The potential of mesenchymal stem cells in nucleus pulposus matrix hydrogels for intervertebral disc regeneration

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ABSTRACT
Notochordal cell-conditioned medium has proven to be able to enhance matrix production and proliferation of NPCs. In addition to that, notochordal cell-conditioned medium also has shown to steer mesenchymal stem cells (MSCs) toward a chondrogenic phenotype. Other research revealed the potential of using lyophilized and pulverized NC-rich NP matrix (NCM) as a therapy for intervertebral disc regeneration. This study investigated the behavior of MSCs placed in NC-rich NP matrix to provide a direction in potential further research on the use of MSC-laden NCM gels for IVD regeneration. Human MSCs were cultured for up to 14 days in a NCM hydrogel, derived from porcine nucleus pulposus (NP) tissue. MSC-free NCM gels served as control group, and allowed for comparison. Samples were obtained and analyzed for biochemical content (GAG, DNA and water), histology by Alcian Blue and Picosirius Red staining and for RNA extraction. Culturing resulted in good cell viability and proliferation, while production or maintenance of GAG was not observed. This led to the conclusion that culturing conditions were not sufficient enough for MSCs to synthesize enough necessary chemical contents for IVD regeneration. The correct circumstances under which the MSCs embedded in NCM gels will behave in a beneficial manner has yet to be determined, and is crucial in the development of a regenerative treatment for IVD.