bFGF-containing electrospun gelatin scaffolds with controlled nano-architectural features for directed angiogenesis

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1. Introduction

Current approaches in therapeutic angiogenesis that involve the administration of angiogenic growth factors, cells or a combination of cells and cytokines have demonstrated promising results in a number of experimental and clinical ischemic settings [1–6]. However, the long term instability and poor organization of the newly formed microvasculature that are associated with current strategies has become a major impediment towards the development of a non-invasive clinically relevant angiogenesis approach.

The extracellular matrix (ECM) is a complex structural network of proteins and carbohydrates that provides structural support to mammalian cells and regulates a number of cellular and tissue functions (i.e. cell migration and growth, wound healing) [7,8]. Structural proteins in the interstitial ECM and basement membranes contain bioactive domains that can bind to cell surface receptors, other structural proteins, or to signaling molecules such as cytokines, chemokines, and matrix proteinases [9]. A large number of bioactive molecules (i.e. growth factors) are bound via non-covalent interactions within the ECM and are released under tissue specific conditions [10]. Furthermore, specific intracellular signaling pathways can be efficiently regulated through biological cues as well as structural interactions (i.e. mechanotransduction) between ECM and the intracellular cytoskeleton [11–14]. As a result, a number of strategies in therapeutic angiogenesis have focused on integrative approaches where angiogenic growth factors and/or cells are combined with 3-D scaffolds that mimic the extracellular matrix...