MODIFICATION OF THE PASSIVE VESTIBULO-OCULAR REFLEX DURING AND AFTER SHORT-DURATION SPACEFLIGHT

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The vestibulo-ocular reflex (VOR) is mediated by integration of canal and otolith inputs to generate compensatory eye movements during head movements. We hypothesized that adaptive change in vestibular processing of gravitoinertial cues would be reflected by plane specific modification of the VOR during passive whole-body rotation during and after spaceflight. Using a repeated measures design, the VOR was assessed in four payload crewmembers in yaw, pitch and roll planes during multiple sessions before, during and after an 8 day orbital mission (STS-42). Rotation was about an earth-vertical axis during ground tests, with the head located off-axis by up to 45cm during pitch and roll rotation (peak acceleration <0.2g). The motion profiles included sum-of-sinusoids between 0.02 - 1.39 Hz (yaw), single sinusoids between 0.05 – 1.25 Hz (yaw and pitch) and velocity steps (yaw, pitch and roll). Eye movements were recorded with both video and electro-oculographic techniques. As expected, VOR gain changes were greater in pitch than in yaw. During pitch rotation, there was a progressive shift in the axis of eye movements during the flight, which was also present during the early post-flight period. This increased horizontal component during pitch, most prevalent at 0.2 Hz, was interpreted as an increase in a translational vergence response elicited during eccentric rotation as subjects imagined a wall fixed target. There was also an increased horizontal component during the eccentric roll step runs performed on flight day 7. These results are consistent with a frequency-dependent increase in otolith-mediated translational VOR responses following adaptation to microgravity. We conclude that the adaptive changes in the VOR are likely to be greatest in the frequency range where there is a cross-over of otolith-mediated tilt and translation responses.

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