Controlling the porosity of electrospun PCL scaffold by Simultaneous Salt releasing Method

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Statement of Purpose: Electrospinning has become a broadly used technology for producing nano- and micro-scale fibers from polymer solutions of both natural and synthetic polymers. High porosity and appropriate pore size are necessary to provide adequate space for cell spreading and migration as well as to allow for proper exchange of nutrients. PCL(Polycaprolactone) nanofiber scaffold has a good biocompatibility and mechanical properties but cells are generally hard to infiltrate the electrospinning PCL nanofiber scaffold because of the small pore size. Therefore, in the present study focuses on utilizing NaCl during electrospinning to create larger pores within scaffolds. Different size NaCl crystals is deposited onto the electrospinning collector and embedded into the electrospun Pore size controlled scaffold.

Methods: Poly(3-caprolactone) (PCL) with an average molecular weight of 80,000 (Sigma Aldrich, St. Louis, MO, USA) was used. Chloroform (Junsei Chemical Co., Ltd., JAPAN), Methanol (Dae Jung, Siheung, Gyonggi, Korea) NaCl was purchased from (Dae Jung, Siheung, Gyonggi, Korea). PCL was a dissolved in a solvent mixture of 80:20 (v/v) chloroform and methanol, and were stirred for approximately 6 h prior to processing to assure thorough mixing. Preparation 8%(w/v)PCL concentration electrospinning solution. To control the pore size of electrospun PCL scaffold for using of the biomaterials, the each NaCl particles(120, 160, 200μm) are simultaneously released above the rotating collector for incorporating into the PCL nanofiber scaffold. Distilled water leaches out NaCl in the scaffolds and performed the lyophilisation for control of pore size.

Results: Average pore size, and thickness increased with NaCl crystals size. Pore size versus NaCl particle sizes are 18.5 μm/200μm, 13.2 μm/160 μm, 5.3 μm/120μm, And 557 μm/200μm, 470 μm/160 μm, 234 μm/120μm. Similarly, porosity increased with NaCl crystals size: 93%/200μm, 89%/160 μm, 83%/120μm. And cell proliferation and cellular infiltration are improved.

Conclusions: The small pore sizes in electrospun scaffolds hinder cell infiltration in vitro and tissue-ingrowth into the scaffold in vivo, limiting their clinical potential. It is not easy to create well-defined pore sizes through the electrospinning technique because of the randomly deposited fibers. The range of NaCl crystals used could be regulated by using a sieve to separate the crystals according to size. Regulating the size of the NaCl crystals would lead to greater control of the size of the pores created when the NaCl is leached out. This could be one method that adjust the size of the pores to the needs of the specific scaffold design. Simultaneous salt releasing method can control the porosity of the electrospinning PCL scaffold and help the development of biocompatible scaffold.

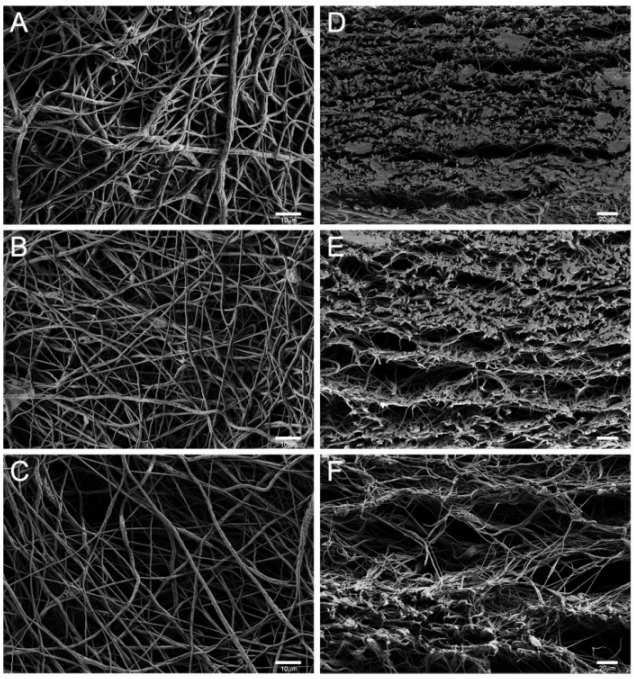

Fig.1. SEM image of porous PCL scaffold obtained using different Nacl crystal size: surface A-D(A:120 μm, B:160 μm, C:200 μm); cross-section D-F (D:120 μm, E:160 μm, F:200 μm) , Scale bars are:(A-C) 100 μm; (D-F) 20 μm.

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