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New Fibrous PET Structures for Vascular Grafts: Effect of Fiber Structure on Endothelial and Smooth Muscle Cell Attachment and Growth

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Conventional synthetic polymers such as PET and PTFE have good tracking of success as vascular grafts but their lack of bioactivity and biomechanical features (*e.g.,* compliance) are still significant issues of concern. Biodegradable synthetic polymers pose some risks due to the toxic effect of some of the degradation products and mechanical matching during degradation. Naturally derived polymers often induce infections or immune reactions. In this study, we investigated the potential of new synthetic fibrous structures made from polyethylene terephthalate (PET) as vascular scaffolds.

The fibres, ranging from 1-15 μm in diameter, were fabricated through a nonwoven process and assembled into discoidal or tubular structures. In contrast to woven materials such as Dacron PET grafts, the nonwoven nature of these new structures allow for mechanical compliance adjustment by modifying fibre diameter and density.

We assessed the ability of human brain endothelial cells (HBEC) and human aortic smooth muscle cells (AoSMC) to attach and proliferate on five different discoidal materials characterized by various fibre diameter ranges and structure layouts. Cells were seeded on either uncoated or 0.5% gelatin-coated structures and were allowed to grow for 6 days at 37 °C. Cells were then stained with a vital dye (CFDA) to visualize and quantify the living cells present on these structures.

All the materials tested allowed attachment and growth of both HBEC and AoSMC. While HBEC grew with similar efficacy on uncoated and gelatin-coated structures, AoSMC growth was significantly higher (30-50%) in the 3 uncoated materials with the smallest fibre diameter range. Overall, the highest efficacy in both HBEC and AoSMC growth was achieved with the structure displaying the smallest fibre diameter range (1-4 μm). The biomechanical and biocompatible characteristics of this novel vascular graft prototype shows promise for *in vivo* testing.

Finally, the fibrous structures were also tested in terms of mechanical compliance in comparison with existing Dacron and ePTFE structures. The behavior observed was much closer to that of actual arteries than commercial available ones.