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Fabrication of 3D Scaffold Consisting of Spiral-Like Micro-Sized PCL Struts and Selectively Deposited Nanofibers as a Tissue Regenerative Material

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Abstract : Tissue engineering scaffolds must be biocompatible and biodegradable, provide adequate mechanical strength and cell attachment site for proliferation and differentiation. Furthermore, the scaffold morphology (such as pore size, porosity and pore interconnectivity) plays an important role. The electrospinning process has been widely used to fabricate micro/nano-sized fibres. Electrospinning allows for the fabrication of non-woven meshes containing micro- to nano-sized fibers providing high surface-to-volume area for cell attachment. Due to its advantageous characteristics, electrospinning is a useful method for skin, cartilage, bone, and nerve regeneration. In this study, we fabricated PCL scaffolds (SP) consisting of spiral-like struts using 3D melt-plotting system and micro/nanofibers using direct electrospinning writing. By altering the conditions of the conventional melt-plotting method, spiral-like struts were generated. Then, micro/nanofibers were deposited selectively. The control scaffold composed of perpendicular PCL struts was fabricated using the conventional melt-plotting method to compare the cellular activities. The effect on the attached cells (osteoblast-like cells (MG63)) was evaluated depending on the bending instability of the struts. The SP scaffolds showed enhanced biological properties such as initial cell attachment, proliferation and osteogenic differentiation. These results suggest that the SP scaffolds has potential as a bioengineered substitute for soft and hard tissue regeneration.

Keywords : cell attachment, electrospinning, mechanical strength, melt-plotting
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