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MRI STUDY OF STRUCTURAL AND FUNCTIONAL CHANGES OF BACK MUSCLES AND SPINE  
UNDER CONDITIONS OF DRY IMMERSION

**Abstract**

Back pain phenomenon is regularly observed in cosmonauts during the first days of space flight and early postflight period (Wing P.C. et al., 1991; Kertsman et al., 2012; Sayson et al., 2013). At the same time exposure to weightlessness is followed by height increase. Both phenomena can be accurately reproduced under simulated weightlessness conditions - Dry Immersion (DI) and anti-orthostatic bedrest (Baum K. et al., 1999; Rukavishnikov I.V., 2016; Treffel L., 2017). The aim of the study was to investigate the changes of back muscles and spine structure and function under conditions of simulated microgravity. 8 healthy volunteer subjects took part in 5-days DI study. On the 3d and 5th days of DI spinal MRI studies were performed. The transverse stiffness of back extensor muscles, height of the subjects and subjective back pain evaluation were registered in the course of DI. All the subjects reported back pain development during the first 2-3 days of DI. The intensity of back pain reached from 4-5 to 9-10 points by ten-mark subjective scale. On the day 4-5 of DI only one subject reported back pain presence. Data analysis revealed the decrease of back extensors transverse stiffness. According to MRI data analysis back column length was increased in average for  $0.32 \pm 0.12$  cm for neck,  $0.49 \pm 0.26$  cm for thoracic and  $0.89 \pm 0.45$  cm for lumbar part of the spine. At the same time the height of intervertebral discs increased  $0.36 \pm 0.03$  on average. Neck kyphosis was flattered for  $6.6 \pm 3.29$  degrees, thoracic - for  $6.0 \pm 2.58$  degrees and lumbar lordosis was flattered for  $6.6 \pm 3.29$  degrees. At the same time MRI analysis revealed significant decrease of cross sectional area of m. quadratus lumborum (by  $86,68 \pm 13,32\%$ ), m. multifidus (by  $88,21 \pm 11,79\%$ ) and m. erector spinae (by  $92,73 \pm 7,27\%$ ) at the level of L4-L5 of spine. Comparative study of the dynamics of changes registered in the course of DI allows to make a conclusion on their positive correlation. It can be suggested that the original cause of back pain and height increase under these conditions can be the flattering of spine curvature and increase of height of intervertebral discs due to axial unloading and atonia of back extensor muscles. The study is supported by RFBR project 16-29-08320 ofi\_m.