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Biological Implications of Satellite Cells for Scaffold-based Muscle Regenerative Engineering

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ABSTRACT

Satellite cells are anatomically localized along the surface of muscle fibers and have been regarded as a population of muscle-specific progenitors that are responsible for muscle regeneration. In response to muscle injuries, satellite cells are activated to enter the cell cycle, then proliferate and differentiate into mature muscle cells to regenerate damaged myofibers. Unfortunately, this natural repair mechanism is interrupted in conditions such as muscle degenerative diseases or volumetric muscle loss. The function of stem cells is regulated by signals from their local microenvironment which is called the stem cell niche. Current satellite cell-based strategies such as direct cell transplantation are hindered by the low survival and poor distribution of transplanted cells due to lack of the cell niche. Thus, the objective of this project is to develop a cell/biomaterial combination strategy for muscle regeneration based on understanding of the characteristics of satellite cells and their cell niche. First, satellite cells were isolated from the skeletal muscles of a wild-type mouse and expanded in culture. The scaffolds were synthesized to mimic the anisotropic organization of myofibers. Cells were then seeded on scaffolds and cultured. Cellular responses of satellite cells to the scaffolds were measured and analyzed for adhesion, self-renewal, and proliferation. These experiments provided critical insight on the interactions between synthetic biomaterials and satellite cells. In the future, this synthetic scaffold system will optimized with appropriate structural and mechanical properties to facilitate transplantation of satellite cells for muscle regeneration.

KEYWORDS

Satellite cells, scaffolds, stem cell niche, regenerative engineering, muscle regeneration