PILOT FIELD TEST: RECOVERY FROM A SIMULATED FALL AND QUIET STANCE STABILITY AFTER LONG-DURATION SPACE FLIGHT

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BACKGROUND

Astronauts returning from the International Space Station (ISS) 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 second test in the PFT battery (following the Sit-to-Stand) was a Recovery from Fall test. It combined the cardiovascular and sensorimotor objectives of testing for orthostatic intolerance and evaluating postural ataxia, respectively. This work focuses on the latter objective.

Test subjects lay prone quietly on a thin mat on the floor for 2 minutes and then stood up on command and maintained a quiet stance for 3.5 minutes with eyes open, arms relaxed along the side of the body, and feet comfortably placed on the floor. 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 evaluate their perceived motion sickness symptoms on a 20-point scale before and after completion of the test.

Consent to participate in PFT was obtained from 18 crewmembers (11 US Orbital Segment 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). Eight 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

In Kazakhstan, two of the 18 PFT participants felt too ill to attempt any tests (at either the landing zone or deployment airport). Two others were unable to complete the entire 3.5-minute quiet stance segment and terminated the PFT early. The remaining 14 test subjects completed the Recovery from Fall test. Most crewmembers reported an increase in their motion sickness symptoms at the end of this test and 2 of 14 were unable to attempt the remaining PFT tests. All participants completed this and other PFT tests on all subsequent test sessions. While everyone was able to stand up without assistance, the prone-to-standing time (time to postural stability) in Kazakhstan ranged from 7 to 22 seconds. Preliminary results indicate continuous reduction of this time throughout at least the second day postflight. The body kinematics data analysis is currently underway, but it is clear that magnitude of postural sway of stochastic nature in both anteroposterior and mediolateral planes was increased in the early postflight test sessions.