

Tackling Complexity in Tissue Engineered Cell/Material Interactions and Methods to Generate Different Complex In Vitro Disease Models

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The selection of a proper material to be used as a scaffold, as a proper matrix, or as a bioink in 3D bioprinting approaches to support or encapsulate cells is both a critical and a difficult choice that will determine the success or failure of any tissue engineering and regenerative medicine (TERM) strategy.

In our research group we have been mainly using natural origin polymers, including a wide range of marine origin materials, for many different approaches that allow for the regeneration of different tissues. Several innovative bioinks with quite specific properties were developed and proposed for several specific uses. We have also been optimizing the respective formulations for using these novel materials in distinct biomanufacturing strategies.

Furthermore, an adequate cell source should be selected. In many cases efficient cell isolation, expansion and differentiation methodologies should be developed and optimized. We have been using different human cell sources namely: mesenchymal stem cells from bone marrow, mesenchymal stem cells from human adipose tissue, human cells from amniotic fluids and membranes and cells obtained from human umbilical cords.

The potential of each biomaterials/cells combination and respective concentrations, as related to different manufacturing technologies, with details when appropriated focusing on bioprinting, to be used to develop novel useful regeneration therapies will be discussed. Several examples of TERM strategies to regenerate different types of tissues will be presented. The use of different cells and new ways to assess their interactions with different natural origin degradable scaffolds and bioinks will be described. A unique high-throughput platform to better understand material/cells interactions and optimise their performance and biological performance will be discussed. This rather innovative platform is based on the use of unique microfluidics-based approaches and allows for the engineering of novel complex in-vitro models, including disease tissue models.