SIMILAR KNEE MECHANICS BUT DIFFERENT MUSCLE ACTIVITY: TIME FOR AUGMENTED ACL REPAIR AS ALTERNATIVE ACL SURGERY

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Introduction

InternalBrace™-augmented anterior cruciate ligament repair (ACL-IB; Arthrex Inc., USA) for proximal ACL ruptures is an alternative to ACL reconstruction (ACL-R). Preservation of the native ACL and no graft harvest in ACL repair is believed to maintain neuromuscular integrity and knee mechanics [1]. We compared knee biomechanics (kinematics, kinetics), ground reaction force (GRF), and m. semitendinosus activity within legs of ACL-IB and between ACL-IB, ACL-R and controls.

Methods

Twenty-nine patients 2 years after ACL-IB, 27 sex- and age-matched patients 2 years after ACL-R (hamstring tendon autograft) and 29 matched controls completed walking analysis. Knee kinematics (rotations, anterior translation) and kinetics were obtained using the Point Cluster Technique [2] and the Conventional Gait Model [3], GRF using force plates, and semitendinosus muscle activity using surface electromyography. Parameters were time-normalized to gait cycle (GC), muscle activity amplitude-normalized to activity during 30-45%GC (terminal stance), and compared within the legs of ACL-IB (paired t-test) and between ACL patients (involved legs) and controls (non-dominant leg, one-way analysis of variance (ANOVA) and posthoc Bonferroni tests) using statistical parametric mapping ($P<0.05$). Significant different intervals >2%GC were interpreted and mean of maximal differences in this interval calculated (mDiff).

Results

A small difference was observed within ACL-IB in posterior GRF (8–11%GC, mDiff -3%body weight (BW), P=0.043). Compared to controls, ACL-IB had significantly less anterior tibia position around heel strike (98–100%GC, P=0.016 and 0–3%GC, P=0.015, mDiff -8.9mm) and ACL-R significantly lower internal rotation moments (34–41%GC, mDiff -0.04Nm/kg, $P<0.001$). However, in these parameters a similar (non-significant) deviation was observed in the respective other ACL group compared to controls. While semitendinosus muscle activity did not differ between patients and controls, its activity was significantly higher in ACL-R than in ACL-IB prior heel strike (90-95%GC, mDiff 5*relative activity, P=0.003, Fig. 1).

Discussion

Observed mDiff in GRF within ACL-IB were within the 95% confidence interval of heathy subjects [4]. Hence, we did not observe relevant leg asymmetry in knee biomechanics, GRF, and muscle activity 2 years after ACL-IB. Comparison between patient groups suggest similar walking adaptations in knee biomechanics, while semitendinosus muscle function seems to differ. Hamstring muscles have been shown to influence the magnitude and timing of ACL loading [5] and may play a role in ACL protection [6]. Therefore, the more similar activity after ACL-IB compared to controls may highlight the importance of preserving this muscle and its function as an agonist of the injured ACL. However, knee biomechanics still appear to be affected by the initial ACL rupture and may not return to normal. These results suggest no inferiority in ambulatory knee and semitendinosus function after ACL-IB, and strengthen the rationale for less invasive ACL-IB of proximal ruptures as alternative method to ACL-R. If these results are also present compared to patients using other grafts (e.g., patellar tendon) is still to be determined.

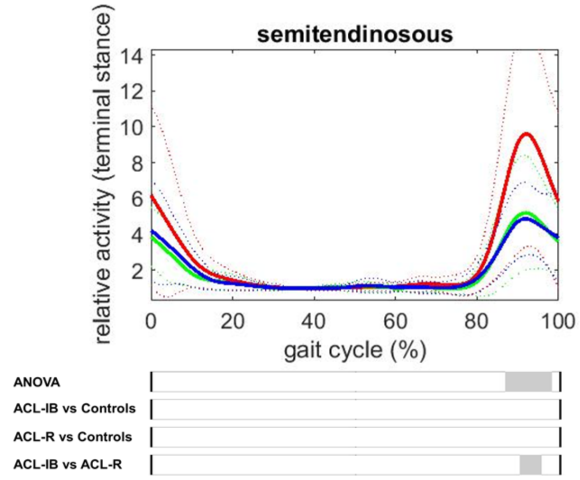

Figure 1: M. semitendinosus activity in ACL-IB (blue); ACL-R (red) and controls (green). ANOVA with posthoc results (grey area indicates significant different interval)

References

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