Adaptability of intra- and inter-foot coordination to altered footwear and posture conditions in upright stance

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INTRODUCTION
Center of pressure (COP) data from one single force platform have been widely used to assess postural control in quiet standing. However, the use of two force platforms provides the capacity to assess the COP separately under each foot and determine the coordination dynamics of the feet.

PURPOSE
- Inter-foot coordination between COP of right and left foot during bipedal stance and intra-foot coordination of the ball and heel of the foot in single leg standing were examined as a function of posture (two legs and one leg), footwear/postural challenge (barefoot, different area based high heel shoes, and toe postures) and postural training (ballet and regular exercising group).
- Moreover, this study investigated the amount of motion and time-dependent structure of COPnet under the different posture conditions.
- The general hypothesis tested was that the negative relation between the variability of foot coupling and SD of COPnet is modulated by the interaction of foot support and postural experience.

DESIGN & METHODS
- Participants: Twenty healthy young adult females.
- Design: (2 Group) × (3 Posture) × (4 Footwear / postural challenge). Three 20s trials in each condition.
- Footwear: Two similar conventional high heel shoe types with constant heel height (7.5 cm), but different area surfaces of the heel (thicker: 6.2 cm² and thinner: 1.8 cm²).

RESULTS
Amount of motion and regularity of COPnet as a function of postural training, posture and footwear / postural challenge

Regularity of intra- and inter-foot coordination is mediated by postural training and footwear / postural challenge

Negative relation between variability of COPnet (SD) and regularity (Cross-SEn) of foot coupling

DISCUSSION
- Stability decreased during single leg stances in contrast to two-legged stances. However, regarding the different euclidean dimensions of motion of COPnet changes in complexity appear to be bidirectional when reducing the base of support.
- Footwear, namely high heels, decreased stability. Increasing the area surface of the heel did not improve stability (COPnet). In addition, toe standing was the least stable two-legged stance condition. Irregularity of COPnet in AP direction was enhanced under the heels conditions and diminished during toe standing compared to barefoot standing.
- In the thinner high heel shoe there was more independent movement between the forefoot and heel than in the thicker high heel shoe. Further, compared to all other conditions inter-foot coupling was less complex during toe standing.
- Ballet dancers had better balance in more demanding tasks that are related to the specific ballet postures.
- There was a negative relation between the complexity of coupling of the respective foot dynamics and SD of COPnet. These findings add to the commonly proposed assumption that movement variability increases as the dimension of the system decreases.

REFERENCES