Protocol Development for PDMS Organ-on-Chip Fabrication Using 3D Printed Molds

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A clear advantage of the microphysiological systems is the combination of living systems and engineering to investigate human physiological conditions difficult to mimic in animal and cell models. Organ-on-chip systems use microchannels to transfer nutrients, gases, and biomolecules to mimic human organ function. However, there is an urgent need for user-friendly co-culture chip models to study reproductive health. This study aimed to establish and optimize 3D printing and Polydimethylsiloxane (PDMS) molding protocols to achieve high resolution and aspect ratios for PDMS organ-on-chip fabrication. In the current study, the 3D printed master-mold model was treated with 60°C heat for 0 minutes, 7.5 minutes (manufacturer recommended), 8 hours, and 24 hours. The 8-hour treatment group resulted in the most accurate resolution and had the most complete curing of PDMS based on cross-section analysis. In addition, dimensions between 100-300 µm were consistently printed 10-50% smaller than their true values, with 300 µm being the limit of resolution. To assess cytotoxicity and hormone binding, a PDMS plate was printed with wells scaled to a 96-well polystyrene plate, where progesterone binding and endometrial stroma cell viability were tested using ELISA and trypan blue exclusion assay. This study demonstrates a potential of 3D printed PDMS molds as a novel and cost-effective alternative to traditional photolithography-based fabrication, with implications for developing organ-on-chip models for reproductive health research.