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Changes in gene expression, protein content and morphology of chondrocytes cultured on a 3D random positioning machine and 2D rotating clinostat

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Chondrocytes are the only cell type found in human cartilage consisting of proteoglycans and type II collagen. Several studies on chondrocytes cultured either in space or on a ground-based facility for simulation of microgravity revealed that these cells are very resistant to adverse effects and stress induced by altered gravity. Tissue engineering of chondrocytes is a new strategy for cartilage regeneration. Using a three-dimensional Random Positioning Machine and a 2D rotating clinostat, devices designed to simulate microgravity on Earth, we investigated the early effects of microgravity exposure on human chondrocytes of six different donors after 30 min, 2h, 4h, 16h, and 24h and compared the results with the corresponding static controls cultured under normal gravity conditions. As little as 30 min of exposure resulted in increased expression of several genes responsible for cell motility, structure and integrity (betaactin); control of cell growth, cell proliferation, cell differentiation and apoptosis; and cytoskeletal components such as microtubules (beta-tubulin) and intermediate filaments (vimentin). After 4 hours disruptions in the vimentin network were detected. These changes were less dramatic after 16 hours, when human chondrocytes appeared to reorganize their cytoskeleton. However, the gene expression and protein content of TGF-β1 was enhanced for 24h. Based on the results achieved, we suggest that chondrocytes exposed to simulated microgravity seem to change their extracellular matrix production behavior while they rearrange their cytoskeletal proteins prior to forming three-dimensional aggregates.

Biography

Ganna Aleshcheva has completed her study of biotechnology at the Technical University to Berlin (Berlin, Germany) and Zurich University of Applied Sciences (Waedenswil, Switzerland) in 2012. Afterwards, she started her PhD about "Tissue Engineering of cartilage" at the Otto-von-Guericke University (Magdeburg, Germany) and Aarhus University (Aarhus, Denmark) as a member of Space Life Sciences Research School (SpaceLife) of the German Aerospace Center and Helmholtz Association.

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