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Postural muscle atrophy prevention and recovery and bone remodelling through high frequency proprioception for astronauts



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Abstract

The difficulty in applying active exercises during space flights increases the importance of passive countermeasures, but coupling load and instability remains indispensable for generating high frequency (HF) proprioceptive flows and preventing muscle atrophy and osteoporosis. The present study, in microgravity conditions during a parabolic flight, verified whether an electronic system, composed of a rocking board, a postural reader and a bungee-cord loading apparatus creates HF postural instability comparable to that reachable on the Earth. Tracking the subject, in single stance, to real-time visual signals is necessary to obtain HF instability situations. The bungee-cord loading apparatus allowed the subject to manage the 81.5% body weight load (100% could easily be exceeded). A preliminary training programme schedule on the Earth and in space is suggested. Comparison with a pathological muscle atrophy is presented. The possibility of generating HF proprioceptive flows could complement current countermeasures for the prevention and recovery of muscle atrophy and osteoporosis in terrestrial and space environments. These exercises combine massive activation of spindles and joint receptors, applying simultaneously HF variations of pressure to different areas of the sole of the foot. This class of exercises could improve the effectiveness of current countermeasures, reducing working time and fatigue.

Keywords: Microgravity; Postural control; Sport; Entropy; Osteoporosis; Load; Rocking board

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