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# INDIVIDUAL LOCOMOTION STRATEGIES FOR DIFFERENT STAGES OF A LONG-TERM SPACE MISSION

**Abstract**

Prevention of hypogravity disorders for interplanetary missions requires an integrated approach to assessing the depth of rearrangements in various physiological systems of the body. This work is aimed at investigation of individual locomotion strategies rearrangements and autonomic support of muscle activity during the long space mission and after its completion. Special new test "Individual strategies" consists of 13 steps of locomotion with alternating slow and fast walking with speed of 3 and 6 km/h and the transition from walking to running with final speed of 15 km/h with acceleration of 2 km/h per minute. This test allows to evaluate the strategy of locomotion and vegetative provision of muscle activity in a wide range of speeds. It was performed 30-60 days before the space flight and 1 week after the flight. The values of vertical components of support reactions with the help of strain gauges mounted on the treadmill, as well as response of cardiovascular and respiratory systems to physical activity were recorded. To unify the comparison of patterns, the one-step pressure curve was normalized by the area under the curve. The space treadmill is equipped with a vibration isolation system, so the locomotions are executed on unstable support. It was found that reaction patterns of astronauts are individually distinguishable, statistically stable, have a good identification sensitivity to the motion regimes. Three types of locomotion functions indicators are proposed. The first type is the relative standard deviation of the integral of the transmitted pulse in one step. The second indicator is the integral deviation of the pressure pulse curve from the reference pattern and corresponds to variation of the pressure curve shape within one step. The third indicator is the unsteadiness time series index of deviations from the reference pattern, which characterizes the degree of randomness in the selected locomotion strategy. The results of the experiment showed that two first indicators monotonically increase during a long space flight for all modes of motion. On the other hand, there is a decrease in the non-stationarity index, so variation becomes more standard and new motor skill was produced. Changes in vegetative support and muscle activity systems during the flight indicate a decrease of work physiological cost. After completion of a long space flight, a return to the original motor strategy was noted, with the acquired more stable step variability maintained. The work was supported by RAS 63.1 and RFBR 17-04-01826.