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THE EFFECT OF PREVIOUS SPACEFLIGHT ON OTOLITH-MEDIATED OCULAR COUNTER-ROLL IN COSMONAUTS AFTER LONG DURATION SPACEFLIGHT

Abstract

INTRODUCTION The otolith system plays an essential role in the estimation of verticality, where an otolith driven eye movement, the Ocular Counter-Roll (OCR), is important to ensure gaze stabilization, as the eyes tilt in the opposite direction to the direction of the head tilt. Long duration exposure to microgravity, as experienced aboard the International Space Station (ISS), will cause a deconditioning of the otolith system. As a result, cosmonauts will experience balance disorders and problems with gaze stabilization after returning on Earth. The aim of this study is to measure the effect of long-term spaceflight on the otolith-mediated OCR, in cosmonauts, with focus on the difference between first time flyers versus frequent flyers.

MATERIAL AND METHODS 44 cosmonaut experiments were performed, first time flyers (1F, N=13) and frequent flyers (FF, N=31), of where several flew up to five times, were exposed to off-axis centrifugation before and after their 6-month space mission to the ISS. The OCR induced by the Visual and Vestibular Investigation System (VVIS) mini centrifuge was assessed and recorded for 20 seconds at a maximal velocity of 254/s, out of a total duration of 5 minutes centrifugation. The OCR measurements were further statistically analyzed in JMP, with p¡0,05 as significance threshold.

RESULTS We found a significant decrease in OCR early post-flight (R+1/3, one to three days after return) for both the 1F group and the FF group. The post-flight OCR decrease in the 1F group was significantly different from the FF group with a greater reduction in the 1F group. A full recovery was seen nine to twelve days after their return (R+9/12).

CONCLUSION The FF group suffered less from a deconditioning of the otoliths, because they may have acquired a central neuro-adaptation from previous space missions. The results argue for that for important missions, e.g. to the Moon or Mars, it is more advisable to send experienced cosmonauts or astronauts because they are noticeably less affected by microgravity regarding the vestibular system.