The Influence of Trunk Flexion during Stand-to-Sit on Knee Extensor Eccentric Control and the Relationship Between Eccentric Control and Postural Stability

MCKENNA WEHRMANN, LINDA STEELE, DEJA JOHNSON

University of Texas at Tyler; Tyler, TX

Category: Undergraduate

Advisor / Mentor: Woohyoung Jeon (wjeon@uttyler.edu)

ABSTRACT

Stand-to-sit (StandTS) is an important functional activity that is done daily. During StandTS, knee extensor eccentric control plays a key role in decelerating the falling momentum for a stable and safe landing. The degree of trunk flexion is an important biomechanics factor to control the vertical downward acceleration of center of mass (CoM) during StandTS. This affects body weight loading on the knee extensors while they are eccentrically lengthening. Thus, manipulation of StandTS trunk flexion angle can modify the knee extensor eccentric control and StandTS landing balance (postural stability). However, the influence of trunk flexion on knee extensor eccentric control and the relationship between knee extensor eccentric control and postural stability during StandTS remains unknown. **PURPOSE:** To examine the effects of trunk flexion on knee extensor eccentric control and to determine the relationship between knee extensor eccentric control and postural stability during StandTS. **METHODS:** 9 healthy younger adults participated in this study (mean age = 21.2 ± 2.9 years). Participants maintained an upright standing position with the feet shoulder-width apart and placed their feet in a self-selected parallel foot position with feet on a force plate. All participants performed a StandTS action after a visual light cue was turned on. They repeated this task for a total of 20 trials, adjusting their trunk flexion angle each time. There were five trials for each of four different maximal trunk flexion angles (0°, 20°, 40°, 60°). Participants crossed their arms over their chest during the StandTS task and sat down on an armless, backless, height adjustable chair. Outcome measures include 1) Vastus Lateralis (VL) (the knee extensor) eccentric electromyography (EMG) burst duration 2) knee joint eccentric work (negative work to resist body weight against gravity) and 3) postural sway (standard deviation of CoM acceleration (SDCoMAccel)) in the anterior-posterior (AP) and medio-lateral (ML) directions during StandTS. One-way multivariate analysis (MANOVA) was used for each variable with Tukey's post hoc test to correct for multiple comparisons. A Pearson's correlation was used to examine the correlation between eccentric control (EMG burst duration and eccentric work) and postural sway. **RESULTS:** There was a main effect of trunk flexion angle on knee extensor eccentric control and postural sway. 60° trunk flexion required greater eccentric control than 0° (EMG burst duration, $p = 0.02$, knee eccentric work, $p = 0.01$) and 20° (EMG burst duration, $p = 0.01$, knee eccentric work, $p = 0.02$). SDCoMAccel (postural sway) in the ML was smaller for 40° ($p = 0.02$) and 60° ($p = 0.01$) trunk flexion compared to 0° trunk flexion. In addition, there was a negative correlation between VL eccentric EMG burst duration and ML SDCoMAccel (postural sway) ($r = -0.30$, $p = 0.04$). **CONCLUSION:** Greater trunk flexion during StandTS required increased eccentric control at the knee joint. Increased knee extensor eccentric control has contributed to improved postural stability during StandTS. Our findings demonstrated the importance of trunk flexion and knee extensor eccentric control to maintain postural stability during StandTS.