Effect of PGS-PCL Electrospun Fibers Orientation on Alignment and Proliferation of Human Umbilical Vein Endothelial Cells

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Statement of Purpose: Developing advanced biomaterials with bimimetic properties is the key to control cell-matrix interactions. A potentially powerful approach to engineering vascularized tissues is to generate scaffolds that can direct the differentiation of stem cells in a controlled manner. Recently, polyglycerol sebacate (PGS), a biodegradable and biocompatible elastomer, has shown promising results for designing vascularized tissues. Synthetic polymer blends such as that of PGS and poly(ε-caprolactone) (PCL) offer advantage of combining properties of different polymers to tune degradation rate, mechanical properties as well as their processability. In this work, we have investigated the effect of PGS-PCL fiber orientation on alignment and proliferation of HUVECs.

Methods: PGS-PCL and PCL scaffolds were fabricated by conventional electrospinning. PGS: PCL weight ratio was kept constant at 2:1. Electrospinning was carried out at 12.5 kV using a 21G blunt needle, a flow rate of 2 mL/h for ~30 min and at constant distance of 18 cm. Scaffolds were stored in a desiccator until further use. The scaffolds were cut into rectangular strips of dimensions 10 X 5 mm^2 and sterilized in 70% ethanol for 1h followed by 30 min UV exposure. Human Umbilical Vein Endothelial Cells (HUVECs) were seeded on each scaffold at a concentration of 200,000 cells/scaffold.

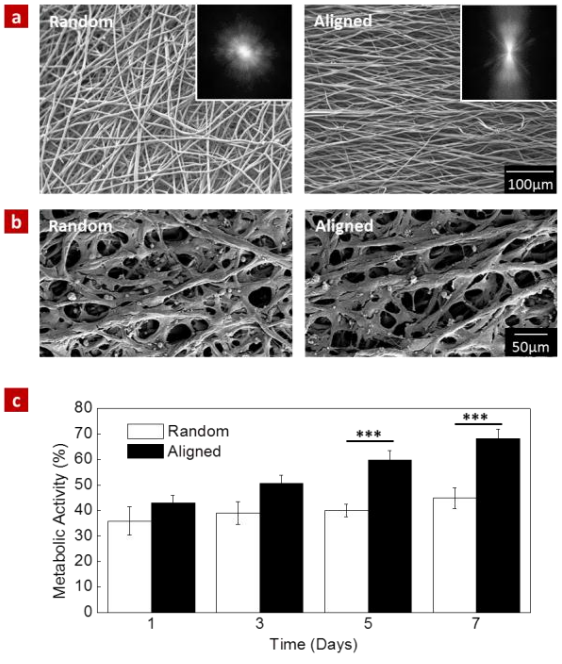

Figure 1. (a) Morphology of random and aligned PGS-PCL scaffolds. (b) HUVEC readily attached to both random and aligned scaffolds. (c) Aligned scaffolds promote HUVEC proliferation compared to random scaffold.

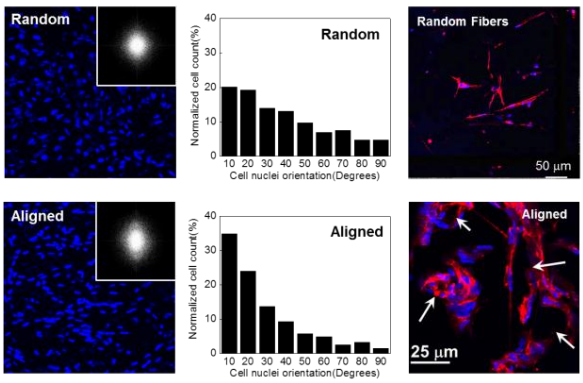

Figure 2. Oriented scaffolds promote alignment of HUVECs and formation of vascular-like structure compared to the random scaffolds.

Results: Electrospinning was used to fabricate PGS-PCL scaffolds. Scanning electron microscopy was used to determine the fiber morphology in random and aligned scaffolds (Figure 1a). The mechanical testing indicates elastic modulus of aligned scaffold (9.26 ± 2.14 MPa) is higher, when compared to random scaffolds (6.53 ± 1.3 MPa). *In vitro* studies indicate that HUVECs readily attach on both random and aligned scaffolds. A significantly higher amount of cell proliferation was observed on aligned scaffolds, as compared to random scaffolds. The effect of fiber orientation on cellular alignment was also evaluated. The results indicate higher cellular alignment on aligned scaffolds than that of the random scaffolds (Figure 2). Moreover, the aligned scaffolds also promote formation of tubular-like structures after 7 days of culture. This indicates that fiber alignment play a significant role in cellular alignment and proliferation.

Conclusions: We successfully fabricated aligned and random scaffolds from PGS and PCL. We investigated the effect of PGS-PCL fiber orientation on HUVECs alignment. HUVECs readily proliferate on aligned scaffolds and significantly higher orientation of cells was observed on the aligned scaffolds. With this, we can conclude that the fiber orientation plays a significant role in HUVECs alignment and proliferation and thus they can potentially be used for vascular tissue engineering.