(OP 213) Novel Micro-Nanofibrous Multilayer Scaffold for Bone Tissue Engineering Applications

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Fibrous structures mimicking the natural extracellular matrix (ECM) morphology are considered promising scaffolds for Tissue Engineering (TE). Scaffold architecture determines its structural integrity, mechanical strength, transport properties and the microenvironment for cell adhesion and proliferation. Therefore, several scaffold processing techniques were developed to control the scaffold architecture. Rapid prototyping (RP) allows the production of scaffolds with precise control of porosity and internal pore architecture; while electrospinning (ES) technique has become very popular in the TE community due to the production of submicron ECM-like fiber meshes.

This work aims to evaluate a novel starch-based scaffold obtained by the combination of starch-polycaprolactone micro- and polycaprolactone nano-motifs, produced by RP and ES, respectively. Scanning Electron Microscopy (SEM) and micro-Computed Tomography micrographs showed a multilayer scaffold composed by parallel aligned microfibers, in a grid-like arrangement, intercalated by randomly distributed nanofibers forming a mesh-like structure.

Human osteoblast-like cells (Saos-2) were dynamically seeded on the multilayer scaffolds using spinner flasks to improve cell seeding efficiency within the scaffold, and the constructs were subsequently cultured under static conditions for 1 and 7 days. SEM micrographs and Hematoxylin-Eosin staining showed the predominant cell attachment and spreading on the nanofiber meshes, which enhanced cell retention at the bulk of the RP scaffold. Cell viability (MTS assay) and proliferation (DNA quantification) results demonstrated the advantageous effect of the combined micro-nano architecture, as compared to the micro structure on cellular performance. These results demonstrated the high potential of the innovative multilayer scaffolds for improving cellular response when pursuing bone TE strategies.