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Scalable Microfluidic Platform for Flexible Configuration of and Experiments with Microtissue Multiorgan Models

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Abstract:
Microphysiological systems hold the promise to increase the predictive and translational power of *in vitro* substance testing owing to their faithful recapitulation of human physiology. However, the implementation of academic developments in industrial settings remains challenging. We present an injection-molded microfluidic microtissue (MT) culture chip that features two channels with 10 MT compartments each and that was designed in compliance with microtiter plate standard formats. Polystyrene as a chip material enables reliable, large-scale production and precise control over experimental conditions due to low adsorption or absorption of small, hydrophobic molecules at or into the plastic material in comparison with predecessor ships made of polydimethylsiloxane. The chip is operated by tilting, which actuates gravity-driven flow between reservoirs at both ends of every channel, so that the system does not require external tubing or pumps. The flow rate can be modulated by adjusting the tilting angle on demand. The top-open design of the MT compartment enables efficient MT loading using standard or advanced pipetting equipment, ensure oxygen availability in the chip, and allows for high-resolution imaging. Every channel can be loaded with up to 10 identical or different MTs, as demonstrated by culturing liver and tumor MTs in the same medium channel on the chip.

Keywords: microfluidics, tilting, microtissue, organs-on-a-chip, plate format