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MUSCLE TONE AND STIFFNESS IN LONG-TERM BED REST WITH REACTIVE JUMPS AS COUNTERMEASURE, AND RECONDITIONING: FIRST RESULTS FROM ESA RSL STUDY AT THE DLR:ENVIHAB FACILITY (2015-16)

Abstract

BACKGROUND Biomechanical property changes of human soft tissue (muscle and tendon were investigated in various clinical studies and in parabolic flight. OBJECTIVES To determine biomechanical property changes of disused healthy human muscle and tendon in bed rest (BR) without and with reactive jumps as countermeasure. METHODS The 60 days head-down tilt (6 degree HDT) RSL study was sponsored by the European Space Agency (ESA) and organized by DLR at the :envihab human physiology facility, Cologne, Germany. Premarked body skin measure points (11 left and 11 right MPs) were examined from different musculature (shoulder, back, legs) on each participant (supine at full body relaxation) from control (BR-CTR, n=12) and countermeasure (JUMP, n=12) group using a hand-held digital palpation device MyotonPRO (Myoton AS, Estonia) at start (HDT+1), end (HDT+58), and after BR in the second week of rehabilitation (R+10). Group effects of BR CTR and JUMP (both HDT+58 vs HDT+1), and reconditioning effects (R+10 vs HDT+58) reflect changes in biophysical oscillation signal levels (frequency [Hz], stiffness [N/m], elasticity [log decr], relaxation time [ms]). Two-way ANOVA and t-tests (p< .o5). RESULTS Trapezius (functional shoulder girdle): BR effects absent (all four parameters) in either groups (internal control). Multifidus (deeper lumbar part): BR effects absent (all parameters). Altered tone and stiffness (less [Hz], [N/m]) and more relaxation time [ms] found after BR in JUMP group. Erector spine (intermediate muscle column): BR effects absent from both groups. Training effect in JUMP at end BR (more stiffness) and after BR (less stiffness). Rectus femoris (knee extensor): BR effects in both groups (less tone). Training effect detectable by maintained stiffness in JUMP group. Gastrocnemius (plantarflexor): BR effects (less tone and stiffness) in CTR. Training effect (parameters maintained) seen in JUMP. Tibialis anterior (dorsiflexor) BR effect in CTR (less tone, stiffness and elasticity). Training effect seen in JUMP (increased relaxation time). Achilles tendon (most rigid structure): BR effects in CTR (less tone, stiffness, and more relax. time). A training effect was seen in JUMP (maintained tone, relaxation time, less elasticity) at endBR. After BR, tone and stiffness increased, relaxation time decreased in JUMP. CONCLUSIONS We provide a first map of region- and structure-specific biophysical oscillation signal patterns at variable types and magnitudes in different functional muscle groups to better understand disuse-induced biomechanical property characteristics in human musculature for optimization of countermeasures in bed rest and health monitoring in space. National Sponsor: Federal Ministry BMWi/DLR e.V., Bonn-Oberkassel, 50WB1421 to D.B.).