

Evaluation of foot position and orientation as manipulated variables to control external knee adduction moments in leg extension training

Kolditz M, Albin T, Abel D, Fasse A, Brüggemann G, Albracht K

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Abstract

Background and Objective: Effective leg extension training at a leg press requires high forces, which need to be controlled to avoid training-induced damage. In order to avoid high external knee adduction moments, which are one reason for unphysiological loadings on knee joint structures, both training movements and the whole reaction force vector need to be observed. In this study, the applicability of lateral and medial changes in foot orientation and position as possible manipulated variables to control external knee adduction moments is investigated. As secondary parameters both the medio-lateral position of the center of pressure and the frontal-plane orientation of the reaction force vector are analyzed. **Methods:** Knee adduction moments are estimated using a dynamic model of the musculoskeletal system together with the measured reaction force vector and the motion of the subject by solving the inverse kinematic and dynamic problem. Six different foot conditions with varying positions and orientations of the foot in a static leg press are evaluated and compared to a neutral foot position. **Results:** Both lateral and medial wedges under the foot and medial and lateral shifts of the foot can influence external knee adduction moments in the presented study with six healthy subjects. Different effects are observed with the varying conditions: the pose of the leg is changed and the direction and center of pressure of the reaction force vector is influenced. Each effect results in a different direction or center of pressure of the reaction force vector. **Conclusions:** The results allow the conclusion that foot position and orientation can be used as manipulated variables in a control loop to actively control knee adduction moments in leg extension training.