Jump-Down Performance Alterations after Space Flight

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INTRODUCTION

Successful jump performance requires functional coordination of visual, vestibular, and somatosensory systems, which are affected by prolonged exposure to microgravity. Astronauts returning from space flight exhibit impaired ability to coordinate effective landing strategies when jumping from a platform to the ground. This study compares jump strategies used by astronauts before and after flight, changes to those strategies within a test session, and recoveries in jump-down performance parameters across several postflight test sessions. These data were obtained as part of an ongoing interdisciplinary study (Functional Task Test, FTT) designed to evaluate both astronaut postflight functional performance and related physiological changes.

METHODS

Seven astronauts from short-duration (Shuttle) and three from long-duration (International Space Station) flights performed 3 two-footed jumps from a platform 30 cm high onto a force plate that measured the ground reaction forces and center-of-pressure displacement from the landings. Neuromuscular activation data were collected from the medial gastrocnemius and anterior tibialis of both legs using surface electromyography electrodes. Two load cells in the platform measured the load exerted by each foot during the takeoff phase of the jump. Data were collected in 2 preflight sessions, on landing day (Shuttle only), and 1, 6, and 30 days after flight.

RESULTS

Postural settling time was significantly increased on the first postflight test session and many of the astronauts tested were unable to maintain balance on their first jump landing but recovered by the third jump, showing a learning progression in which performance improvements could be attributed to adjustments in takeoff or landing strategy. Jump strategy changes were evident in reduced air time (time between takeoff and landing) and also in increased asymmetry in foot latencies on takeoff.

CONCLUSIONS

The test results revealed significant decrements in astronauts' abilities to maintain balance and achieve a postural stability upon landing from a jump early after flight. However, the jump landing adaptation process often begins after the first jump with full recovery of most performance parameters within days after space flight. As expected, performance of ISS astronauts on the first day after flight was similar to that of Shuttle crewmembers on landing day.