PhD Program
in
TECHNOLOGY FOR HEALTH

DEVELOPMENT OF HYBRID POLYMERIC SCAFFOLDS FOR TISSUE ENGINEERING

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Background

Scaffolds are biomaterial-based devices employed in tissue regeneration, requiring an interconnected porous structure to host the cells, adequate mechanical properties (compatible with the specific tissue), biocompatibility, biodegradability and safe manufacturing. Considering the limited healing capabilities of bone and cartilage tissues, recent studies regarded rigid porous polymeric scaffolds, mimicking both bone morphology and stiffness, and micro-macroporous hydrogels, able to induce osteogenic and chondrogenic differentiation. These two types of scaffold can be combined to obtain hybrid integrated structures, acting both as structural support and as bioactive substrate for cell proliferation and differentiation.

Objectives

The aim of this work is to develop complex biomaterial-based core/shell scaffolds for *in vitro* cell culture, mainly addressing bone regeneration. This goal can be divided into two objectives: (i) development of a simple synthesis approach of the starting materials; (ii) study and optimization of the hybrid scaffold properties.

Methodologies

The porous core will be designed and realized by 3D printing of stiff, biocompatible and bioresorbable polymers. It will be covered by a softer bioactive hydrogel shell, promoting cell adhesion, growth and differentiation. Hybrid scaffolds will be characterized by morphological, chemical, thermal and mechanical analyses, also evaluating the effects of water immersion on swelling, mass loss and mechanical properties. These studies could be supported by biomechanical simulations, while tissue regeneration capability will be assessed in collaboration with national and international research groups.

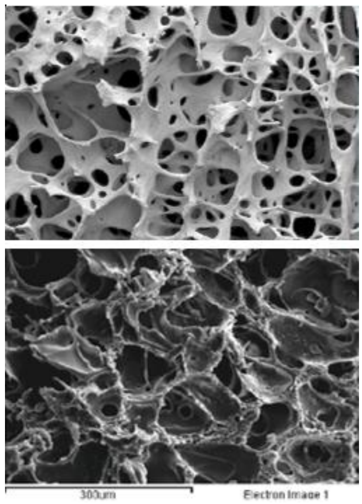

FIGURE 1. SIMILARITY BETWEEN THE POROUS STRUCTURE OF BONE TISSUE (TOP) AND A CORE/SHELL SCAFFOLD (BOTTOM).

Expected Results and Impact

Hybrid scaffolds are expected to closely match the requirements for regeneration of specific tissues, due to the enhanced tuneability of their mechanical, chemical and biological properties, stimulating not only cell proliferation but also their differentiation. They could provide an alternative solution to repair damaged tissues such as bone and cartilage, currently treated with transplants and invasive operations.