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Original Article

A new diagnostic parameter for patellofemoral pain

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Abstract: Purpose: Q-angle measurement procedure have not been well standardised. There is a lack of consensus about subject position and knee flexion angle while measuring the Q-angle. Morover Q-angle value which obtained in a single position is a static value and gives an information about the subject's current position. The aim of this study is to obtain a more significant parameter which includes different postures (supine, standing, sitting) and different knee flexion angles instead of a single Q-angle in a fixed position. At the same time this parameter must be functional and dynamic,not a static value like Q-angle. We named this parameter as ΔQ. Methods: Our study was applied on case and control groups. All subjects in both groups were male. Case group was consisted of 14 subjects who had patellofemoral pain. Control group was consisted of 14 subjects who had normal knees and normal lower extremities with no reported knee problems. We obtained 3 different Q-angle values and 3 different ΔQ values for each subject in both groups. Pearson correlation analysis was used for investigation of continuous variables in normal distribution, Spearman correlation analysis was used in abnormal distribution. t test was used in the comparison of values. Logistic regression analysis(forward conditional mod) was used for detecting of determinants of pain. Results: ΔQ1s of both groups were found as the only statistical significant predictive value for patellofemoral pain. Conclusion: There is not an agreement about a standardised q-angle measurement procedure in the literature. Moreover, present procedures provide information about a single and fixed position. In this situation Q-angles which obtained in these fixed positions are static values. We think that we can overcome these problems with this new value. ΔQ contains multiple q-angles and gives information about all. Also it is a dynamic value for being oriented to position change. Therefore, ΔQ is an useful indicator for evaluating patellofemoral pain.

Keywords: Q-angle, patellofemoral pain, ΔQ

Introduction

The quadriceps angle (Q-angle) is defined as the acute angle formed by the vector for the combined pull of the quadriceps femoris muscle and the patellar tendon [1]. Q-angle is formed by a line from the anterior superior iliac spine to the patella center and a line from the patella center to the tibial tuberosity [2]. The biomechanical principle of the Q-angle has gradually come to be an accepted part of the patellar examination [3].

The quadriceps angle is intended to provide some indication of the direction of the net lateral force applied to the patello-femoral joint by contraction of the quadriceps [4]. It is responsible for the bowstring effect, whereby the patella tends to move laterally as the quadriceps contract [5].

The Q-angle is widely used as an indicator of patellofemoral problems such as patellofemoral pain syndrome (PFPS). When the Q-angle exceeds 15-20 degrees it is thought to contribute to knee extensor mechanism dysfunction and patellofemoral pain by increasing the tendency for lateral patella malposition [6].

Traditionally, the Q-angle has been measured with subjects in supine, knee extended and with the quadriceps muscle relaxed [7]. For others, however,the need to measure the Q-angle under conditions which more accurately depict the functional position of the lower limb [8, 9]. Since Insall et al. [7] described the traditional measure in its current form there has been continuous debate within the literature regarding normal values, subject positioning,contraction status of the quadriceps and validity of the technique [10, 11]. Knee flexion angle [12],

whether the patient is supine or standing, quadriceps muscle activity [13] may influence the Q-angle magnitude during the measurement.

The aim of this study is to obtain a more significant parameter which includes different postures (supine, standing, sitting) and different knee flexion angles instead of a single Q-angle in a fixed position. At the same time this parameter must be functional and dynamic, not a static value like Q-angle. We aimed to investigated whether this parameter is more significant than Q-angle for patellofemoral pain or not.

Materials and methods

Subjects

Our study was applied on case and control groups. All subjects in both groups were male. Case group was consisted of 14 subjects who had patellofemoral pain. They had no additional knee or lower extremity problems. Subjects with a history of knee pathology or knee trauma, gait abnormality were excluded. Mean age of the subjects in case group was 35.8 years (range 27-54 years).

Control group was consisted of 14 subjects who had normal knees and normal lower extremities with no reported knee problems. Mean age of the subjects in control group was 30.5 years (range 17-43 years). These subjects were volunteers.

Q-angle measurement

The Q-angle was measured on the right leg of each subject in the supine, sitting and standing positions. All three of the positions and alignment of the lower limb in these positions were standardized. All measurements were performed by a single investigator. All subjects were measured using the same goniometer.

In the first position as in the traditional method, subjects were in supine, knees were extended and quadriceps were relaxed. The hip, leg and foot were maintained in neutral position. Patella and foot were pointing upwards.

In the second position subjects were sitting and the knee flexion was 90 degrees. The knee flexion angle was confirmed using a goniometer. Quadriceps were relaxed. The hip, leg and foot were maintained in neutral position.

In the third position subjects were standing in their normal stance, patella and foot were pointing directly in front.

3 different Q-angles in 3 different positions for 28 subjects in both groups were obtained. Q-angles which measured in supine, sitting and standing was named as follow respectively:

Q-supine, Q-sitting, Q-standing. The 3 differences between each subject's 3 different Q-angle values (Q-supine, Q-sitting, Q-standing) were calculated separately. The difference value between Q-supine and Q-sitting was named as ΔQ1; Q-supine and Q-standing as ΔQ2;

Q-standing and Q-sitting as ΔQ3. Thus we obtained 3 different Q-angle values and 3 different ΔQ values for each subject in both groups.

Statistical analysis

SPSS for Windows software,version 17.0 (SPSS, Chicago, IL) was used for the evaluation of research data. Conformity to normality of the distribution of variables was evaluated with Kolmogrov-Simirnof test before the analysis of data and all values were determined to be normally distributed. Data were given as mean, standard deviation and percentage. Pearson correlation analysis was used for investigation of continuous variables in normal distribution, Spearman correlation analysis was used in abnormal distribution. t test was used in the comparison of values. Logistic regression analysis (forward conditional mod) was used for detecting of determinants of pain.

Results

The mean Q-angles and ΔQ values for the case and control group were as in the **Table 1**.

Values except ΔQ1s of both groups did not show statistically significant differences when compared with t test.

In the same manner, values except ΔQ1s of both groups did not show significant relationships when the relationship between the pre-

Table 1. Mean Q-angle and ΔQ values.

	Case group	Control group
Q-supine	11.64	14
Q-sitting	14.50	12.42
Q-standing	12.64	13.57
ΔQ1	2.85	-1.57
ΔQ2	1.00	-0.42
ΔQ3	1.85	-1.14

cence and absence of patellofemoral pain evaluated with correlation analysis.

ΔQ1s of both groups were found as the only statistical significant predictive value when determinants of patellofemaral pain evaluated with regression analysis.

Discussion

Our goal was to investigate availability of ΔQ in assessment of patellofemoral pain. The finding of our study suggests that ΔQ is a significant indicator for evaluating patellofemoral pain.

Q-angle measurement is a part of lower extremity phsical examination. especially for patients who have patellofemoral problems. Since the Q-angle was first described by Brattström [14] there are various forms of Q-angle measurement procedures in the literature. Q-angle measurement procedure have not been well standardised. There is a lack of consensus about subject position and knee flexion angle while measuring the Q-angle. However on the other hand knee flexion angle [12] and whether the patient's supine or standing position [13] may affect Q-angle measurements.

In traditional method patients are in supine, knee is extended and the quadriceps muscle is relaxed [7]. The measured Q-angles which were performed in this position may not give information about true phsyological conditions. This measurement is a static method which may not provide information about the lateralizing forces on the extensor mechanism [15].

In the other method Q-angle is measured in the standing position with the knees in extension [16]. Some of the authors believe that the standing position depicts the functional position of the lower limb more appropriately than the supine position [17] therefore the measured Q-angles may reflect true phsyological conditions.

According to a further expect measuring the Q-angle in some flexion may be more meaningful than terminal extension with regard to better reflect the clinical condition [18]. However there is no consensus about the knee flexion angle's degree during the Q-angle measurement if it should be measured in flexion. Magee [19] proposed measuring the Q-angle in sitting position with the quadriceps relaxed.

Making comment with a single Q-angle value which obtained by measuring in a single position can be problematic for two reasons: First: We can not have a precise idea about in which position measurements will more accurately reflect the clinical condition according to the information available in the literature. However we can overcome this problem by achieving ΔQ because ΔQ includes all of these positions. Second: No matter in which position measurements made, value of Q-angle obtained in a single position is a static value and gives an information about the subject's current position. However a person does not remain in a fixed position during the day but ΔQ is a dynamic value and demonstrates the variations between the person's positions during the day.

Our hypothesis was: Q-angle of a person is in a continuously changing during the day depending on that person's position and knee flexion so it is a dynamic entity. Now then there is not a just one Q-angle for a person,but there are several Q-angles. Magnitudes of these Q-angles are different. Therefore the magnitudes of a person's Q-angles are in a sustained swing between the lowest and highest values like a pendulum. We can find the range of swing if we find the lowest and the highest values and their amount of difference. This range of swing can give us more efficient and more precise information than Q-angle for understanding the etiology and diagnosing the problem in patellofemoral problems, particularly for patellofemoral pain. We found that this range of swing as a significant parameter for patellofemoral pain. We named it as ΔQ.

The weakness of this study is that we measured 3 different Q-angles in 3 different positions, however we could evaluate Q-angle in further positions like as different knee flexion

angles, one leg standing, ascending or descending stairs. Additionally we could carry out the study with greater number of subjects.

Conclusions

There is not an agreement about a standardised Q-angle measurement procedure in the literature. Moreover, present procedures provide information about a single and fixed position. In this situation Q-angles which obtained in these fixed positions are static values. We think that we can overcome these problems with this new value. ΔQ contains multiple q-angles and gives information about all. Also it is a dynamic value for being oriented to position change.

ΔQ is an useful indicator for evaluating patellofemoral pain.

Disclosure of conflict of interest

None.

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