# Impact of Graft Choice on Outcome of ACLR

Written by Maria Vinall

Inferior outcomes are often noted following revision anterior cruciate ligament reconstruction (ACLR) compared with primary ACLR. This finding is supported by a consensus of ~90 authors in the Multicenter ACL Revision Study (MARS) Group, as well as a number of studies [Wright RW et al. *J Bone Joint Surg Am* 2012; Wright R et al. *J Knee Surg* 2011; Spindler KP et al. *J Bone Joint Surg Am* 2005].

Previous studies have demonstrated that the odds of graft rupture following allograft primary reconstruction are four times higher than reconstructions employing autografts [Kaeding CC et al. *Sports Health* 2011]. In addition, for each 10-year decrease in age, the odds of graft rupture increase by 2.3 times. Whether this was true with revision reconstructions was unknown.

The MARS Group gathered a mix of >80 US academic and private surgeons at 52 sites to compare patient outcomes after ACLR with autografts versus allografts. Autografts, more than allografts, improved sports outcomes and decreased rerupture rate, but had no impact on subsequent reoperation rate. No outcome differences were seen between soft tissue and bone-patella tendon-bone (BTB) grafts for either type of graft.

Patient reported outcomes (PRO) using standardized patient questionnaires and surgeon questionnaires were employed in the study [NCT00625885]. Multivariable regression models were utilized to examine the independent variables. The study employed the Musculoskeletal Transplant Foundation's approach using The Vanguard Method. The purpose of the study was to determine if the use autograft versus allograft affected sports function, re-rupture rates, and reoperation rates. In addition, a comparison was made between soft tissue and BTB grafts within the autograft and allograft groups.

Official Peer-Reviewed Highlights From

AOSSM 2014 ANNUAL MEETING JULY 10-13, 2014 Seattle, WA

There were 1205 subjects (697 males and 508 females) enrolled; median age was 26 years (range, 12 to 63). At the 2-year follow-up, 82% of patients had responded to the questionnaire and 92% had responded via a phone interview. The International Knee Documentation Committee scores improved with autograft reconstruction (Table 1). The Knee Injury and Osteoarthritis Outcome Score for the Sports and Recreation and Quality of Life subscales were significantly improved with the use of autografts as compared with allografts. Activities of Daily Living and Symptom scores were not predicted by graft choice. Marx activity level improved with an autograft plus allograft combination graft in 31 patients.

Table 1. Reconstruction Improvement Results

| Score | OR | 95% CI | p Value |
|---|---|---|---|
| IKDC | 1.33 | 1.01 to 1.7 | 0.045 |
| KOOS Sports and Recreation | 1.33 | 1.02 to 1.73 | 0.037 |
| KOOS QoL | 1.33 | 1.03 to 1.73 | 0.031 |
| Marx Activity | 3.33 | 1.43 to 7.78 | 0.005 |

IKDC=International Knee Documentation Committee Score; KOOS=Knee Injury and Osteoarthritis Outcome Score; QoL=Quality of Life.

Overall, autografts, more than allografts, improved sports outcomes and decreased the re-rupture rate but had no impact on subsequent reoperation rate. No outcome differences were seen between soft tissue and BTB grafts for either type of graft. Re-rupture occurred in 37 of 1112 patients (3.3%; 12 autografts, 24 allografts, and 1 combination graft). Re-rupture was 2.78 times less likely to occur in patients who received autografts (95% CI, 1.01 to 7.69; p = .047). Re-rupture rates were not different between BTB versus soft tissue when using either autograft or allograft.

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.

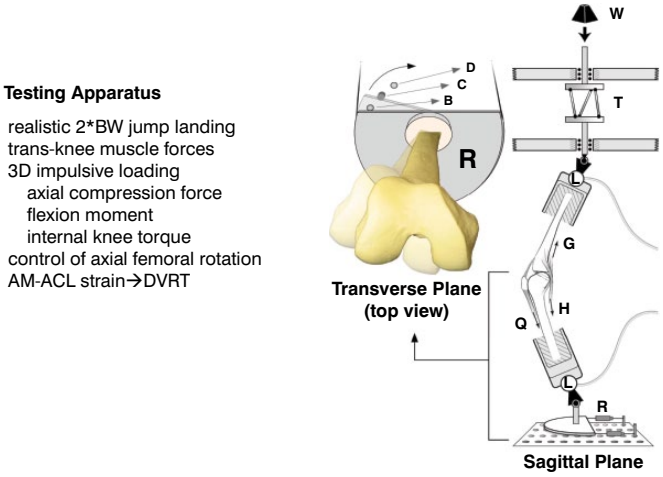
The study was grounded in 2 hypotheses. The first posited that as internal femoral rotation decreases, the magnitude of peak ACL strain increases. The second was that women have greater peak ACL strain than do men, regardless of the range of internal femoral rotation.

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 ± .05 m; women, 1.67 ± .06 m), 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/m$^2$; women 21.6 ± 3.1 kg/m$^2$) 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.

Figure 1. Diagram of the Testing Apparatus




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

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