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

Anuj Kumari, Shabnam Joshi, Sonu Punia and Sivachidbaram Kulandaivelan

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; Statistics: 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 Brattstrom 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°–17° in males and 12°–20° in females [2, 3].

A higher Q angle (greater than 20°) 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°, 22° 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 show a 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 [29]. 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
Exploratory 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.

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](image1)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Positions</th>
<th>Mean ±SD</th>
<th>T- value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps relaxation</td>
<td>Standing</td>
<td>13.88±2.86</td>
<td>3.25*</td>
<td>0.0016</td>
</tr>
<tr>
<td>Quadriceps contraction</td>
<td>Standing</td>
<td>12.04±2.76</td>
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<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Variables</th>
<th>Positions</th>
<th>Mean ±SD</th>
<th>T- value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps relaxation</td>
<td>Supine</td>
<td>12.76±2.76</td>
<td>3.34*</td>
<td>0.0011</td>
</tr>
<tr>
<td>Quadriceps contraction</td>
<td>Supine</td>
<td>10.92±2.73</td>
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</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Variables</th>
<th>Positions</th>
<th>Mean ±SD</th>
<th>T- value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps relaxation</td>
<td>Standing</td>
<td>13.80±2.53</td>
<td>3.38*</td>
<td>0.0011</td>
</tr>
<tr>
<td>Quadriceps contraction</td>
<td>Standing</td>
<td>12.12±2.42</td>
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<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Variables</th>
<th>Positions</th>
<th>Mean ±SD</th>
<th>T- value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps relaxation</td>
<td>Supine</td>
<td>12.60±2.50</td>
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<tr>
<td>Quadriceps contraction</td>
<td>Supine</td>
<td>10.72±2.35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Left leg in standing</th>
<th>Right leg in standing</th>
<th>T- value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps relaxation</td>
<td>13.80±2.53</td>
<td>13.80±2.86</td>
<td>0.14Ns</td>
</tr>
<tr>
<td>Quadriceps contraction</td>
<td>12.12±2.42</td>
<td>12.04±2.78</td>
<td>0.15Ns</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Left leg in supine</th>
<th>Right leg in supine</th>
<th>T- value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadriceps relaxation</td>
<td>12.60±2.50</td>
<td>12.76±2.76</td>
<td>0.30</td>
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<tr>
<td>Quadriceps contraction</td>
<td>10.72±2.35</td>
<td>10.92±2.73</td>
<td>0.39</td>
</tr>
</tbody>
</table>

* means p values ≤0.05; ** means p values ≤0.01; *** means p values ≤0.001 respectively; 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 \[26-30\]. 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 \[28, 29, 30, 31\]. 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 \[40\] and altered position of tibial tuberosity with respect to midpoint of patella \[40\].

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
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