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Multi-nozzle inkjet and its potential for the industrialization of bioprinting

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Industrial inkjet printheads feature hundreds of nozzle in parallel while enabling the deposition of drops in physiologically relevant resolution. We hypothesize that this high-throughput industrial technology will enable the cost-effective fabrication of 3D tissue models, potentially leading to the industrialization of bioprinting. To test our hypothesis, we are investigating the reliability of the printing process, its throughput and its impact on cells. A 3D bioprinting platform was developed and set up with a special Xaar 128 printhead compatible with water-based inks. Bioinks based on culture media were enhanced with viscosity modifiers to improve the stability of the cell suspensions while remaining liquid enough for inkjet printing (<15mPa*s). Human primary cells (HUVEC) were cultivated and suspended in bioinks and their sedimentation rate in the bioink measured. When using DMEM with 10%FBS as a bioink, suspended cell concentration in the printed batches dropped to 31% after 5 min settling and sedimented cells were observed to clog the nozzles. Increasing the viscosity of the bioink by adding 5% Ficoll PM400 led to an increase of the cell concentration to 81% after 5 minutes settling while limiting the clogging of the nozzles. Viability directly after printing and for up to 4 days culture remained over 85%, suggesting that the printing process and the addition of Ficoll has a limited impact on the cells. Our study demonstrates that high-throughput and reliable cell deposition can be achieved through industrial inkjet by modifying the rheological properties of the bioink.

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