7th World Congress of Biomechanics
July 6-11, 2014
John B. Hynes Veterans Memorial Convention Center
900 Boylston Street | Boston, Massachusetts 02215

Print this Page for Your Records Close Window

Control/Tracking Number: 14-IS-4578-WCB
Activity: Invited Speaker
Current Date/Time: 7/24/2014 4:36:34 PM

What is the influence of biarticular muscles on postural control?

Author Block: J. A. Reinbolt, M. Mansouri;
University of Tennessee, Knoxville, TN.

Abstract:
Biarticular muscles are commonly affected in patients with spastic cerebral palsy and result in complex movement abnormalities altering balance and locomotion. Surgeries are designed to correct problematic muscle function and improve mobility. However, treatment outcomes are inconsistent, in part, due to insufficient understanding of biarticular muscles for postural control and their changing roles with spasticity and following treatments.
Monoarticular and biarticular muscles have different roles in producing functional movements. Monoarticular muscles produce ground reaction forces parallel to the limb, but biarticular muscles have a considerable perpendicular force component as well. Monoarticular muscles produce most of the net joint moments, while biarticular muscles regulate the distribution of these moments for desired contact control tasks. In cycling, biarticular rectus femoris and hamstrings distribute joint moments to control the direction of force on the pedal. In running, monoarticular muscles contribute mainly positive work and their active forces are low during lengthening; however, biarticular muscles have high forces during lengthening for control of the ground reaction force vector as well as elastic energy storage. Although there are recognized differences in the roles of monoarticular and biarticular muscles during many movements, the influence of these muscles on postural control is not well understood and biarticular muscles may offer unrecognized benefits to maintaining balance in children with spastic cerebral palsy.
We used musculoskeletal modeling, biologically-inspired control systems, and forward dynamic simulation to investigate the influence of biarticular muscles on whole-body center of mass displacements in response to support-surface translations. A three dimensional musculoskeletal model was scaled in OpenSim to represent developing children sizes. These models were placed in postures from mild to severe crouch. The feet were modeled using elastic foundation contact geometry to generate ground reactions from the support surface. The support surface was prescribed to translate in either the anterior or posterior direction. Computed muscle control was used to estimate high-level muscle activities for quiet standing. A low-level reflex controller was used to manage muscle responses to perturbations through a combination of muscle spindle and Golgi tendon organ feedback. The reflex controllers were modified to simulate typically developing children and those with spastic diplegia. Post-treatment models were modified to simulate virtual rectus femoris transfer surgeries.
The influence of biarticular muscles on postural control provides insights needed to understand the role of spasticity in locomotion and improve treatment outcomes.
:

Presentation Type (Complete): Invited Podium Presentation (no more than 2 total per speaker)
Track (Complete): Special Topics in Biomechanics
Session Details (Complete):
Session Chair : Ilse Jonkers and Friedl De Groote
Session Title : Towards understanding the role of spasticity in locomotion: combining experimental and simulation-based research insights

Availability (Complete):
Status: Complete