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Centre of pressure or centre of mass feedback
in mediolateral balance assessment

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1 Introduction

2 Impairments of balance in the mediolateral (ML) direction, reflected in inability to correctly shift
3 weight and in impaired stepping responses are of special interest since these are associated to an
4 increased number of falls (Mille et al., 2013; Robinovitch et al., 2013). Recently a mediolateral
5 balance assessment method based on tracking of predictable and unpredictable target signals with
6 the center of pressure (CoP), coined MELBA, has been proposed (Cofré Lizama et al., 2013). MELBA
7 characterizes balance control through the phase-shift (PS) and gain (G) between the CoP and a target
8 signal that moves mediolaterally under a predictable (sinusoidal) or unpredictable (multisine)
9 pattern. From these measures the frequency at which PS and G drop below a pre-defined threshold
10 and the averages within the bandwidth defined by these frequencies are calculated. The method was
11 shown to be reliable and did not show ceiling effects, not even not among young adults (Cofré
12 Lizama et al., 2013).

13 During locomotion, transitions and standing, stability of the CoM has to be maintained through
14 voluntary and reflexive motor commands to avoid falling (Woollacott, 2000). The use of center of
15 pressure feedback (CoP_{fb}) in balance testing therefore relies on the assumption that consistent ML-
16 CoM displacements (CoM_d) are elicited by ML-CoP displacements (CoP_d), as the CoM is the controlled
17 variable in balance control (Winter, 1995). Since the distance between CoP and CoM is roughly
18 proportional to the CoM acceleration, for limited angular excursions in upright stance a consistent
19 relationship is expected albeit with CoM_d decreasing at constant CoP_d as frequency increases
20 (Morasso et al., 1999; Winter et al., 1998). Although CoP_{fb} during MELBA tasks can thus impose
21 consistent CoM_d , control over CoP may not arise as intuitively as control over the CoM, hence center
22 of mass feedback (CoM_{fb}) may be more suitable when demanding CoM_d . Furthermore, it is possible
23 that CoP_{fb} and CoM_{fb} may elicit different strategies to control the CoM, which may be of utility in
24 identifying the source of balance impairment at the effector levels. Therefore, a modified version of

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