OpenChip: An Accessible, Low-Cost Organ-on-a-Chip Platform for Ethical Drug Testing

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Organ-on-a-Chip (OOC) devices have the potential to revolutionize drug testing as an ethical, in vitro alternative to traditional methods. However, further research and adoption is limited by the lack of accessibility, standardization, and reproducibility inherent in current manufacturing approaches. To address these issues, this study develops and validates a low-cost OOC fabrication technique using widely accessible tools and materials. Standard Fused Deposition Modeling (FDM) 3D printing was combined with a controlled acetone vapor smoothing process to produce high-fidelity master molds. The process was iteratively optimized through adjustments to printing parameters, surface finishing techniques, exposure environment, and vapor exposure time. For proof-of-concept, a PDMS-based lung-on-a-chip device was fabricated. Surface roughness was reduced from 7.11 µm (as-printed) to 0.620 µm (processed), and COMSOL Multiphysics simulations confirmed uniform shear stress profiles consistent with physiological conditions. This methodology reduced the marginal cost of OOC fabrication to $0.60 per chip, representing a ~10× decrease compared to conventional photolithography methods. All resources used in this fabrication technique are available for free on OpenChip, a first-of-its-kind, open-source repository created to share accessible, validated OOC designs, protocols, and performance data, democratizing access to Organ-On-a-Chip technology and enabling broader participation in biomedical innovation.

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