Morphology and Organization of Tissue Cells in Foam Scaffolds

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We demonstrate an efficient method to fabricate large-domain monodisperse foam scaffolds for 3D cell culture. We characterized important fabrication parameters and the mechanical properties of the scaffolds. We tested three distinct tissue cell types cultured in foam scaffolds composed of uniform spherical pores. The cells displayed appropriate physiological, morphological, and functional characteristics: epithelial cells formed cyst-like structures and were polarized inside pores, myoblasts adopted a tubular structure and fused into myotubes, and fibroblasts exhibited a wide variety of morphologies. We examined the change of fibroblast morphology when the scaffold stiffness and pore sizes changed. The negatively curved substrate breaks the basal-apical asymmetry of a cell on a 2D substrate and brings the distribution of actin bundles and focal adhesions in a cell to 3D. We also observed peculiar cusp shape around the focal adhesions without any attachment to substrate in the 3D pore. Our foam scaffold serve a novel assay to dissect the effect of dimensionality for cell culture.