

Abstract

Electrospinning is an attractive method for producing nanofibrous scaffolds for tissue engineering and for controlled drug delivery.

The aim of this thesis was to develop functionalized nanofibers as a controlled delivery system for growth factors. Nanofibers were functionalized by simple adhesion of bioactive agents to the nanofiber surface, and incorporating them into the nanofiber mesh using a blend or coaxial electrospinning technique.

Within the framework of this thesis, poly- ϵ -caprolactone (PCL) nanofibers were functionalized with platelets, and also with synthetic growth factors and with growth factors incorporated into liposomes adhered to the nanofiber surface. Functionalized PCL nanofibers with adhered bioactive agents appear to be suitable for drug delivery of growth factors, and for tissue engineering applications with comparatively short time scales. In the second set of experiments, we focused on prolonging the release time of growth factors by incorporating them into the liposome-nanofiber system using blend or coaxial electrospinning. It was found that liposomes are not preserved intact during the blend electrospinning process. Moreover, loss of protein activity was observed. However, coaxial electrospinning enabled liposomes to be incorporated into nanofibers and thus to preserve the protein activity. The importance of activity protection was further emphasized by more potent stimulation of mesenchymal stem cells (MSCs). Finally, nanofiber scaffolds containing alpha-granules as a natural source of growth factors were prepared by coaxial electrospinning. Successful preservation of molecular bioactivity required a low concentration of the growth factors that were delivered in order to stimulate cell viability and also chondrogenic differentiation of MSCs.

In conclusion, core/shell nanofibers with incorporated liposomes and incorporated alpha granules are promising systems for applications in tissue engineering with comparatively prolonged time scales.