Internship Proposal

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Project Title:
Bioengineering hydrogels from decellularized matrix to investigate intervertebral disc degeneration in 3D

Level:

Master Student

Project Summary:

Low Back Pain (LBP) is on the top 10 disorders ranked in years lived with disability and the leader in rehabilitation services according to the 2020 Global Burden Disease Study (1). The main cause of LBP is the degeneration of the spine joint, the intervertebral disc (IVD), for which no current treatments able to restore/repair the degenerated IVD exists.

Biomaterials based on decellularized extracellular matrix (dECM) are emerging as new promises for regeneration of different tissues, including the IVD (2). Our team established a universal protocol to decellularized ECM from bovine IVDs from distinct ages (fetal, adult, old) and has shown that younger dECM has the potential to promote de novo matrix synthesis by IVD cells (3). However, the full biological potential of these dECM-based biomaterials is still to be unraveled.

With this project we propose to move further on the development of dECM-based hydrogels to be used as reliable and complex 3D models to enhance the knowledge on the IVD degeneration.

Work to be developed by the student:

Objectives:

1) Decellularization of bovine IVD tissue

2) Solubilization of dECM and hydrogel preparation

3) Structural and biomechanical characterization of hydrogels from dECM

4) Analysis of IVD cell viability and phenotype in dECM-based hydrogels

Techniques: rheometer, SEM, cell culture, immunohistochemistry, immunofluorescence

Requirements: basic knowledge of lab work, pipetting with micropipettes, cell culture basics and at least 3 months availability.

References:

(1) Ferrari et al., Global Burden of Disease Study 2021, The Lancet;

(2) Fiordalisi M et al. Decellularized Scaffolds for Intervertebral Disc Regeneration. Trends Biotechnol. 2020 Sep;38(9):947-951;

(3) Fiordalisi MF et al. The impact of matrix age on intervertebral disc regeneration. Biomater Adv. 2022 Dec;143:213192.

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