

**Publication**

The effect of voluntary lateral trunk bending on balance recovery following multi-directional stance perturbations.

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Stabilising shifts of the centre of mass (COM) are observed during balance recovery when subjects simultaneously execute voluntary unilateral knee flexion or unilateral arm raising. Here, we examined whether voluntary lateral trunk bending provided more beneficial stabilising effects, and how motor programs of balance corrections are combined with those of the focal voluntary action. The upright balance of 24 healthy young subjects (19-33 years of age) was perturbed using multi-directional rotations of the support-surface. The perturbations consisted of combined pitch and roll rotations (7.5 degrees and 60 degrees/s) presented randomly in six different directions. Three conditions were tested: perturbation of stance only (PO); combined balance perturbation and cued uphill bending of the trunk (CONT); and combined perturbation and cued downhill bending of the trunk (IPS). For comparison, subjects were required to perform trunk bending alone (TO). Outcome measures were biomechanical responses and surface EMG activity of several muscles. Calculated predicted outcomes (PO + TO) were compared with combined measures (CONT or IPS). CONT trunk bending uphill showed two phases of benefit in balance recovery for laterally but, in contrast to voluntary knee bending, not for posterior directed components of the perturbations. IPS trunk bending had negative effects on balance. Early balance correcting muscle responses were marginally greater than PO responses. Prominent secondary balance correcting responses, having a similar timing as voluntary responses observed under TO conditions, were seen under CONT only in trunk muscles. These, and later stabilising, responses had amplitudes as expected from PO + TO conditions being significantly greater than PO responses. The ability with which different muscle synergies for balance corrections and voluntary trunk bending were integrated into one indicates a flexible adjustment of the CNS programs to the demands of both tasks.

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