

Original investigation

Changes in forward step velocity on step initiation from backward and forward leaning postures

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Abstract

The integration of posture and movement are required for achieving the goal of motor task in biped stance. The aim of this investigation was to elucidate whether and how the differences of the postural requirement with changing the initial leaning postures affect the task performance (step velocity) in step initiation from a standing position. Ten healthy subjects performed the initiation of a single step forward as fast as possible from standing positions at three initial leaning postures (FI, forward inclination; US, upright stance; BD, backward declination of the body axis). The maximum step velocity at BD showed a higher value than at US or FI (ANOVA, $F_{2,259} = 3.60$, $P < 0.05$; Tukey post-hoc tests, $P < 0.05$, respectively). As the initial body declination to a backward direction increased, the duration of the backward shift in the center of pressure (CP) and excitatory activities in both the tibialis anterior (TA) in the anticipation phase lengthened (CP, $F_{2,259} = 106.15$; TA of swing leg, $F_{2,258} = 131.21$; TA of stance, $F_{2,258} = 158.93$; $P < 0.001$, respectively), and the forward velocity acquired in the anticipation phase prior to the onset of the first heel-off became significantly higher ($F_{2,259} = 10.30$, $P < 0.001$). These results provide evidence that anticipatory activities prior to the first heel-off can contribute not only to creating the necessary conditions to initiate a step movement but also to increasing step velocity in step initiation.

Key words Step initiation, Performance, Initial standing position, Anticipatory postural adjustments

1. Introduction

The differences in velocity when transferring the body mass on rapidly stepping forward from a quasi-static standing position have an important influence on performance in the field of sports, such as ball games, martial arts, and swordsmanship. On step or gait initiation, it is generally known that the anticipatory activities of the center of pressure (CP) and the bilateral tibialis anterior (TA) muscles emerge prior to the execution of the intended forward-oriented movement from a standing position (Crenna and Frigo, 1991; Ito et al., 2003). These phenomena are thought to play a role in transferring the

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