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Morphological Changes of Graft Donor Semi-Tendinosus and Gracilis After ACL Reconstruction

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Summary:
This longitudinal study evaluating change in muscle morphology of semi-tendinosus (ST) and gracilis (G) graft donor muscles used during ACL reconstruction found marked or complete atrophy and a substantial proximal shift of the muscle belly; these findings have implications for approach to surgery/rehabilitation.

Abstract:
Objective:
To evaluate change in muscle morphology of semi-tendinosus (ST) and gracilis (G) graft donor muscles used during ACL reconstruction.

Methods:
Longitudinal assessment was performed on 20 adult participants awaiting ACL reconstruction surgery. Bilateral lower extremity MRI was obtained at 2-weeks pre- and 12-months post-surgery to include the ischial tuberosity to 10 cm proximal to the lateral knee joint line with 5.0 mm slice-thickness and a 1.5 mm inter-slice gap (repetition time 660 ms, echo time 15 ms) using a Siemens 1.5T (Siemens, Burlington, ON). Cross-sectional areas of ST and G were computed for each slice (minimum 25 slices per participant) using a custom algorithm in MatLab (Mathworks, Natick, MA). The difference in muscle areas within the harvested limb was examined between time points, as well as a between limbs at 12 months.

Results:
Mean (SD) age of the participants was 29.2 (7.1) years with fifteen males and five females. From pre- to 12-months post surgery, there was a significant reduction ($p<0.001$) in muscle area of the proximal muscle belly in both graft donor ST and G, but no reduction in muscle area in the corresponding contralateral unharvested muscles. At 12 months, the graft donor muscle areas were significantly reduced ($p<0.001$) by 79 (8.2)% and 49 (5.0)% for ST and G, respectively, relative to the contralateral limb. Complete atrophy of the graft donor muscle was observed in 29% of participants for ST and no participants for G. In addition, there was a mean proximal shift of 57 (28.8) cm for ST and 42 (23.2) cm for G. At 12 months, there were no participants that maintained muscle cross section within 5% of the pre-surgical values or within 5% of the contralateral limb.

Conclusions:
Marked or complete atrophy of graft donor STG muscle has implications for functional outcome. Regardless of compensatory hypertrophy in other muscles, a resultant change in the line of action at the knee and the potential shift from bi-articular to uni-articular force generation are inevitable. Approach to muscle harvest in surgery and/or greater emphasis on hamstring rehabilitation may mediate this consequence and should be further investigated.