

## DEVELOPMENT OF A PROTOCOL TO TEST PROPRIOCEPTIVE UTILIZATION AS A PREDICTOR FOR SENSORIMOTOR ADAPTABILITY

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Astronauts returning from space flight show significant inter-subject variations in their abilities to readapt to a gravitational environment because of their innate sensory weighting. The ability to predict the manner and degree to which each individual astronaut will be affected would improve the effectiveness of countermeasure training programs designed to enhance sensorimotor adaptability. We hypothesize participant's ability to utilize individual sensory information (vision, proprioception and vestibular) influences adaptation in sensorimotor performance after space flight. The goal of this study is to develop a reliable protocol to test proprioceptive utilization in a functional postural control task.

Subjects "stand" in a supine position while strapped to a backpack frame holding a friction-free device using air-bearings that allow the subject to move freely in the frontal plane, similar to when in upright standing. The frame is attached to a pneumatic cylinder, which can provide different levels of a gravity-like force that the subject must balance against to remain "upright". The supine posture with eyes closed ensures reduced vestibular and visual contribution to postural control suggesting somatosensory and/or non-otolith vestibular inputs will provide relevant information for maintaining balance control in this task. This setup is called the gravity bed.

Fourteen healthy subjects carried out three trials each with eyes open alternated with eyes closed, "standing" on their dominant leg in the gravity bed environment while loaded with 60% of their body weight. Subjects were instructed to: "use your sense of sway about the ankle and pressure changes under the foot to maintain balance". Maximum length of a trial was 45s. A force plate underneath the foot recorded forces and moments during the trial and an inertial measurement unit (IMU) attached on the backpack's frame near the center of mass of the subject recorded upper body postural responses.

Series of linear and non-linear analyses were carried out on several force plate and IMU data including stabilogram diffusion analysis on the center of pressure (COP) to find a subset of parameters that were sensitive to detect differences in postural performance between eyes open and closed conditions. Results revealed that seven parameters (root mean square (RMS) of medio-lateral (ML) COP, range of ML COP, RMS of roll moment, range of trunk roll, minimum time-to-boundary (TTB), integrated TTB, and critical mean square planar displacement ( $\Delta r^2_c$ ) were significantly different between eyes open and closed conditions. We will present data to show the efficacy of using performance in single leg stance with eyes closed on the gravity bed to assess individuals' ability to utilize proprioceptive information in a functional postural control task to predict re-adaptation for sensorimotor and functional performance.

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