

At 2 years, 150 of 1112 patients (13.5%) having revision ACLR underwent re-operation. Graft choice did not predict the need for re-operation. For those experiencing a third revision, patients were 4.7 times more likely to require re-operation (95% CI, 1.34 to 16.4; $p = .016$).

These findings are strengthened by the large study size that allowed modeling to control for a high number of variables and the use of PRO questionnaires and phone call follow-ups that avoided attrition bias. A longer-term study is needed with future onsite follow-ups of a nested cohort. The surgeon is the number one driving force to determine graft choice, surpassing previous graft type, patient age, sport, or revision number (MARS unpublished data). Improved outcomes can occur if surgeons are educated on graft choice.

Limited Internal Femoral Rotation Increases ACL Strain

Written by Brian Hoyle

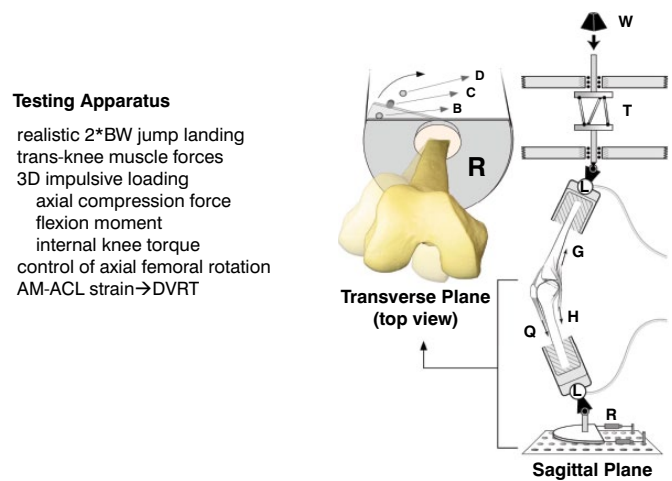
Mélanie Beaulieu, MSc, a doctoral student at the University of Michigan School of Kinesiology, Ann Arbor, Michigan, USA, reported on the underlying mechanism of injury to the anterior cruciate ligament (ACL) associated with decreased internal rotation of the hip.

Limited range of hip internal rotation has been associated with an increased risk for ACL injury, whereby the hips of ACL-injured patients rotated 12.6° less than those of noninjured individuals [Gomes JL et al. *Arthroscopy* 2008]. The most common cause is femoroacetabular impingement, a condition in which 1 or both bones of the hip joint are abnormally shaped. This deformity can produce abnormal contact between the bones, which progressively damages the joint. The prevalence of femoroacetabular impingement is 6% to 25% in individuals who are asymptomatic [Monazzam S et al. *Bone Joint J* 2013; Reichenbach S et al. *Arthr Care Res* 2010] but exceeds 60% in patients with pathological hips [Beck M et al. *J Bone Joint Surg Br* 2005]. Affected individuals are predominantly young (eg, college athletes) and have an increased risk for early osteoarthritis of the hip.

The study was grounded in 2 hypotheses. The first posited that as internal femoral rotation decreases, the magnitude of peak ACL strain increases. The second was that women have greater peak ACL strain than do men, regardless of the range of internal femoral rotation.

Twenty knee specimens, 10 each from men and women, were harvested from fresh, unembalmed cadavers and tested. The donors were similar in age (men, 59.9 ± 6.6 years; women, 55.2 ± 10.5 years), with men being predictably taller (men, $1.77 \pm .05$ m; women, $1.67 \pm .06$ m),

Figure 1. Diagram of the Testing Apparatus



AM-ACL=anteromedial anterior cruciate ligament; BW=body weight; DVRT=differential variable reluctance transducer.

Reproduced with permission from M Beaulieu, MSc.

heavier (men, 81.3 ± 8.2 kg; women 60.5 ± 8.3 kg), and with greater body mass indexes (men, 25.9 ± 2.3 kg/m²; women 21.6 ± 3.1 kg/m²) than women. Each knee was dissected to leave the joint capsule and associated tendons of the quadriceps, hamstrings, and gastrocnemii intact. Each knee specimen was inverted and positioned in a testing apparatus, diagrammed in Figure 1. The device was designed to subject the specimen to forces that simulate a jump landing at twice body weight, including a twist of the knee (ie, internal tibial torque). The forces, moments, and motion produced during the landings were measured. Also, ACL strain was measured using a device called a differential variable reluctance displacement transducer, which was placed on the anteromedial bundle of the ACL. For each knee specimen, 4 conditions of internal femoral rotation were simulated, ranging from locked to free rotation (~3°-15°).

As expected, peak ACL strain increased as internal femoral rotation was decreased during the simulated pivot landings. Furthermore, the female ACLs experienced greater peak strain than did the male ACLs, irrespective of the range of internal femoral rotation.

The researchers surmised that the cause of the increased ACL strain is the increased internal rotation and anterior translation of the knee joint that occur. The authors postulated that screening for a limited range of hip internal rotation might be helpful in identifying athletes with increased risk for ACL injury. These athletes may benefit most from participating in ACL injury prevention programs.