SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (3)

Author: Prof. Naoto Shiba
Kurume University Hospital, Japan, nshiba@med.kurume-u.ac.jp

DEVELOPMENT OF A TRAINING METHOD FOR WEIGHTLESS ENVIRONMENT USING BOTH ELECTRICAL STIMULATION AND VOLUNTARY MUSCLE CONTRACTION

Abstract

Extreme skeletal muscle atrophy is rampant in astronauts exposed to extended periods of microgravity (μG), and it is one of the main problems in human space exploration. A "Hybrid training" (HYB) method utilizing combined electrical stimulation and voluntary muscle contraction has been developed as a possible solution. A wearable HYB device and a virtual reality (VR) system were developed for use in space, and were verified at μG generated by parabolic flight (PF). A 36 year-old male subject performed HYB reciprocal flexion and extension as a knee joint exercise training in a seated position at 1G, 2G and μG. The wearable HYB device and VR system developed for the study functioned well during the flight. However knee extension was insufficient at 1G and 2G, and the maximum knee extension angles at 1G and 2G were smaller than at μG. The extension velocity in the latter half of each motion was slower than in the first half at 1G and 2G, but no difference in velocity was observed at μG. The subject could extend the knee joint sufficiently and keep a constant extension velocity because his legs were weightless at μG. Congruity between the subject's actual joint motions and instructed joint motions during μG were improved when VR was employed with or without body fixation, and the subject was able to perform the desired joint motion. The VR system improved HYB exercise performance at μG during PF. HYB is considered a useful training method for future human space exploration.