

PILOT FIELD TEST: PERFORMANCE OF A SIT-TO-STAND TEST AFTER LONG-DURATION SPACE FLIGHT

I.S. Kofman¹, M.F. Reschke², J.M. Cerisano¹, E.A. Fisher¹, T.R. Phillips¹, I.V. Rukavishnikov³, V.V. Kitov³, N.Yu. Lysova³, S.M.C. Lee¹, M.B. Stenger¹, J.J. Bloomberg², A.P. Mulavara⁴, E.S. Tomilovskaya³, I.B. Kozlovskaya³

¹Wyle Science, Technology and Engineering Group, Houston, TX, USA 77058, ²NASA Johnson Space Center, Houston, TX, USA 77058, ³Institute of Biomedical Problems, Russian Academy of Sciences, Moscow, Russia, and ⁴Universities Space Research Association, Houston, TX, USA 77058

BACKGROUND

Astronauts returning from the International Space Station are met by a team of recovery personnel typically providing physical assistance and medical support immediately upon landing. That is because long-duration spaceflight impacts astronauts' functional abilities. Future expeditions to planets or asteroids beyond the low Earth orbit, however, may require crewmembers to egress the vehicle and perform other types of physical tasks unassisted. It is therefore important to characterize the extent and longevity of functional deficits experienced by astronauts in order to design safe exploration class missions. Pilot Field Test (PFT) experiment conducted with participation of ISS crewmembers traveling on Soyuz expeditions 34S – 41S comprised several tasks designed to study the recovery of sensorimotor abilities of astronauts during the first 24 hours after landing and beyond.

METHODS

The first test in the PFT battery sequence, and also the least demanding one from the sensorimotor perspective, was a Sit-to-Stand test. Test subjects were seated in the chair and had to stand up on command and remain standing for ten seconds. The subjects were instructed to stand up unassisted as quickly as they were able to, while maintaining postural control. Synchronized wireless inertial sensors mounted on the head, chest, lower back, wrists, and ankles were used to continuously log body kinematics. Crewmembers' blood pressure and heart rate were monitored and recorded with the Portapres and Polar systems. Each session was recorded with a digital video camera. During data collections occurring within the 24-hour postflight period, crewmembers were also asked to (1) evaluate their perceived motion sickness symptoms on a 20-point scale before and after completion of the test and (2) estimate how heavy they felt compared to their normal (preflight) body weight.

Consent to participate in PFT was obtained from 18 crewmembers (11 US Orbital Segment [USOS] astronauts and 7 Russian cosmonauts). For 10 subjects, the first set of data was collected in the medical tent in Soyuz landing zone (1-2 hours after landing); the other 8 subjects were tested at the Kazakhstan deployment airport (4-5 hours after landing). 8 of the 11 astronauts were tested twice more within the first 24 hours postflight, at a refueling stop on the way to Houston (~13 hours after landing) and at the Johnson Space Center (~24 hours after landing). Later postflight data were collected in the first two weeks on some crewmembers. Finally, 6 astronauts were tested 60+ days after landing to establish a delayed baseline.

RESULTS/DISCUSSION

Two of the 18 PFT participants felt too ill to attempt any tests in Kazakhstan (at either the landing zone or deployment airport). The remaining test subjects completed the Sit-to-Stand test and their reported motion sickness scores were unaffected by this task. The task completion times and body kinematics data analysis are currently underway. Preliminary analysis of astronaut data shows a steep improvement in the time to complete the task on the second data take, and in some cases, the trend continues through day six postflight. Head and trunk pitch angles and pitch rates were also examined and increases in all measures are evident throughout the observed recovery period (60+ days postflight). Interesting patterns of head and trunk pitch coordination have also emerged. One of the data analysis objectives is comparison of initial postflight performance and recovery of experienced crewmembers and first-time fliers. Another one – possible differences in performance between USOS and Russian crewmembers.