The Influence of Initial Foot Position During Stand to Sit on Trunk and Knee Joint Movement Control

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Category: Masters

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ABSTRACT

During StandTS, trunk flexion and knee extensor eccentric control are two key factors influencing descending balance control of StandTS movement- trunk flexion plays an important role in controlling the vertical downward acceleration of the center of mass, while knee extensor eccentric control is essential for arresting the falling momentum to ensure a stable and safe landing. Since the initial foot position (IFP) is an important factor that can improve sit-to-stand (STS) performance by modifying STS kinematics and kinetics during the uprising phase, we explored the effects of IFPs on StandTS. **PURPOSE:** The purpose of this study was to examine the effects of IFP on trunk flexion and knee extensor eccentric control during StandTS. **METHODS:** Twelve healthy younger adults participated in this study (21.5 ± 2.1). At the start of StandTS, participants maintained an upright standing position with different IFPs and performed STS at their preferred speed after the visual light cue was turned on. Three IFPs were tested: 1) Reference: the feet were placed shoulder-width apart and positioned in parallel on a force plate. A horizontal baseline was set at the center of the toes 2) Wide: each foot was shifted laterally by 25% of the shoulder width. 3) Asymmetric: the dominant leg was placed two-thirds of the foot length behind the baseline. Three trials were performed for each of IFP. Outcome measures include trunk flexion, knee joint kinematics (controlled knee flexion), knee extensor eccentric work, and knee extensor eccentric work duration. A one-way repeated measures ANOVA was used to determine whether there were differences between the three IFPs. The Bonferroni test was used for post hoc analyses. **RESULTS:** There was a main effect of IFP on trunk flexion angle. Reference IFP required a greater trunk flexion (37.86 ± 8.96°) compared to wide IFP (32.30 ± 9.64°) and asymmetric IFP (34.31 ± 8.44°, $p < 0.01$). There was a main effect of IFP on controlled knee flexion angular displacement. Wide IFP (83.63 ± 1.25°, $p < 0.01$) and asymmetric IFP (81.69 ± 1.88°, $p < 0.03$) displayed a greater controlled knee flexion angular displacement compared to reference IFP (73.40 ± 2.67°). In addition, there was a main effect of IFP on knee extensor eccentric work and duration. Wide (0.08 ± 0.4 Nm/kg, $p = 0.01$) and asymmetric IFP (0.08 ± 0.02 Nm/kg, $p = 0.01$) showed greater negative knee extensor eccentric work compared to reference IFP (0.04 ± 0.01 Nm/kg). Wide IFP also showed longer duration (1.69 sec ± 0.13 $p < 0.01$), compared to asymmetric IFP (1.36 ± 0.13 sec, $p = 0.03$) and reference IFP (1.03 ± 0.12 sec, $p < 0.01$). **CONCLUSION**: Wide and asymmetric IFPs during stand to sit required less trunk flexion, greater controlled knee flexion angular displacement, greater knee extensor eccentric work, and work duration compared to the reference IFP. This information could aid clinicians in developing safe and effective strategies for patients with trunk flexion issues or leg impairments (pain, instability, or weakness) during stand to sit movements.