Deep Hip Muscle Function during Gait

INTRODUCTION:

Sensory signals activated by movements of the hip are of major importance in the control of gait. As the limb approaches its most posterior position, sensory signals from the muscles and joint capsule promote the switch from extensor to flexor activity. The deep muscles that produce hip flexion or extension also promote hip internal or external rotation and may influence transverse plane hip stability. However, diminutive information is available on the activation patterns of the deep hip muscles during walking. This omission in the literature has been primarily due to the inaccessibility of the muscles to surface electrodes and the proximity of the femoral vessels for indwelling techniques. The purpose of this paper was to investigate deep hip muscle activation during walking to describe their role during sagittal and transverse plane motions.

METHODS:

Ten healthy individuals (1.72 ± 0.04 m; 674.17 ± 43.3 N; 28.70 ± 2.00 y) participated in this study. All participants provided written consent prior to participation, in accordance with the Vail Valley Medical Center’s Institutional Review Board.

The participants performed over-ground walking at a cadence of 90 bpm. Indwelling electrodes were used to record (1200 Hz) muscle activation from the pectineus, iliopsoas, gluteus medius and piriformis muscles. The electrodes were ultrasound guided to assure correct placement into the muscle and for patient safety. A radiologist that was blinded to the study confirmed electrode placement via inspection of the digital ultrasound pictures. The EMG data (Bagnoli-8, DelSys, Boston, MA, USA) were processed with a 50 ms, root-mean-squared (RMS) moving window (1 ms increments) with custom software (MATLAB, Natick, MA, USA). The EMG data were scaled to a maximum EMG reference value measured during the MVC trials and represented 100% MVC.

Fifty-three retro-reflective, spherical markers (diameter =1.0 cm) were attached to select anatomical landmarks. A ten-camera motion analysis system (Motion Analysis, Cortex 1.1.4, Santa Rosa, CA, USA) and force plate (Bertec Corporation, Worthington, OH) were used to capture three-dimensional hip motions and ground reaction forces at a frequency of 120 and 1200 Hz, respectively. The marker trajectories were low pass filtered at 10 Hz with a fourth order Butterworth filter. Three-dimensional hip kinematics and kinetics were calculated (Motion Monitor, Version 7.0, Innovative Sports Training, Chicago, IL, USA) using a YXZ sequence.

RESULTS:

The sagittal and transverse plane hip positions and joint torques calculated from toe-off to toe-off are illustrated in Figure 1. The swing phase occurred from 0 to ≈40% of cycle time.

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REFERENCES: