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The Function of the Intrinsic Foot Muscles During Turns and Mediolateral Shifts in Balance

An Honors College Project Presented to
the Faculty of the Undergraduate
College of Health and Behavioral Sciences
James Madison University

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Accepted by the faculty of the Department of Kinesiology, James Madison University, in partial fulfillment of the requirements for the Honors College.

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Abstract

Purpose: Atrophy of the intrinsic foot muscles (IFM) has been associated with foot deformity, balance deficiencies, and plantar ulceration in patients with diabetes. Nevertheless, little is understood regarding the function of the intrinsic foot muscles responsible for abduction of the toes, and no study has directly assessed the role of the abductors in maintaining mediolateral balance or foot alignment and integrity during turning and other nonlinear activities. The purpose of this study was to determine the activation levels of abductor hallucis (ABDH), abductor digiti minimi (ABDM), the first (PDIO1) and third (PDIO3) dorsal interossei, and flexor digitorum brevis (FDB) during dynamic turns and static balance activities. **Methods:** Seven adults without a history of lower limb injury or deformity in the past six months completed dynamic turning and static balance tests. Surface electromyography was used to measure muscle activation of five intrinsic foot muscles (ABDH, ABDM, PDIO1, PDIO3, FDB) while mediolateral balance was simultaneously assessed by measuring change in center of pressure (COP) on a plantar pressure mat during both static balance activities and turns. **Results:** EMG activity of all muscles was consistently higher during static balance activities than during walking ($p < 0.05$) and increases in activity were associated with decreases in COP movement. However, contrary to our predictions, EMG activity was similar among intrinsic muscles, regardless of condition. **Conclusion:** The intrinsic foot muscles responsible for abduction of the toes are important for the maintenance of mediolateral balance and the reduction of mediolateral sway. Therefore, strengthening these muscles may help populations with balance issues, including the elderly, to maintain balance more effectively when standing or walking non-linearly, and may help athletes during cutting maneuvers. Strengthening the IFM to improve balance should not only focus on the flexors of the toes but should also include activities that directly address the pedal abductors

and adductors. A complete understanding of the role of the intrinsic foot muscles studied here during walking and turning and will likely require indwelling EMG studies on considerably more subjects.

Keywords: Intrinsic foot muscles, electromyography, plantar pressure, center of pressure, muscle activation, turns, balance, abductor hallucis, abductor digiti minimi, dorsal interossei, flexor digitorum brevis