The strength of the anterior cruciate ligament in humans and Rhesus monkeys

Abstract: The mechanical properties of anterior cruciate bone-ligament-bone specimens from humans and rhesus monkeys were determined in tension to failure under high strain-rate conditions. The age range of the human specimens was from sixteen to eighty-six years. The values from human specimens obtained from young adults with regard to elastic modulus, ultimate tensile stress, and strain energy to failure were approximately two to three times those for specimens from humans in the sixth decade and older. The major mode of failure was ligament disruption in the specimens from young adult humans and avulsion of bone beneath the ligament insertion site in the specimens from older humans. The difference in mode of failure correlated with histological observations of decreased bone mass at the site of ligament attachment in the specimens from older humans. Rhesus monkey specimens had higher values for elastic modulus, failure stress, and strain energy. Significant reductions in strength and stiffness properties of ligament units were shown to occur with advancing age to a greater degree than expected. All experiments in which specimens from older human cadavers are used should be interpreted with caution when the results are applied to mechanisms of ligament failure for younger or athletic individuals.