Laser Printing of Cells into 3D Scaffolds

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Introduction
Native tissues consist of several cell types which are embedded in a matrix with a distinct architecture. For the in vitro generation of a functional 3D tissue, a technique for the directed deposition of cells into predefined scaffolds is a prerequisite.

Materials and Methods
Two-photon polymerization (2PP) was applied to generate a hexagonal, structured scaffold (2 mm in diameter, 200\textmu m in height) (Fig.1) from poly ethylene glycol diacrylate (PEGda) monomers and a photoinitiator (Irgacure 369, Ciba). Using Laser Induced Forward Transfer (LIFT, Fig.2) droplets of a hydrogel suspension of endothelial (EC) or smooth muscle-like (SMC) cells (~20 cell/droplet) were propelled selectively into the target cylinders of the scaffold. Layer-by-layer one droplet was put on the top of another until the cylinder was completely filled. The deposition of the differently pre-stained ECs and SMCs was monitored directly after the LIFT-process by fluorescence microscopy.

Results
Fluorescence microscopic pictures, taken immediately after the LIFT procedure, confirm the selective deposition of the two cell types within the scaffold areas(Fig. 3). The outer rim of the scaffold (separated by the white hexagon) was successfully seeded with calcein stained SMCs (green), while the inner perimeter was seeded with Tamra-5 stained ECs (red). Higher magnification pictures of the borderline show a distinct transition from ECs to SMCs.

Discussion and Conclusions
By combining 2PP and LIFT we were able to deposit ECs and SMCs in three dimensions. This represents a first step towards the reproduction of the matrix architecture and cell arrangement observed in native arteries.

References

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The Authors have nothing to disclose.