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Cartilage tissue engineering

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Introduction: The repair of damaged cartilage has, until recently, been carried out using surgical stimulation techniques. Newer cell based techniques aim to improve the quality of repair that can be achieved in cartilage lesions. One of the types of cell being considered for these therapies are mesenchymal stem cells (MSCs), found in the bone marrow. By encouraging cellular development, these cells can be made to produce cartilage. This process however causes the cells to develop further into a stage called hypertrophy. Hypertrophic cells produce markers associated with bone such as type X collagen. We aim to prevent hypertrophy by mimicking the natural scenario seen in lengthening bones, where hypertrophic cells maintain the production of cartilage markers in less developed cells.
Methods: MSCs are seeded into polyurethane scaffold and then cultured in growth medium containing a growth factor called TGF-β, this encourages the cells to develop into cartilage producing cells and then over time into hypertrophic cells. After one week a scaffold containing fresh MSCs is placed on top of the original scaffold. This positioning of less developed cells on top of hypertrophic cells reflects the cellular organisation within lengthening bones. The constructs are then cultured for two weeks before having their gene expression and production of cartilage components analysed.
Results: Our results so far suggest an increase in the important cartilage molecules type II collagen and aggrecan in the top scaffolds.
Discussion: The data collected so far suggests that the culture of cartilage producing MSCs on top of hypertrophic cells slows the progression of these less developed cells in the bottom scaffolds towards hypertrophy. As a result there is an increase in the production of the cartilage markers type II collagen and aggrecan. Further work is needed to fully access the effects of co-culturing these cells under various conditions.