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Tensile Properties of the Human Acetabular Labrum and Hip Labral Reconstruction Grafts

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Summary:
We observed that the gracilis tendon, anterior tibialis tendon, semitendinosus tendon, iliotibial band and native hip labrum have similar cyclic elongation behavior.

Abstract:
BACKGROUND
In cases where the acetabular labrum is severely damaged and irreparable, labral reconstructions are becoming an increasingly preferred means of preserving the fluid seal effect of the labrum. However, the graft that most closely replicates the biomechanical properties of the native labrum remains undetermined.

PURPOSE
The purpose of this study was to characterize the tensile properties and geometry of the labrum, as well as iliotibial band, semitendinosus, gracilis, and anterior tibialis grafts, and determine which grafts more closely replicate the biomechanical behavior of the native labrum.

STUDY DESIGN: Controlled Laboratory Study

METHODS
Five graft groups – 1) acetabular labrum, 2) iliotibial band, 3) semitendinosus, 4) gracilis, and 5) anterior tibialis – with eight specimens per group were tested. Grafts were tested using a material testing system in response to a stepwise sinusoidal cyclic loading protocol. Uniaxial tensile loads were initially applied from 20-50 N for 100 cycles at 0.5 Hz, followed by incremental increases of 50 N in the upper force every 100 cycles until failure or successful completion of 100 cycles at 300 N. This protocol was designed to be representative of progressive loading experienced during rehabilitation. Cyclic displacement was recorded after 100 (50 N), 200 (100 N), 300 (150 N), 400 (200 N), 500 (250 N) and 600 (300 N) cycles.

RESULTS
The mean elongation (95% Confidence Interval) after 100 cycles from 20-50 N was similar for all groups: acetabular labrum, 0.68 mm (0.57-0.78 mm); iliotibial band, 0.68 mm (0.47-0.89 mm); semitendinosus, 0.68 mm (0.51-0.84 mm); gracilis, 0.62 mm (0.46-0.79 mm); and anterior tibialis, 0.66 mm (0.58-0.73 mm). After 100 cycles from 20-300 N (600 cycles total), the mean elongation of the labrum was 4.53 mm (3.71-5.35 mm), and the mean elongations of the iliotibial band, semitendinosus, gracilis, and anterior tibialis were 4.65 mm (3.23-6.07 mm), 4.41 mm (3.45-5.36 mm), 5.12 mm (3.09-7.16 mm), and 5.33 mm (4.40-6.25 mm), respectively.

CONCLUSION
All tested grafts and the acetabular labrum exhibited similar cyclic elongation behavior in response to simulated

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physiologic forces. In addition, differences in variability in both elongation and geometry existed for all graft types.

CLINICAL RELEVANCE
All tested grafts can be considered viable acetabular labrum reconstruction graft options