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Fabrication of Hybrid Scaffolds Consisting of Cell-laden Electrospun Micro/Nanofibers and PCL Micro-structures for Tissue Regeneration

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Abstract : Tissue engineering is a rapidly growing interdisciplinary research area that may provide options for treating damaged tissues and organs. As a promising technique for regenerating various tissues, this technology requires biomedical scaffolds, which serve as an artificial extracellular matrix (ECM) to support neotissue growth. Electrospun micro/nanofibers have been used widely in tissue engineering because of their high surface-area-to-volume ratio and structural similarity to extracellular matrix. However, low mechanical sustainability, low 3D shape-ability, and low cell infiltration have been major limitations to their use. In this work, we propose new hybrid scaffolds interlayered with cell-laden electrospun micro/nano fibers and poly(caprolactone) microstructures. Also, we applied various concentrations of alginate and electric field strengths to determine optimal conditions for the cell-electrospinning process. The combination of cell-laden bioink (2 x 10^5 osteoblast-like MG63 cells/mL, 2 wt% alginate, 2 wt% poly(ethylene oxide), and 0.7 wt% lecithin) and a 0.16 kV/mm electric field showed the highest cell viability and fiber formation in this process. Using these conditions and PCL microstructures, we achieved mechanically stable hybrid scaffolds. In addition, the cells embedded in the fibrous structure were viable and proliferated. We suggest that the cell-embedded hybrid scaffolds fabricated using the cell-electrospinning process may be useful for various soft- and hard-tissue regeneration applications.

Keywords : bioink, cell-laden scaffold, micro/nanofibers, poly(caprolactone)
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