142be Characterization and Fabrication of Capillary Flow Networks in Collagen-Based Scaffolds for the Development of Tissue-Engineered Products with Built-in Microvasculature

Vijayakumar Janakiraman, Brian Kienitz, and Harihara Baskaran

Convective delivery of nutrients is important to enhance mass transport within tissue engineered (TE) products. Depending on the target tissue, an ideal TE product will have a built-in microvasculature that will eliminate mass transport limitations that can occur during product growth *in vitro* and integration *in vivo*. We have developed a synthetic approach to create TE products with built-in microvasculature that involves the design and development of flow networks with optimal mass transfer characteristics. Choosing skin as the tissue model and utilizing planar bifurcating networks as our basic design, we previously obtained optimal designs of micron scale flow networks. In this work, we present results of network flow characterization studies and fabrication of the networks in collagen-glycosaminoglycans (collagen-GAG) scaffolds. By using standard photo/soft lithography techniques, the network designs were obtained in poly-dimethyl siloxane (PDMS) molds. Subsequently, microfluidics was established in the PDMS networks and the flow distribution efficacy of the networks was quantified by the method of residence time distribution. In addition, pressure drop-flow rate relationship was obtained as a function of network generations and network porosity. A new soft-lithography technique was developed to obtain collagen-GAG scaffolds embedded with micron scale flow networks. The collagen-GAG networks were subsequently endothelialized with HUVECs and cell viability was quantified. Collectively, the results validate our approach for incorporating synthetic ‘vascular' networks with TE products.