Design of a Microfluidic Open-Source 3D Bioprinting for functional tissue engineering

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The development of 3D bioprinting has shown great promise in the field of tissue engineering and disease modelling. However, the high cost of commercial 3D bioprinters has limited their accessibility, especially to those laboratories in resource-limited settings. Moreover, the need for a 3D bioprinting system capable of handling multiple materials is growing. Therefore, the development of low-cost 3D bioprinters is necessary to make this technology accessible to a wider range of researchers.

To address these issues, we developed a customized, open-source, low-cost 3D bioprinter based on a commercial fused deposition modelling (FDM) 3D printer. This bioprinter is designed to print biomaterials for tissue engineering purposes using a coaxial nozzle for in situ cross-linking the biomaterial, and it includes three syringe pumps that can also be used to deliver liquid in microfluidic chips. The affordability of our bioprinter is a significant advantage, as it makes it accessible to a broader spectrum of users, working in different fields such as tissue engineering, drug discovery, and disease modelling. The open-source nature of the bioprinter also allows for easy customization and adaptation to specific research needs. The performance of the 3D bioprinter has been validated by constructing lattice scaffolds which are being widely used in tissue engineering.

In fact, we developed advanced tissue models resembling cancer and skeletal tissue by combining our bioprinter advanced engineering features. We specifically studied the effects of pro-osteogenic growth factors (bone morphogenetic protein-2) within these models. These findings suggest that new 3D bioprinting platform for engineering functional tissue constructs can be established, offering significant advancements in regenerative medicine and orthopaedics. The validation of our bioprinter for fabricating tissue substitutes and cancer models and underscores its potential for broad applications in tissue engineering.