

Editorial Commentary: Anterior Cruciate Ligament Autograft Morbidity: Who Needs Strong Hamstrings in Greater Than 90° of Knee Flexion?



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Abstract: An understanding of expected morbidity of various anterior cruciate ligament graft options is important to inform patient expectations and facilitate successful return to sport following anterior cruciate ligament reconstruction. Hamstring harvest results in decreased hamstring strength. Gracilis preservation may mitigate the degree of strength loss, particularly in deep knee flexion. The extent to which knee flexion strength at high flexion angles is important to return to play and functional outcomes remains unknown and is likely sport-dependent.

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The anterior cruciate ligament (ACL) reconstruction literature is replete with studies that evaluate the effects of graft choice on outcomes. Studies comparing allograft to autograft tissue and comparisons between hamstring and patellar tendon autografts, although varied in their results, all point to the conclusion that there is no 1 best graft for everyone. Graft choice must be patient-specific, with both the effectiveness of the graft and the morbidity of harvest informing this important decision.

In their study, “Assessment of Flexion Strength Following Single- Versus Double-Hamstring Tendon Harvest for Anterior Cruciate Ligament Reconstruction,” Hu, Lawton, Nelson, Selley, Sweeney, Tuttle, Johnson, Balderama, Gryzlo, and Terry evaluate strength, knee laxity, functional outcomes, and patient-reported outcomes after ACL reconstruction with hamstring autograft.¹ Specifically, they compare doubled semitendinosus/gracilis (ST/G) autografts with quadrupled semitendinosus autografts. At a minimum of 1-year follow-up, they identified significantly greater isometric

knee flexion strength deficits in high degrees of knee flexion when graft harvest included the gracilis tendon. Although prior authors have identified that the largest effects of gracilis harvest on strength are in higher degrees of knee flexion, the comprehensive evaluation of isometric strength deficits in this study is among the clearest descriptions of this effect.²⁻⁴

The obvious next question here is whether hamstring strength loss at high flexion angles matters. Perhaps more specifically: are there specific patients for whom this deficit may be *clinically* relevant? As the authors note in their discussion, most hamstring muscle activation during gait and most other daily activities occurs near full knee extension, with activation near full flexion happening infrequently.⁵ There are likely specific sports, including certain strength competitions, cycling, judo, gymnastics, and wrestling, where hamstring strength in deep knee flexion becomes important.^{3,4,6} We are aware of no studies that specifically evaluate the impact of knee flexion strength deficits at high flexion angles on functional outcomes or rates of return to these or other sports.

Although this study is focused on and appropriately powered to detect differences in isometric knee strength based on graft choice, other outcomes are reported as well. The authors conclude that there were few or no significant differences between quadrupled ST autografts and doubled ST/G autografts relating to functional, clinical, and patient-reported outcomes. As

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examined in their discussion, this point deserves careful and tempered consideration. One must remember that this study is not appropriately powered to detect differences in these other outcomes between the groups. Larger cohorts and future randomized controlled trials are needed to definitively draw meaningful conclusions regarding the influence of gracilis preservation of knee function.

Another interesting consideration is the relevance of isometric knee strength in knee function. Although the utilization of isometric testing facilitates evaluation of strength at specific flexion angles, relatively few sporting activities use isometric muscle contraction. The literature does support that gracilis harvests affects concentric muscle contraction as well. Monaco et al. recently evaluated a gracilis-sparing technique and found it to result in better flexion strength recovery at lower angular velocities when compared with traditional a traditional ST/G technique.⁷

Given the relatively limited understanding of the impact of hamstring weakness in high degrees of knee flexion on knee function, the influence that these deficits should have on clinical decisions such as therapy progression or return to sport is unclear. In general terms, the interplay between graft healing, functional recovery, and patients' goals should drive rehabilitation following ACLR. A better understanding of how ACL reconstruction rehabilitation protocols should be tailored to address specific strength and functional deficits is warranted. The future may bring more variation in postoperative protocols that are individualized to the patient, specific strength and functional deficits, surgical technique, and graft choice, including gracilis preservation.

Finally, it is worth mentioning that any discussion comparing the outcomes of quadrupled semitendinosus with those of doubled semitendinosus and gracilis graft is incomplete without consideration of the resulting graft size. The quadrupled semitendinosus technique results generally in larger graft sizes, which numerous prior studies have demonstrated to result in lower graft failure risk.⁸⁻¹¹ Interestingly, the authors of this study report that all grafts were larger than 8 mm, regardless of harvest technique. This finding does not match our experience, as we frequently encounter small grafts, particularly in female patients, with the doubled ST/G technique. In our practice, this difference in graft size has served as the primary motivator for use of the quadrupled semitendinosus graft in young, active patients. Any potential hamstring strength benefits,

particularly in deep knee flexion, are a welcome bonus in most patients and may prove particularly important in a small subset.

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