

567f A Microfluidic Scaffold for Tissue Engineering

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One of the greatest promises of tissue engineering is the potential to provide replacements for damaged or malfunctioning tissues. To serve this role, engineered tissue must closely replicate the biological and structural characteristics of native tissue. Among the many challenges associated with engineering appropriate tissues are: 1) the limited total thickness of viable tissue that can be cultured in vitro, and 2) the limited spatial control of the chemical environment within a tissue scaffold, which results in a limited control over where the appropriate phenotypes are expressed. These obstacles must be overcome in order to grow in vivo-like tissues. Current strategies, such as simple bioreactors, are hampered by a lack of microscale control and/or by the use of inappropriate scaffold materials. Here we propose a strategy to address both of these limitations, by using embedded microchannels to control fluid flow within a highly diffusively permeable tissue scaffold. The microfluidic network can be connected to an external fluid pumping system, and can thus be used to provide both nutrients and soluble factors to distinct sections of the scaffold. In this talk we present the fabrication and initial characterization of a microfluidic tissue scaffold which demonstrates spatial and temporal control over delivery of reagents. We describe the necessary steps to fabricate the devices, including the molding and sealing of separate layers of a hydrogel (a material commonly used in tissue engineering applications), and the formation of fluidic connections. We examine the mass transfer characteristics with respect to different operating parameters, such as: scaffold thickness, channel size and spacing, internal flow speed, external bath conditions, and molecular weight of reagent. Finally, we present preliminary results from cell-seeded scaffolds.