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The evolving technology of bio-printing

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Bio-printing is a novel method of tissue engineering that uses living cell spheroids as the 'bio-ink' and biocompatible gels as the 'bio-paper' with a three dimensional printer that deposits these aggregates into the gel with great precision. The deposited aggregates fuse into three dimensional tissue structures of the desired conformation due to the liquid like nature of cells and tissues, serving as the driving force of biological self assembly. Successful results from previous experiments and theoretical modeling of the fusion process prompted the development of a standardized and automated method that increases the speed, accuracy and reproducibility of printing. To fulfill these requirements, a cell packer, an aggregate cutter and bio-printer was developed, calibrated and tested. The tools produced more uniform and spherical aggregates as compared to the manual protocols, allowing the standard size and shape necessary for rapid and precise printing. The printed structures (ring and grid-like arrangements of aggregates) fused into toroids and compact sheets, fundamental building blocks of a living organism. The precision of the printing, combined with the cell packer and aggregate cutter makes bio-printing a feasible technology. The automated process using organ specific cells could allow histologically analogous tissues to be produced and used for tissue repair and regeneration.