

# Measurement the “Q” angle through the application of direct method and indirect method

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## Abstract

**Introduction:** The “Q” angle is used to measure global alignment of the kneecap, representing the kneecap normal alignment. The average of 15 degrees in ordinary people is accepted as “Q” angle value, 14 degrees for men and 17 degrees for women. Anatomic changes caused by variants produces converging kneecaps or lateral deviation of the tibial tuberosity, changing the “Q” angle value and causing pathologies. **Objective:** Measure the “Q” angle of asymptomatic people, comparing obtained results. **Materials and Methods:** The “Q” angle measurement was taken from 12 subjects (6 males and 6 females), with ages from 18 to 35, at the Physiotherapy Clinic of José do Rosário Vellano College, in Alfenas, MG. **Results:** After evaluating the 12 subjects following ANOVA test, using  $p \leq 0.05$ , no significant statistic difference could be observed among examiners, gender or right and left limbs, considering both direct and indirect methods. **Conclusion:** Data obtained in this research allows us suggest that there is no difference between “Q” angle values among genders, direct and indirect methods and lateral symmetry.

**Keywords:** “Q” angle, photogrammetry, goniometry.

## 1 Introduction

The aim of this work was to measure the Q angle of asymptomatic subjects by comparing the values obtained among female and male genders, the right and left sides and the measurements taken by two different examiners, all related to the direct and indirect measurement, to verify the applicability of both methods.

The knee joint is the largest synovial joint of the human body, allowing the movements of a hingy joint type (flexion and extension) and also allows a certain degree of rotation. (D'ANGELO and FATTINI, 1998). Inflammatory diseases such as infectious arthritis, rheumatoid arthritis, synovial diseases ranging from nonspecific synovitis, which can have numerous causes, including viral, until synovial tumors (sinovyal sarcoma, for example), passing through specific synovitis (pigmented villonodular synovitis, for example), chondrocalcinosis (pseudo gout limestone) are the cause of biomechanical changes of the knee joint, which suggests a directed change at Q angle. (HEBERT, XAVIER, PARDINI et al., 1998).

The angle Q is an overall patellar alignment measurement, representing the normal alignment of the patella. This is the angle between a line extending from the anterosuperior iliac spine to the center of the patella and a line extending from there to the center of the tibial tuberosity. The average of 15 degrees is accepted as “Q” angle value in ordinary people, 14 degrees for men and 17 degrees for women. (REIDER, 2001).

Anatomical changes caused by variants produce convergent patella or lateral deviation of the tibial tuberosity, increasing this angle measurement. Patellofemoral pain may be associated with this increase. (REIDER, 2001). Cases arising from genu valgus, high patella, pronated feet, wide pelvis, increased femoral

anteversion and external tibial torsion also correlate with the increase that angle. (KISNER and COLBY, 1998). Some knee joint pathologies, as mentioned above, explain why some people with high Q angle value at rest show little difference when the quadriceps is isometric ally activated and others with the normal Q angle value at rest show a considerable loss of such angle. (LATHINGHOUSE and TRIMBLE, 2000).

Complications of lateral displacement occur more often in women and may be due to the slight increase in lateral traction exerted by the quadriceps mechanism. Dysfunction of the oblique vastus medial is, tense lateral structures, including the iliotibial band, patellar retinaculum and the greater subtalar pronation that results in increased Q angle value are responsible for lateral patellar displacement. (ANDREWS, HARRELSON and WILK., 2000).

The so-called “pathological Q angle” is an indication of medial transposition of the tibial tuberosity. But different Q angles depend on the position in which the knee is measured (extension or inflection), also if the position of the patient is supine or upright, if the quadriceps muscle is relaxed or contracted as well as the patient's gender. Clinical findings and Q angle measurements only in extension position may be elusive in many cases. Researches show that there is no correlation between the Q angle measurement in full extension and the position of the patella in the trochlea. (BIEDERT and WARNKE, 2001).

Evidences indicate that young adult women have a good Q angle value compared to men, with differences in magnitude from 2.7 to 5.8 and 3.4 degrees to 4.9 degrees when measured with the quadriceps relaxed in supine position and standing,

respectively. A significant decrease in the magnitude of the Q angle (1.1 to 3.5 degrees) appears when the patella moves superiorly and laterally with the contraction of the femoral quadriceps. It also considers that clinical evaluation of Q angle has been an ongoing matter, and it can be measured with inflected knees, sometimes dynamically, with contracted quadriceps and the use of standardized feet position (LIVINGSTON, 1998).

According to the American Society of Photogrammetry, photogrammetry is

[...] the art, science and technology of obtaining reliable information about physical objects and the environment through recording processes, measurement and photographic images interpretation, and radiant electromagnetic energy patterns and other sources. (TOMMASELLI, SILVA, HASEGAWA et al., 1999).

Despite all the methodological care, the use of computerized photogrammetry still needs to be better grounded, since studies that tested the reliability and repeatability of measurements obtained by this method were found. Hence, it is not possible to say whether the analysis that the method provides reproducible and reliable (SATO, VIEIRA and GIL, 2003).

The caliper is an instrument used to measure linear internal, external and depth dimensions of a piece. It consists of a graduated ruler, with fixed stop, on which a cursor slides. It is used to take length measurements up to about 15 cm, with an accuracy of hundredths of centimeter (in general). The object to be measured is placed between bulkheads. As you can see, there are two types of bulkheads for internal and external diameters. (SOHN, 2006).

Goniometry (from the Greek gonia = angle and metron = measurement) is the application of the coordinates system on a joint to measure the motion degrees present at each axis of a joint system (SMITH, WEISS and LEHMKUH, 1997).

## 2 Materials and Methods

The measurement of Q angle was performed in 12 asymptomatic subjects (6 females and 6 males) within 18-35 years old range at the Clinic of Physical Therapy, in José do Rosário Vellano University, during the year 2008. The measurement was performed by two different examiners, being made by each in different times but with the same patient. The image digitalization was performed using a Sony 7.2 megapixels resolution digital camera. The pictures were taken to a microcomputer where they were analyzed in ALCIMAGEM® software program, also by the same examiners. For the test,

patients were placed standing up. The patients' hips were lined up, the anterosuperior iliac spine was marked with a dermatographic pencil, and then the center of the patella and tibial tuberosity were identified. Making use of a measurement tape and dermatographic pencil, a line was drawn from the center of the tibial tuberosity to the patella center, and from there another line to the anterosuperior iliac spine was also drawn. The angle formed between these two lines was measured with a goniometer.

## 3 Results

After the evaluation of 12 subjects, statistical analysis on the obtained values was conducted to compare all groups and both methods. The ANOVA test was used, where  $p \leq 0.05$ .

When comparing the measurements performed by the indirect method, no significant difference among examiners, gender or right and left limb was observed. The highest value observed was the average of 16.59°, obtained on female's left knee and the lowest value observed was the average of 13.80°, obtained on men's right knee (Table 1).

As observed applying the direct method, the direct method showed no significant difference between the established parameters. As in the previous method, the highest value was obtained in the female left knee with average of 17.83°, and the lowest value was obtained in the male right knee, with average of 14.00° (Table 2). And, when comparing both methods with each other, also no significant difference was observed.

## 4 Discussion

According to Belchior, Arakaki, Bevilacqua-Grossi et al. (2006), it is very important that the examiner checks the condition of the quadriceps muscle in all situations when performing the measurement of the Q angle, so there will be a standard followed during the evaluation, once it was observed that in a relaxed state there is a significant difference on the measurement between symptomatic and asymptomatic subjects and that this difference is not present in a maximal isometric contraction of the quadriceps muscle with a decrease in the value of the angle in both groups. Thus, the values presented on this study in both direct and indirect methods, were obtained with relaxed quadriceps.

Parallel to a 2005 study by Domingues, Gomes, Monteraso et al. (2005), this research also found no significant statistical difference between these groups: male right knee, male left knee, female right knee and female left knee. Teixeira,

**Table 1.** Demonstration of the average values found in the measurement using the indirect method.

	FEMALE LEFT KNEE	MALE LEFT KNEE	FEMALE RIGHT KNEE	MALE RIGHT KNEE
Examiner 1	16.59°	13.98°	16.40°	13.80°
Examiner 2	16.54°	14.05°	17.29°	13.81°

**Table 2.** Demonstration of the average values found in the measurement using the direct method.

	FEMALE LEFT KNEE	MALE LEFT KNEE	FEMALE RIGHT KNEE	MALE RIGHT KNEE
Examiner 1	17.83°	15.66°	17.00°	14.33°
Examiner 2	16.66°	15.66°	16.66°	14.00°

Masuyama and Folha (2008) showed a bigger average of Q angle in female when compared to male subjects.

According to Carvalho, Mazzer and Barbieri (2012) it was observed both in the photogrammetric and in the goniometer, in general, a significant correlation among groups and methods, indicating that proportionally, the measurements vary in a similar way, they have relationship with each other and they are simultaneously reliable, thereby ensuring reproducible data. This work showed similar results regarding this relationship.

In this study, goniometry when compared to photogrammetry, showed reliable results for Q angle. However, the results found in 2007 by Sacco, Alibert, Queiroz et al. (2007), showed reliability of these methods for all angles, except for Q angle.

Evaluating the range of movement (ROM) of the elbow joint in 2011, Silva, Coelho, Vale et al. (2011) did not observe a good correlation between fleximetry and radiologic goniometry, denoting that the procedural difference between these two methods of ROM hindered such correlation, or suggesting that this factor might hinder any correlation between such technique so evaluative instruments that distinct. It contradicts this work, where no significant statistic difference between the goniometry and the photogrammetry were found, even though being different methods.

We observed that the examiners found similar results in all applied methods. It was also stated in 2011 by Santos, Oliveira, Silveira at al. (2011) where the application of different tests to measure the same parameter lead to comparable and consistent results, ensuring increased quality of communication between different professionals and contributing to the scientific basis of practical clinic.

## 5 Conclusion

Therefore, data obtained on this study allow us to suggest that there are no differences between Q angle measurement values: among genders, direct and indirect methods, lateral symmetry and between different examiners.

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