



NEUROSCIENCE 2012

Presentation Abstract

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Presentation Title: [Human neck reflex adaptation towards the frequency content of anterior-posterior torso perturbations](#)

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**Abstract:** Reflex modulation has been extensively reported during posture maintenance in response to task instructions, and to perturbation type, bandwidth and amplitude. For the head-neck system the modulation of the vestibulocollic (VCR) and cervicocollic (CCR) reflexes is essential to maintain upright head posture during unexpected disturbances. Previous studies have estimated that VCR and CCR contribute equally during perturbations in the sagittal plane; however, their modulation with respect to the properties of the disturbance remains unclear. This study seeks to establish how neck reflexes are modulated during perturbations with varying properties and how each reflex contributes to stabilization behavior. We hypothesized that VCR and CCR (a) modulate according to the perturbation bandwidth, (b) are unaffected by the perturbation amplitude and (c) increase when performing a visual acuity task.

**Methods:** Twelve subjects were perturbed via the torso while restrained in a seated position on a motion platform. The anterior-posterior perturbations varied in bandwidth from 0.3 Hz to a maximum frequency of 1.2, 2.0, 4.0 and 8.0 Hz, at three different amplitudes, and with eyes open and closed.

**Results:** Head kinematics and neck muscle EMG demonstrated significant ( $P < 0.05$ ) changes due to bandwidth, which through modeling and closed loop identification were attributed to modulation of VCR and CCR gains. VCR and CCR demonstrated dominant contributions to stabilization during high (8.0 Hz) and low bandwidth (1.2 and 2.0 Hz) perturbations respectively, and equivalent contributions during mid bandwidth perturbations (4.0 Hz). However both were attenuated when perturbations exceeded the systems natural frequency (~2-3 Hz). Amplitude had an effect only for the lowest amplitude relative to other conditions attributed to thresholding properties of the semicircular canals. With eyes closed reflex gains decreased, attributed to the reduced ability to discriminate self-motion without vision.

Conclusions: To maintain head-upright posture adaptations of neck reflexes are observed to occur due to perturbation frequency and visual task conditions but not amplitude. Estimation of reflex contributions demonstrates that previous literature has underestimated the contribution of CCR, particularly during low frequency perturbations.

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