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Abnormal Q Angle and Orthotic Support

By Mark Charrette, DC

The Q angle is an important indicator of biomechanical function in the lower extremity. This measurement reflects the effect of the quadriceps mechanism on the knee (hence the "Q" angle). When assessed correctly, it supplies very useful information concerning the alignment of the pelvis, leg and foot. Determination of the Q angle is particularly important for patients who are involved in competitive or recreational sports. It is also necessary to measure this angle in female patients who walk for health or climb stairs frequently. The effects of excessive pronation on the Q angle also deserve attention, since controlling foot pronation can often reduce the detrimental effects of an abnormal Q angle.

Determining the Q Angle

Definition and procedure: The Q angle is the angle between the quadriceps muscle (primarily the *rectus femoris*) and the patellar tendon.¹ It provides useful information regarding the alignment of the knee in the frontal plane. A measurement is made of the angle formed by the quadriceps muscle's pull from the pelvis to the patella, and the patellar tendon's pull on the tibia. Since large forces are transmitted through the patella during extension, misalignment will cause problems with knee function.

To measure the Q angle, start with the patient's knee and hip in extension, and the quadriceps muscle relaxed. First, place the center axis of a long-arm goniometer over the center of the patella. Next, palpate the proximal tibia and align the lower goniometer arm along the patellar tendon to the tibial tubercle. Take the upper arm of the goniometer and point it directly at the anterior superior iliac spine (ASIS). The small angle measured by the goniometer is the Q angle.

Patient position: Slight variations in patient positioning have a significant effect on the measurement of the Q angle, and measurement reliability in the supine position is only moderate.^{2,3} The best way to perform this test is with the patient standing. This has the advantage of measuring the Q angle in the patient's usual upright posture, so that the normal weight-bearing stresses are included. This means additional valgus

stresses on the knee and internal rotation forces, due to excessive foot pronation, are included in the measurement. Since we are most concerned with assessing how the knee functions during daily activities and sports participation, it certainly makes sense to obtain this important measurement while in a weight-bearing position.

Normal ranges: When measured standing, the Q angle should fall between 18 degrees and 22 degrees.⁴ Males are usually at the low end of this range, while females (because of a wider pelvis) tend to have higher measurements. One author considers standing Q angles greater than 25 degrees in females and 20 degrees in males to be abnormal.⁵ When measured in the supine position, the values will be lower, and the normal range ends at 15 degrees in males and 20 degrees in females.⁶ Generally speaking, when it comes to the quadriceps angle, less is better than more.

Problems Associated With the Q Angle

Increased measurements: A Q angle measured at the higher end of the normal range indicates a tendency for added biomechanical stress during strenuous or repetitive activities using the knee. When the measurement is above normal limits, the probability of developing knee joint symptoms increases rapidly. These problems are dependent on a number of factors, including habitual forces on the knee and other alignment abnormalities.

Patellar tracking: A high Q angle interferes with the smooth movement of the patella in the femoral groove. Over time, and especially with sports activities and/or stairclimbing, this microtrauma causes nonspecific anterior knee pain. Patellofemoral pain syndrome develops when abnormal tracking continues, and causes muscle imbalance,⁷ eventually leading to wearing away of the cartilage on the underside of the patella (*chondromalacia patellae*) and degeneration of the articular surfaces of the knee (degenerative joint disease). At this point, permanent damage has been done, and complete recovery is usually not possible.

Excessive foot pronation: Whenever a patient has excessive pronation of the foot, Q angle stresses are magnified. Prolonged time in pronation causes excessive internal rotation of the tibia, impeding its normal external rotation during gait progression in the stance phase. This excessive internal tibial rotation transmits abnormal forces upward in the kinetic chain and produces medial knee stresses, force vector changes of the quadriceps mechanism, and lateral tracking of the patella.⁸ The combination of a higher Q angle with excessive pronation causes a more rapid progression: knee dysfunction, to patellofemoral arthralgia, to degenerative joint disease.

Decreasing the Q Angle

Orthotic supports: The most effective way to decrease a high Q angle and lower the biomechanical stresses on the knee joint is to prevent excessive pronation with custom-made, flexible orthotics.⁹ One study found that using soft corrective orthotics was more effective in reducing knee pain than a traditional exercise program.¹⁰ A more recent study showed that Q angle asymmetries, secondary to excessive pronation affecting knee alignment, can be effectively controlled or corrected utilizing custom-made, flexible orthotics.¹¹

Adjustments and exercises: While no adjustment has been reported to reduce the Q angle, a search for pelvic and knee misalignments should be a standard part of care. It is important that good biomechanical function is restored to all joints of both lower extremities. Stretching of tight muscles and strengthening of weak areas should be included. Muscles commonly found to be tight include the quadriceps, hamstrings, iliotibial band and gastrocnemius.

The *vastus medialis* obliquus is usually weaker than the opposing *vastus lateralis* muscle. Sometimes, the coordination of these muscles has become abnormal. Strengthening may require special focus on the timing of muscle contractions. Closed-chain exercises (such as wall squats), performed only to 30 degrees of flexion, are currently recommended.¹²

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