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Does an Increased Q-angle Increase the Risk of Anterior Cruciate Ligament Tears in Female Athletes?

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By

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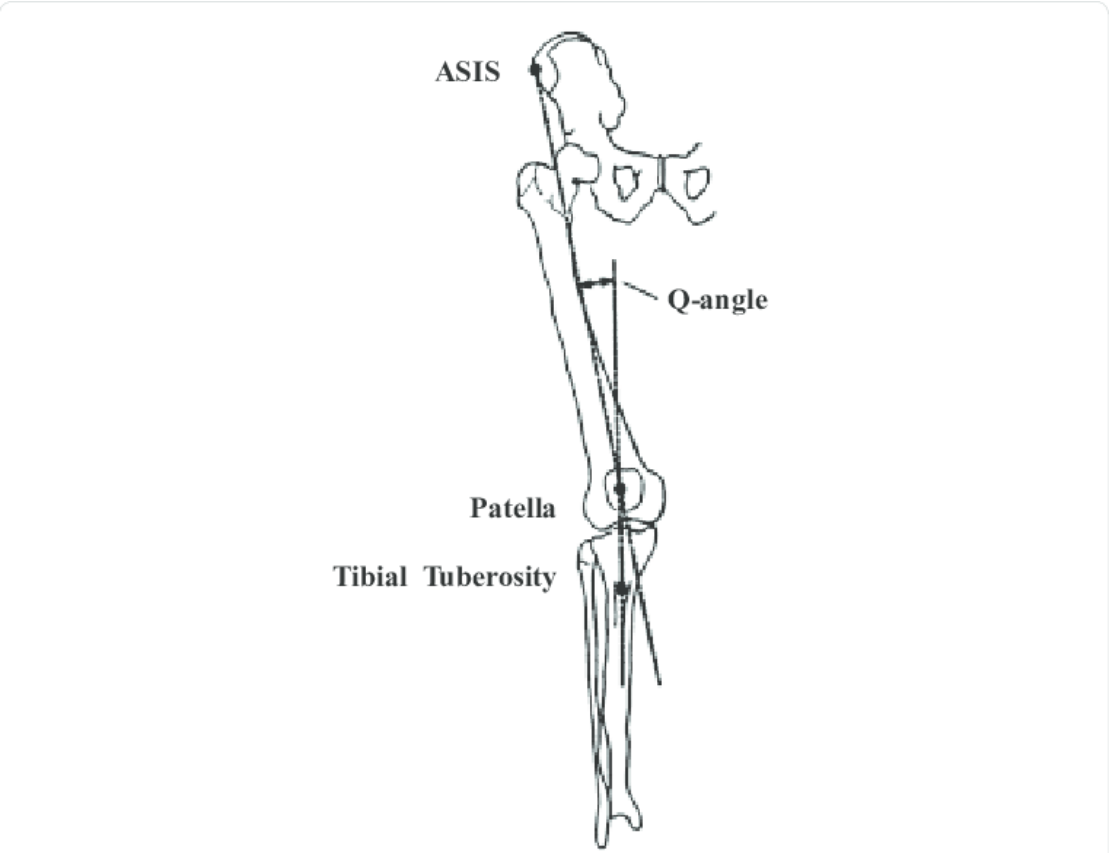
Introduction

An anterior cruciate ligament (ACL) tear is the most severe ligament injury to the knee in athletics. [1] Female athletes are at a greater risk for ACL tears than males. A report of National Collegiate Athletic Association (NCAA) injury statistics declared that women's basketball players were six times more likely to sustain an ACL tear than their male equivalents. Gender variances that may provide justification for this include anatomic features, as well as distinctive differences in strength between genders.[1] Anatomic features include one main variance between the sexes, which is the lower extremity alignment. Alignment of the hip, knee, and ankle is thought to play a significant role in the load distribution of the knee and the tension placed on the ligament structures during athletic competition.[2] Lower extremity alignment has been declared as a risk factor for acute and chronic lower extremity injuries, including patellofemoral syndrome and anterior cruciate ligament injuries [2] Another anatomic feature given credibility as a risk for ACL injuries is the Quadricep angle (Q-angle).[1] The Q-angle, which has been repeatedly researched, is defined as an angle created by a line from the anterior superior iliac spine to the patella center and a line from the patella center to the tibial tuberosity (see the diagram below).[3] An increase in the Q-angle is an element of the misalignment mechanism at the knee and lower extremity extension, and can be a cause of overuse injuries. An increased Q-angle has been linked with patellofemoral pain syndrome, knee joint hypermobility, chondromalacia patellae, recurrent subluxation of the patella, and anterior cruciate ligament tears.[4] The causes for an increased Q-angles among females are related to increased pelvic width, shorter femur length, or more laterally placed tibial tuberosity.[4] Whether an increased Q angle

compared to a normal Q angle in female athletes increases their risk for ACL tears during athletic is relevant to female athletes. If this association is confirmed, then these athletes can be advised of their increased risk of an ACL tear during competition.



Source: https://www.researchgate.net/figure/Quadriceps-Angle-Q-Angle-Markings_fig1_257052075

Discussion

Numerous risk factors for non-contact ACL injuries were identified, then separated into four categories: environmental, anatomical, hormonal, and biomechanical.[5] Irregular posture and lower extremity malalignment (hip, knee, and ankle) significantly predispose a person to ACL injuries by adding to an increased strain on the ACL.[5]

Among the eight lower extremity alignment measurements, only ankle dorsiflexion, hip internal rotation, and hip anteversion were statistically significant predictors of the ACL injury. [5] This retrospective study by Amree et al., evaluating 53 male athletes, did not find a substantial association between the Q angle as a risk factor for non-contact ACL injury. [5] Another retrospective study by Hertel et al., compared lower extremity malalignments and ACL ligament injury history in 20 volunteers among university students and concluded that lower extremity malalignments do not appear to predispose females more than males to tears of their ACLs, nor does a large Q-angle increase the risk for either sex. [6] Both these studies were small in sample size and were retrospective, for which reasons the question remains unanswered as to whether a large Q angle poses an increased risk of ACL tear in female athletes. In addition, the Japanese study by Mitani et al. examining 224 participants, both female and male athletes, did not find statistical associations between Q angle and ACL tears in female athletes. Instead, a significantly higher angle of internal rotation of the hip joint was noted in females compared to males. The position of internal rotation of the hip joint is thought to determine the increased risk for ACL injury.[9] This anomaly, rather than an increased Q-angle, was associated with increased ACL tears in these female athletes. Furthermore, in the retrospective case control study by Kizilgöza et al. 3 radiologists reinterpreted the pre-operative magnetic resonance images of 86 patients who

had undergone surgery for an ACL rupture. The radiologists did not find an association between the Q-angle and an increased risk for ACL tears.[10] This finding could have been more significant had the radiologists reinterpreted a larger number of magnetic resonance images.

The above research found no evidence that an increased risk of ACL injury was associated with increased Q-angles. However, all studies had the same findings. A retrospective observational study of 24 females of South African elites soccer players determined that three anatomical factors that were thoroughly researched within in a South African elite soccer team declared the Q-angle, pelvic width, and intercondylar notch could not be used to predict knee injuries amongst the U-23 female players in South Africa. [7]

In summary, no significant relationship between an increased Q-angle and an increased risk for ACL injury was found in the currently available research. Limitations of these investigations included small population sizes and non-prospective studies. Whether these findings will be confirmed by prospective and larger studies in more diverse populations is unknown. Other gaps in knowledge include whether strength and conditioning exercises could prevent ACL tears in patients with lower limb malalignment.

Conclusion

In conclusion, an increased Q-angle does not increase the risk of an ACL tear in female athletes. Therefore, because wide Q angles do not increase the risk of an ACL tear, involvement in sports is not proscribed if a patient's Q angle is abnormally large. Future areas of investigation include the need for larger studies that are prospective, more diverse, have longer durations of follow-up, and explore the effects of strengthening exercises on ACL tear prevention.

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