Electrospinning Micro- to Nano-scale Fibrous Tissue Engineering Scaffolds

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Since the inception of the field of tissue engineering there has been a considerable effort to develop an "ideal" tissue-engineering scaffold. Biocompatibility, mechanical stability and bioresorption/degradation are the defining assets of an “ideal” scaffold yet this combination has continually eluded researchers. Electrospinning is proving to be able to overcome many of the historical limitations due in particular to the ability to produce fibrous scaffolds that can mimic the composition and architecture (fiber size and orientation) of the native extracellular matrix. Our laboratory has demonstrated that nano- to micro-scale fibrous scaffolds (various geometries) can be reproducibly electrospun from biopolymers including collagen type I, II, and III, elastin, fibrinogen, poly(glycolic acid), poly(lactic acid), and polycaprolactone either individually or in combinations tailored to a specific application. Fiber diameters are controllable via electrospinning solution concentration and mechanical properties of the scaffolds are controllable via fiber orientation. Cellular/tissue interactions have been shown to be dependent on the characteristics of the electrospun scaffolds with composition and fiber diameter as the dominant variables in the process. Thus, electrospinning provides a means to produce scaffolds that address the fundamental needs of tissue engineering scaffolds for a wide variety of tissues and organs.