

The Strain Behavior of the Anterior Cruciate Ligament During Squatting and Active Flexion-Extension

A Comparison of an Open and a Closed Kinetic Chain Exercise

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Abstract

The effects of weightbearing (closed kinetic chain) and nonweightbearing (open kinetic chain) exercises on the biomechanical behavior of an injured anterior cruciate ligament or a healing anterior cruciate ligament graft are unknown. To understand the effects of these exercises on the healing graft, we measured the strain behavior of the normal anterior cruciate ligament in human subjects while they performed squatting, a closed kinetic chain exercise, and active flexion-extension of the leg, an open kinetic chain exercise. The maximum anterior cruciate ligament strain values obtained during squatting did not differ from those obtained during active flexion-extension. Also, anterior cruciate ligament strain values obtained during squatting were unaffected by the application of elastic resistance intended to increase muscle activity. These findings indicate that squatting, which produces a substantial compressive joint force, does not necessarily protect the anterior cruciate ligament more than active flexion-extension of the leg, which is characterized primarily by contraction of the dominant quadriceps muscle. These findings also demonstrate that increasing resistance during the squat exercise does not produce a significant increase in anterior cruciate ligament strain values, unlike increased resistance during active flexion-extension exercise.