Reduced Rate of Quadriceps Activation during Running and Jumping in Collegiate Athletes post ACL Reconstruction
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Running, jumping, and most sports activities involve sequences of rapid muscle activation and relaxation, or rapid increases and decreases in force production. Rapid quadriceps activation and force development (typically assessed with isolated, isometric methods) are reduced after anterior cruciate ligament reconstruction (ACLR). Rate of neuromuscular activation during sports activities after ACLR has not been examined.

Purpose: To investigate side-to-side asymmetries in rate of neuromuscular activation of the thigh and hip muscles during jumping and running in collegiate athletes post-ACLR.

Methods: Twelve Division I athletes (age 20.6 ± 1.8, BMI 25.5 ± 2.8, 7.0 ± 3.1 months post-surgery) performed maximal countermovement jumps (CMJ) and treadmill running at preferred speed (2.88 ± 0.27 m/s) while surface electromyography (EMG) of the bilateral rectus femoris (RF), vastus lateralis (VL), medial hamstrings (MH), biceps femoris (BF), and gluteus maximus (GMX) was recorded. Root mean square values of the EMG signal from 0-50 ms were computed from the initiation of the eccentric (ECC), concentric (CONC), and landing (LAND) phases of the CMJ (e.g., RF$_{0-50}$). During running, rate of EMG rise (e.g. RFRR) was averaged over 18.8 ± 1.3 strides. Limb asymmetries were computed and compared for each muscle and condition using Wilcoxon Signed Ranks tests.

Results: VL$_{0-50}$ was significantly lower in the INV limb in all CMJ phases (ECC: INV 24.3 ± 17.8%, UN 36.1 ± 22.5%; CONC: INV 59.3 ± 26.2%, UN 76.2 ± 22.1%; LAND: INV 34.1 ± 12.2%, UN 58.9 ± 27.5%). RF$_{0-50}$ was significantly lower in the INV limb at initiation of the CONC (INV 46.0 ± 25.0%, UN 70.1 ± 23.4%) and LAND (INV 45.1 ± 19.3%, UN 57.8 ± 27.6%) phases. INV limb BF$_{0-50}$ was significantly reduced in the CONC phase (INV 46.6 ± 28.5%, UN 64.8 ± 31.3%). During running, VLRR and RFRR were significantly lower in the INV limb (79.9 ± 41.7% and 78.2 ± 27.2% of UN limb values). There were no between-limb differences in MH or GMX rate of activation in either task.

Conclusion: Collegiate athletes demonstrated reduced INV limb rate of quadriceps activation during jumping and running 7 months post-ACLR. These findings have important clinical implications as sports activities require rapid muscle activation. Rehabilitation efforts to improve fast activation of the quadriceps should be explored.