

# ORIGINAL RESEARCH

## ANKLE JOINT CONTROL DURING SINGLE-LEGGED BALANCE USING COMMON BALANCE TRAINING DEVICES – IMPLICATIONS FOR REHABILITATION STRATEGIES

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### ABSTRACT

**Background:** A lateral ankle sprain is the most prevalent musculoskeletal injury in sports. Exercises that aim to improve balance are a standard part of the ankle rehabilitation process. In an optimal progression model for ankle rehabilitation and prevention of future ankle sprains, it is important to characterize different balance exercises based on level of difficulty and sensori-motor training stimulus.

**Purpose:** The purpose of this study was to investigate frontal-plane ankle kinematics and associated peroneal muscle activity during single-legged balance on stable surface (floor) and three commonly used balance devices (Airex®, BOSU® Ball and wobble board).

**Design:** Descriptive exploratory laboratory study.

**Methods:** Nineteen healthy subjects performed single-legged balance with eyes open on an Airex® mat, BOSU® Ball, wobble board, and floor (reference condition). Ankle kinematics were measured using reflective markers and 3-dimensional recordings and expressed as inversion-eversion range of motion variability, peak velocity of inversion and number of inversion-eversion direction changes. Peroneus longus EMG activity was averaged and normalized to maximal activity during maximum voluntary contraction (MVC), and in addition amplitude probability distribution function (APDF) between 90 and 10% was calculated as a measure of muscle activation variability.

**Results:** Balancing on BOSU® Ball and wobble board generally resulted in increased ankle kinematic and muscle activity variables, compared to the other surfaces. BOSU® Ball was the most challenging in terms of inversion-eversion variability while wobble board was associated with a higher number of inversion-eversion direction changes. No differences in average muscle activation level were found between these two surfaces, but the BOSU® Ball did show a more variable activation pattern in terms of APDF.

**Conclusion:** The results showed large kinematic variability among different balance training devices and these differences are also reflected in muscle activation variability. The two most challenging devices were BOSU® Ball and Wobble board compared to Airex® and floor. This study can serve as guidance for clinicians who wish to implement a gradual progression of ankle rehabilitation and prevention exercises by taking the related ankle kinematics and muscle activity into account.

**Level of Evidence:** Level 3

**Keywords:** Ankle sprain, EMG, kinematics, rehabilitation.

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