HAMSTRINGS LENGTH CHANGES DURING DROP JUMP AND SQUAT MANEUVERS

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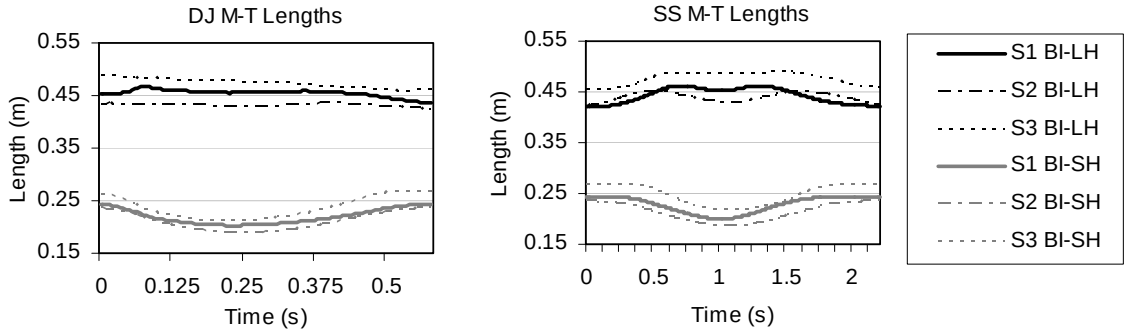
INTRODUCTION: A number of preventive conditioning programs have been developed that attempt to decrease knee ACL injury rates by increasing the strength and control of the muscles of the lower extremity. These programs require specificity of speed, muscle contraction, and lower extremity mechanics (1). Thus, to most effectively condition the lower extremity muscles during sport activities it is important to understand the specific muscle mechanics. Additionally, the hamstring muscle group contributions to knee joint stability during activity have recently been questioned due to high shortening velocities (2). Therefore the purpose of this study is to describe and contrast overall muscle-tendon (M-T) length changes during a slow squat (SS) and a faster drop–jump (DJ) maneuver.

METHOD: Three healthy active females (ages 24-37) performed squats and drop jumps, while kinematic data were collected with a seven camera high-speed motion analysis system (Motion Analysis Corp.) at 200Hz. Force data were collected synchronously at 1000Hz. Subjects performed three trials of a squat and three trials of a maximal vertical jump immediately after dropping from a height equal to their countermovement jump height. Kinematic data were used to estimate muscle–tendon (M-T) length changes for the bi-articular biceps femoris long head (BI-LH) and mono-articular short head (BI-SH) using Simm 4.1.1 (Musculographics, Inc).

RESULTS: Figure 1 depicts M-T length changes for each subject (three trial average) for the long head and short head of the biceps femoris for squats and drop jumps.



DISCUSSION / CONCLUSIONS: These preliminary results indicate clear distinctions between subjects and activities. While the BI-SH shortened during flexion (as expected) for both activities, the bi-articular BI-LH behaviour was more complex. The BI-LH lengthened during the SS flexion phase while maintaining a more constant overall length throughout the DJ due to a different coupling of hip and knee flexion. Interestingly, each subject demonstrated different patterns of hip/knee synergy at ground contact during the DJ, reflected by differences in the M-T length curves for BI-LH at that instant. There was an initial lengthening for one subject (S1), shortening for another (S3), and a nearly isometric contraction for the third (S2). This initial phase of landing is when the knee is at greatest risk for injury, so these subtle differences in muscle behaviour may have implications for an individual's ability to use the hamstrings to protect the knee. This also raises the question of whether there is an optimal synergy of hip and knee flexion.

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