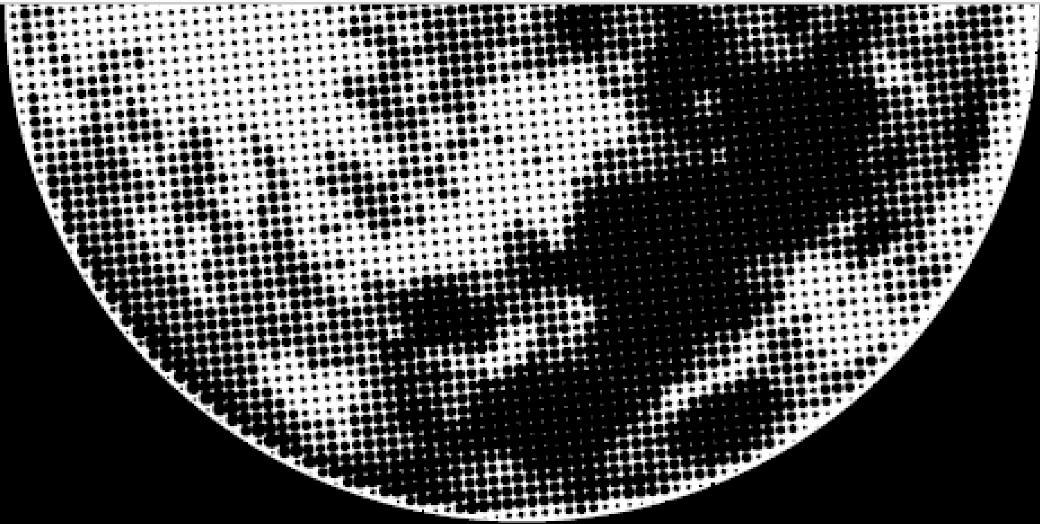

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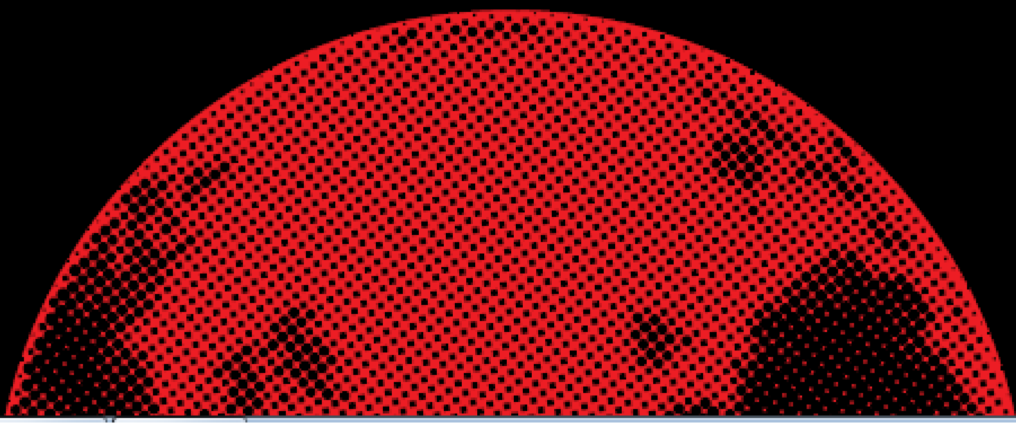

ROLE OF NEURONAL CONTROL IN DEVELOPMENT OF IMMOBILIZATION OSTEOPOROSIS

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Osteoporosis is a musculoskeletal system disorder characterized by loss of bone mass, alteration of mechanical properties of bone and disruption of balance between osteogenesis and bone resorption. Modern lifestyle shows prevalence of loss of mobility for an average person, both in workplaces and everyday life thus making immobilization osteoporosis a high-risk disease for everybody regardless of social status or age. There are different factors that contribute to stable functioning of musculoskeletal system: gravitational pull, bearing area, physical activity and innervation. Immobilization disrupts all factors simultaneously which could be observed in changing of different parameters of bone and muscle. Effects of these changes combine into overall pathological state. Purpose of this study is to evaluate contribution of effects from disruption of different factors utilizing different techniques that simulate immobilization osteoporosis. Current study was conducted on wild-type lab rats (w=180-200 g.). Animal housing and all procedures were conducted in accordance with bioethical norms and regulations. Rats were anesthetized with mixed anesthesia ('Zoletil 50' 'Virbac', France, 0.5 ml/kg + Xylazalum, 'Biogel', Belarus, 0.05 ml/kg – 0.5 ml/kg) via intramuscular injection. Dosage was calculated according to animals body mass. Animals were divided into four experimental groups: hindlimb unloading+tenotomy ("HU+ten", n=8), hindlimb unloading+denervation ("HU+den", n=5), tenotomy only ("ten", n=7), denervation only ("den", n=5). Hindlimb unloading was performed as in Morey-Holton (1979) with custom modifications by Ilyin and Novikov (1980). Denervation was performed as described in C. De Angelis et al. (1994). Animals were subjected to sciatic nerve dissection with subsequent nerve compression by a "mosquito" forceps for forty seconds. Tenotomy was performed after anesthetization in aseptic conditions. Achilles tendon was dissected at the site of attachment to the foot. In order to determine the mechanical parameters of bones, three-point bending tests were carried out in a specially prepared experimental setup [Baltina et al., 2017]. For each sample, the geometric parameters were preliminarily measured, weight and volume were also determined. The result of the experiment was a binary file containing tabular data of time, displacement and applied force. The processing of the data array was carried out on the basis of a registered author's software, which makes it possible to automatically plot the dependence of displacements on the applied load, as well as to select linear sections with their subsequent approximation. Group "HU+den" didn't show significant alterations of rigidity in femur and forearm. Tibia and humerus shows significantly lesser loss of rigidity than in "den" group. According to Young modulus assessment, stiffness was significantly higher in femur, forearm and humerus in "HU+den" group than in "den" group. Stiffness of tibia was not significantly changed between groups. There were no significant changes in rigidity and Young modulus between groups "HU+den" and "ten". Therefore, these results show that hindlimb unloading worsens strength and stiffness in combination with denervation more than in combination with tenotomy. Hindlimb unloading by itself didn't alter bone properties in combination with tenotomy. With that in mind, stiffness and strength are lower after pure tenotomy than after pure denervation. Thus, denervation effects on bone during osteoporosis are lesser than those of tenotomy. Alterations of bone properties during hindlimb unloading are dependent upon changes in neuronal control.
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References:
Baltina T.V., Ahmetov N.F., Sachenkov O.A., Fedyanin A.O., Lavrov I.A. The Influence of Hindlimb Unloading on Bone and Muscle Tissues in Rat Model. BioNanoSci. 2017(7): 67-69. DOI 10.1007/s12668-016-0288-8