Three-dimensional motion analysis of clinical stress tests for anterior knee subluxations


Abstract: The three rotations and three translations that comprise total knee motion were simultaneously measured in cadaveric knees during the commonly employed clinical tests for anterior cruciate injury. A second study determined the three-dimensional motions that occurred when known forces and moments were applied. A total of eight whole lower limbs were studied. A 6 degree-of-freedom instrumented linkage (3-D electrogoniometer), rigidly mounted to the tibia and femur, was used. The ligaments sectioned included the lateral extraarticular restraints (iliotibial band, lateral capsule) and the anterior cruciate ligament, both separately and in combination. After sectioning the anterior cruciate ligament alone, anterior displacement of both the medial and lateral tibial condyles increased markedly during the flexion rotation drawer and pivot shift tests. At 30 degrees knee flexion, total anterior-posterior displacement increased 100 percent, but internal-external tibial rotation increased only 15 percent. In all the anterior displacement type of clinical tests (including Lachman's test), there was not a true rigid coupling of knee motions because the examiner controlled the amount of internal tibial rotation and anterior tibial translation. After anterior cruciate sectioning alone, both the lateral and medial tibial condyles displaced anteriorly. Sectioning the medial structures caused additional anterior translation of the medial and lateral tibial condyles. We measured many different combinations of motions that depend on the ligament and capsular structures injured, the clinical test used, and how the clinician performed the test. Differing types of anterior subluxation require that the separate subluxations of the medial and lateral tibial condyles be determined during each stress test.