Appendix E-1

Specimen Preparation

The tibia and femur were sectioned mid-shaft and scraped clean of soft tissue to within 10 cm of the joint line. The bone ends were potted in cylindrical molds of polymethylmethacrylate acrylic (PMMA) cement for gripping in the test fixtures. The skin and all soft tissues surrounding the knee capsule were left intact to help prevent dehydration of ligamentous tissues. The 3 to 4-cm medial parapatellar arthrotomy incision (used for insertion of the drilling guide and visualization) was closed with sutures, and a wet towel soaked in saline solution was wrapped around the knee during testing.

After the tibia and femur were potted, the femur was clamped with its shaft parallel to the floor and the patella facing down. A weight was suspended from the tibia to produce a 2.5-N-m extension moment. The angle between the tibia and the femur was defined as 0° of flexion (full extension).

A bone plug containing the tibial insertion of the anterior cruciate ligament was isolated with use of a tibial coring cutter. Prior to complete mechanical isolation of the bone cap containing the tibial insertion fibers of the anterior cruciate ligament, six miniature wood screws were fixed to its undersurface. The porous cancellous bone and protruding screw heads were incorporated into an acrylic cylinder containing a steel core. This core was connected by an attachment screw to the shaft of a custom-designed miniature load cell. The base of the load cell was attached by a hex-head bolt to a mounting plate, which in turn was incorporated into a large acrylic mass surrounding screws fixed into the tibial shaft. After final mechanical isolation of the bone cap, all ligament force passed through the load cell, which measured the three components of anterior cruciate ligament force, as external loads were applied to the tibia. The tibial base of the ligament always remained in its precise anatomical location.

The Valgus Loading Apparatus

The potted femur (Fig. E-1) was attached to a fixture that allowed manual flexion and extension of the knee. Flexion angle was recorded by a rotary potentiometer mounted to the flexion-extension shaft. The distal aspect of the tibia was supported by a roller bearing mounted to an extension shaft attached to the distal end of the tibial acrylic; this kept the tibia level as the femur was flexed (Fig. E-1). In this configuration, tibial rotation was unconstrained and free varus-valgus rotation of the tibia was allowed in the horizontal plane. Care was taken to mount the femur on the femoral fixture such that when the knee was moved through a range of motion, the tibia had minimal varus-valgus angulation and minimal tendency to "piston" in the proximal-distal direction.

For flexion tests with applied valgus moment, a cord looped around the roller bearing passed over a pulley and suspended a weight, which acted to produce a lateral force on the tibial extension shaft. This force, acting at a right angle to the tibia, produced a valgus bending moment in the horizontal plane; tibial rotation was recorded by a rotary potentiometer during the test. A second rotary potentiometer, connected to a roller housing through a four-bar linkage, recorded varus-valgus rotation during the test (Fig. E-1). A thin wire, attached near Gerdy's tubercle, was connected to a linear variable-differential transformer that recorded anterior-posterior displacement of the lateral tibial plateau. A line sutured to the iliotibial band tendon was connected to a weight, through a pulley system, to simulate muscle force.

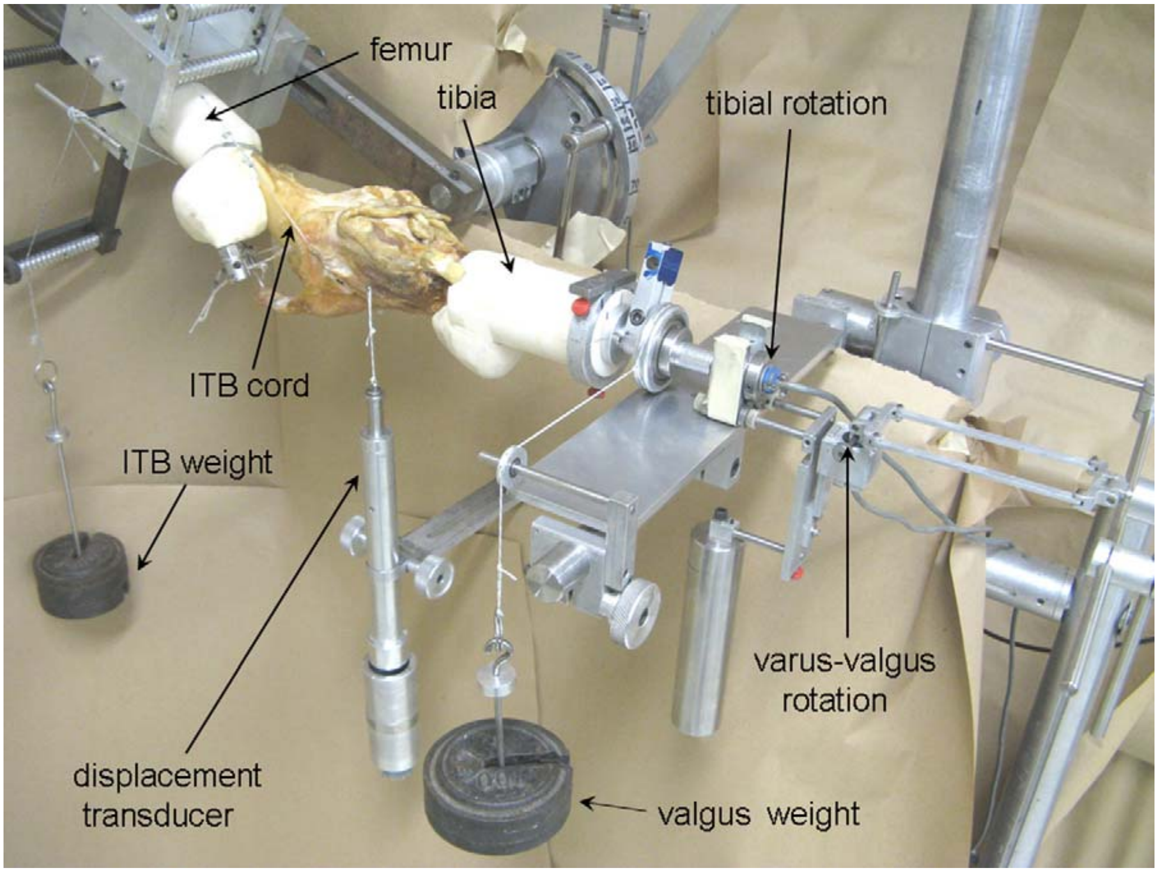

Fig. E-1

Valgus loading apparatus. ITB = iliotibial band.