SPACE LIFE SCIENCES SYMPOSIUM (A1)
Human Physiology in Space (2)

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MECHANICAL PROPERTIES OF THE LUMBAR MUSCLES REGARDED TO G-VECTOR.

Abstract

On Earth, human-being has adopted unique ability to keep body's longitudinal axis in line with the vector of the Gz force. It has been calculated that bipedal-locomotion is very economic way to move. Stretched to the skeleton, the muscles are pre-tensed creating a complex structure allowing this phenomenon (1). Contraction, stretch and position dependent changes in mechanical properties of the muscles can be observed under gravity (2; 3; 4; 5; 6; 7). The ability to stand degrades in weightless and this loss becomes prominent at re-adaptation to gravity. Measurements of upper trapezius and tibialis anterior muscles elasticity (decr), tension (Hz), and stiffness (N/m) we presented previously (7). Our interest was to quantify change in these parameters of the lumbar muscles at the level of L4, from standing to lying prone. METHODOLOGY: We used MyotonPro® device (allowing measuring also in transversal plane) and registered mentioned parameters bilaterally at the level of L4 in 8 healthy male subjects in standing and in prone – 6deg head down, and horizontally. Two locations were measured bilaterally; 1cm (medial) and 2cm (lateral) paravertebrally. RESULTS: Single significant factor to change the mechanical characteristics was body position: F(2,93)=17,45 (ANOVA/MANOVA); decr-p<0,0001; freq-p=0,0958; stiff-p<0,0001. No significant difference was between prone positions [Average\Stdev; Newman-Keuls test (p-compared to standing); n=32]; decr, Stand 1,12\0,13; Prone-6deg 1,42\0,29 (p<0,0001); Prone-0 1,41\0,25 (p<0,0001); Hz 18,57\2,81; 17,56\1,85 (p=0,09); 17,37\1,87 (p=0,108); Stiff 416,31\92,52; 347,37\57,26 (p=0,0003); 346,93\55,32 (p=0,0006) accordingly. CONCLUSIONS: The possibility to measure muscle mechanical properties regardless of G-vector is great advance of MyotonPro®. For the first time we demonstrate quantified changes in the postural spinal muscles regarded to body axis. Elasticity is declining (decrement rising), oscillation frequency and stiffness is lowering when changing from standing to prone. It is our opinion that myotonometry is proper method in micro-gravity studies to monitor the mechanical properties of the muscles and spinal muscles are perspective muscles to study. References: 1. Borelli GA. (1685) De Motu Animalium. Batavis: Lugduni. 2. Bizzini M., Mannion A.F. (2003) Clinical Biomech (Bristol, Avon), 18(5):459-61 3. Ditroilo, M., A. M. Hunter, et al. (2011) Physiol Meas 32(8): 1315-26. 4. Gavronski, G., A. Veraksitš, et al. (2007) Physiol Meas 28(6): 625-37. 5. Hein V, Vain A. (1998) Scand J of Med Sci in Sports, 8: 7-13. 6. Jarocka, E., J. Marusiak, et al. (2011) Physiol Meas 33(1): 65-78. 7. Viir R, Vain A, et al. (2006) IAC-06-A1.3.04.