NOVEL THREE-DIMENSIONAL CULTURE APPROACHES TO ADDRESS REGENERATIVE MEDICINE CHALLENGES

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The goal of regenerative medicine is to replace or regenerate diseased or damaged cells, tissues or organs by bringing together the tools of engineering, biology and medicine to restore or establish normal function. While substantial advances have been made in the field since the term regenerative medicine was coined in the 1990s, many challenges remain. In this presentation, I will discuss two challenges that we are addressing in our research laboratories, cell expansion to provide adequate cells for therapeutic applications and development of scaffolds for soft-tissue regeneration.

The ability to generate large quantities of terminally differentiated cells is critical for regenerative medicine applications. Expansion and differentiation of pluripotent cells holds great promise to meet this need; however, bioreactors for expansion and differentiation of pluripotent and progenitor cells for regenerative medicine applications are currently lacking. Approximately 100 billion to 1 trillion cells per patient will likely be required for cell therapy applications, necessitating new technologies in biomanufacturing. Using a novel, wicking matrix bioreactor in which cells are grown on a cellulosic matrix suspended in air, we cultured induced pluripotent cell-derived pancreatic progenitor cells and differentiated them into insulin-producing cells.

Tissue regeneration also requires development of scaffolds with appropriate physical, chemical and biomechanical properties to support cell, tissue and organ function. In particular, matching the structures and elastic properties is critically important for regeneration of soft tissues such as the salivary gland. Using a novel scaffold preparation technique known as cryoelectrospinning, we have created honeycomb-like scaffolds with low stiffness and demonstrated their ability to support salivary gland function *in vitro*, setting the stage for addressing salivary gland disease and injury.