initiate a kinesiotherapeutic SLR exercising program associated to the hip abduction. Physical exercises promote a sensorial re-education through the motor activity and this is beneficial to patellofemoral disorder bearer individuals since in general they present proprioceptive abnormalities.

Conclusion

The results of this study accept the alternate hypothesis that there is significant difference between quadriceps relax and during isometric quadriceps contraction. The study primarily tried to analyze the effect of isometric quadriceps contraction on Q-angle in standing and supine position. Considering the data attained in the present study, it was verified that there was a reduction in the value of Q angle during isometric quadriceps contraction and the magnitude of this decrease is corresponding to the magnitude of the Q angle before the isometric contraction. And there is no significant difference between the Q-angle values in standing and supine position which supports the previous studies.

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