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Bioengineered Cell Niche for Skeletal Muscle Regeneration

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ABSTRACT

Skeletal muscles can self-repair minor strains, lacerations, and contusions; however, in cases of volumetric muscle loss and muscle degenerative diseases, tissue fails to regenerate. Current cell-based therapies, such as myoblast transplantation, have significant drawbacks of low survival rates and engraftment efficacy, mainly due to the absence of supportive cell microenvironment. Scaffolds that mimic the natural cell microenvironment provide a robust platform to support cell adhesion, migration, proliferation, and differentiation. Electrospinning is a versatile technology platform used for fabricating the fiber scaffold that mimics the extracellular matrix. Thus, we aim to reconstitute the cell microenvironment through development of aligned fiber scaffolds by electrospinning as oriented muscle fibers create natural microenvironment of myogenic cells. In particular, aligned fiber scaffolds will be optimized in term of mechanical properties and fiber diameters as fiber curvature and mechanical stiffness provide significant physical cues for myogenic cell behaviors. Here, we fabricated and characterized electrospun polyester fiber scaffolds with different diameters from micro-scale to nano-scale. The mechanical properties of the fabricated nanofibers were found to be in the range of contractile muscles as evidenced from atomic force microscopy measurements. With these scaffolds, C2C12 myoblasts were seeded and analyzed for the initial attachment. It was shown that aligned fibers with varying diameters resulted in different responses in cell attachment, indicating the role of cell topography sensing in cell-biomaterial interactions. Current ongoing studies focus on long-term *in vitro* culture of scaffolds in a custom-made muscle bioreactor emulating the contraction/relaxation of skeletal muscle tissue.

KEYWORDS

Polymers scaffolds, cell-material interactions, myoblasts, skeletal muscle regeneration, bioreactor