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LOAD ON THE TIBIA DURING THE SEATED EXECUTION OF ORDINARY CALF RAISES ON THE MULTIFUNCTIONAL DYNAMOMETER FOR APPLICATION IN SPACE

Abstract

An exercise regimen of the Multifunctional Dynamometer for Application in Space (MDS) was performed by a crew of 6 astronauts and cosmonauts during the "Mars-500" isolation project. This intensive testing focused on the capabilities, durability and efficiency of the exercise countermeasure device. It also provided valuable qualitative and quantitative feedback and revealed the potential and limitations of the overall construction. The evaluation of miscellaneous responses and basic discussions led to a further measurement on the device.

The MDS met a recently postulated appeal pointing out the need for an additional aerobic training feature within a single device (Hackney et al., 2012). Further constructional demands concerning compactness, costs and maintenance of future exercise equipment were also issued by Hackney and colleagues – established in cooperation with NASA's Exercise Physiology Countermeasures Project. We are confident that we provide a remedy with the beneficial design of the MDS and meet the above-mentioned requirements.

The leg press sled of the MDS is used for high intensive loading exercises (e.g. Leg Press, Leg Press Calf Raises). Intensive loading exercises of other developments (e.g. Running, Squat) have been quantitatively confirmed as being inadequate on board of the ISS (Genc, 2011). With our setup we are confident to generate greater loads on certain bone sites during countermeasure exercise compared to other devices. Especially Leg Press Calf Raises could produce such high forces, which should preserve at least the distal tibia bone mass. Together with the common Leg Press exercise it should be performed dynamically in a single-legged mode, to generate a better osteogenic stimulus. These two exercises are chosen because they are spine-protective and allow the implementation of higher active forces on certain structures without harming the trunk. They mainly affect the lower limb as target area of intensive loading, not transmitting high loads throughout the whole body (e.g. Squat).

A force plate was installed on the footplate and investigations of the training behaviour of a representative number of persons occurred. The results of this study will be presented and discussed.