

## Original Article

## Q-angle: An Invaluable Parameter for Evaluation of Anterior Knee Pain

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**Background:** Patellofemoral pain syndrome is a descriptive term applied to patients with nonspecific anterior knee pain, and is the most common knee problem. The pain in most patellofemoral disorders is generalized to the anterior part of the knee. One important concept in patellofemoral joint function is the quadriceps angle (Q-angle). Theoretically, a higher Q-angle increases the lateral pull of the quadriceps femoris muscle on the patella and potentiates patellofemoral disorders. This study was undertaken to evaluate the relationship between the anterior knee pain and Q-angle.

**Methods:** This prospective study was performed on two groups; the case group consisted of 100 outpatients (44 men, and 56 women) aged between 15 and 35 years, with anterior knee pain. The control group consisted of 100 outpatients (50 men, and 50 women) with the same age distribution, who presented with different problems in the upper extremities and no knee problems. The Q-angle of each knee was measured in all participants, using a universal goniometer.

**Results:** The mean Q-angle for men, women, and all participants in the case group was 15.2, 20.1, and 18.0 degrees, respectively. In the normal control group the angles were 12.1, 16.7, and 14.9 degrees, respectively. All these differences were statistically significant ( $P < 0.001$ ).

**Conclusion:** These results substantiate the fact that patients with anterior knee pain have larger Q-angles than healthy individuals.

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**Keywords:** Anterior knee pain • patellar malalignment • quadriceps angle (Q-angle)

### Introduction

Patellofemoral pain syndrome is a descriptive term applied to patients with nonspecific anterior knee pain, and is the most common knee problem.<sup>1, 2</sup> The pain in most patellofemoral disorders is generalized to the anterior part of the knee.<sup>3, 4</sup> One important concept in patellofemoral joint function is the quadriceps angle (Q-angle).

Theoretically, a higher Q-angle increases the lateral pull of the quadriceps femoris muscle on the patella and potentiates patellofemoral

disorders.<sup>5</sup> This study was undertaken to evaluate the relationship between the anterior knee pain and Q-angle.

### Materials and Methods

This study was carried out on two groups; the case and control groups. The case group included 100 outpatients (56 women) aged between 15 and 35 years (average 22.2 and 23.5 years, respectively) with anterior knee pain.

The control group consisted of 100 out-patients (50 women) having the same age range (average 21.4 and 21.9 years, respectively), with different unrelated problems in the upper extremities, who had normal knees. Informed consent was obtained for each person.

A clinical diagnosis of anterior knee pain was made in the case group. Radiographic evaluation including anteroposterior, lateral, and tangential

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views of the patella was made in the case and control groups in order to determine the structural abnormalities.

We excluded the following patients: patients with a noticeable history of trauma, patients with ligament laxity or positive McMurray test, and patients with a positive radiographic finding in favor of structural abnormalities. The age and sex of each subject in both groups were recorded and the test protocol was explained to all of them. All measurements were taken while the participants were in a standing position, the knees exposed in full extension, the patella directed forward in the sagittal plane, and the foot in the neutral position. The Q-angle of both knees of all participants were measured using a universal goniometer. All the measurements for a given subject were taken by the senior author. The Q-angle for each knee was measured in degrees and recorded.

When the Q-angles differed in an individual subject, the mean Q-angle was recorded for analysis.

#### Data analysis

Q-angle rules and ranges were established by calculating the mean and standard deviation for each group. Data from men, women, and the entire population in both case and control groups were analyzed separately. Student's *t*-test was used for comparing Q-angle in both groups. The level of significance selected was 0.01 (two-tailed test).

### Results

Mean Q-angle for men, women, and all subjects in the case group was 15.3, 20.1, and 18.0 degrees, respectively. Mean Q-angle for men, women, and all subjects in the control group was 12.1, 16.7, and 14.4 degrees, respectively. Mean Q-angle for men, women, and all subjects in the case group was 3.2, 3.4, and 3.6 degrees, greater than their counterparts in the control group, respectively. These differences were all statistically significant ( $P < 0.001$ ).

Mean Q-angle of females in the case and control groups was 4.8 and 4.6 degrees, respectively, greater than the values for male counterparts. ( $P < 0.001$ ). No men in the control group had a Q-angle value of 20 degrees or greater, but 10 (20%) of the women did. In contrast, 36% of the participants (4 men, and 32 women) in the case group had Q-angles of 20 degrees or more.

### Discussion

The increase in Q-angle observed in patients with anterior knee pain, as compared to healthy individuals, is worthy of comment. A few similar studies have been previously performed with less noticeable values. Hand and Spalding reported that Q-angle measurement was a poor predictor of patellofemoral pain syndrome.<sup>6</sup>

Tallay in his epidemiological study could not identify any statistically significant intrinsic risk factors, although changes in the Q-angle might be related to an increased prevalence of patellofemoral pain syndrome.<sup>7</sup>

Herrington and Nester reported that any method that improved the reliability and applicability of Q-angle measurement could be useful in investigating the etiology and outcome of patellofemoral pain syndrome treatment.<sup>8</sup> Moreover, this study searched for the relationship between anterior knee pain and Q-angle, as an important concept in patellofemoral joint function. Based on the results of this study, the average Q-angle values for the men and women in the control group were 12.1 and 16.7 degrees, respectively. Among the pathologic group, the average values were 15.3 degrees for men and 20.1 degrees for women.

Our mean values differ 1.9 and 0.7 degrees in the control and case groups, respectively, from the values attributed to Caylor et al.<sup>9</sup> The difference in population, sampling, precision of method, and measuring equipment may account for these differences. Besides, some daily living habits of our patients such as excess knee flexion and high compressive loads on patellofemoral joint may contribute to these differences. The results of our study also established that the mean Q-angle in the normal population was  $14.4 \pm 3.7$  degrees.

Our mean differs 0.4 degree from the normal values reported by Insall et al,<sup>10</sup> 0.8 degree from the averages stated by Neely,<sup>11</sup> and 0.9 degree from that reported by Horton and Hall.<sup>5</sup> All these values are within one standard deviation from the mean found in our study. Thus, the normal values established in our study are consistent with the values previously considered normal. It is worthy of comment that our results, which showed the mean Q-angle of  $12.1 \pm 2.7$  degrees for normal men and  $16.7 \pm 3.0$  degrees for normal women, are also consistent with the well established normal values.<sup>12</sup>

Based on the studies conducted by Aglietti et al,

Insall et al, and Hvid et al, 40, 48, and 32% of the subjects with patellofemoral pain, respectively had Q-angles of 20 degrees or greater.<sup>10, 13, 14</sup> This ratio was 36% in the present study. Compared to men, the larger Q-angle of women in the control group is consistent with the values reported in many other previous studies.<sup>9, 10, 13</sup> Moreover, with greater Q-angles, women are believed to be at greater risk of patellofemoral pain. In our study, 56 of 100 (56%) participants in the case group were women. This ratio in the study conducted by Aglietti et al was 62%.<sup>13</sup> It seems that a high Q-angle could influence biomechanics of the knee joint and especially patellofemoral articulation by creating an abnormally high valgus angle. This exerts a laterally directed force leading to maltracking and excessive pressure on the patellofemoral articulation, consequently resulting in anterior knee pain. It must be remembered, however, that increased Q-angle alone is not responsible for this problem, because 16% of the males and 20% of the females in our control group had abnormally high Q-angles without any knee pain symptoms.

We found that there was an apparent relationship between the anterior knee pain and Q-angle. The mean normal Q-angle in our subjects is comparable to the currently accepted data and the higher mean value for women is similar to other studies. Therefore, the Q-angle is a simple, well-defined, and useful clinical parameter in the evaluation of patients with anterior knee pain, which is now usually underestimated and ignored.

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