O5.2: Development and characterization of nanocellulose-alginate chondroitin/dermatan sulphate 3D bioprinted scaffolds for cartilage regeneration

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Cartilage is a connective tissue of diarthrodial joints. It is composed of low metabolic activity cells, chondrocytes, which are surrounded of a highly structured extracellular matrix (ECM). As it is devoid of blood vessels, lymphatic system and nerves, its capacity for healing and repairing is limited. Recent therapeutic advances, such as tissue engineering, has become a promising treatment due to the use of scaffolds, which act as not only a supportive cell structures, but are also designed to imitate as closely as possible the native tissue. In addition, three-dimensional (3D) bioprinting has become an emerging additive manufacturing technology in tissue engineering because of its rapid prototyping capacity and the possibility of creating complex structures. Our study is focused on the development of nanocellulose-alginate (NC-Alg) based bioinks for 3D bioprinting for cartilage regeneration. In addition, chondroitin sulphate (CS) and dermatan sulphate (DS) were added to the NC-Alg bioink in order to fabricate NC-Alg-CS and NC-Alg-DS bioinks. CS and DS are found in the ECM and have numerous biological properties, such as cell adhesion, proliferation and maturation. Furthermore, chondrogenesis differentiation of mesenchymal stem cells (MSC) can be promoted.

First, both bioinks´ characterization (rheological and physicochemical properties, printability and cytotoxicity) was assessed. Then, bioprinted scaffolds were characterised (inner structure, swelling and degradation). Finally, previously sterilised NC-Alg-CS and NC-Alg-DS bioinks were loaded with murine D1 MSCs and cell viability and functionality were assessed in the bioprinted scaffolds. Results showed that the addition of CS and DS to the NC-Alg bioink improved its characteristics. Moreover, cell viability and therapeutic protein release increased. Thus, the use of MSCs containing NC-Alg-CS and NC-Alg-DS scaffolds can become a feasible tissue engineering approach for cartilage regeneration.

References

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