

## **3D Bioprinting of biopolymer-based structures for organoids and cellular systems**

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The PhD research project, conducted in close collaboration with Nanodent (SME), aims to use 3D bioprinting of biomimetic tissues for tissue engineering applications and organoids as biological models for the study of tumors.

Three-dimensional bioprinting (3D) is an emerging technology that involves 3D printing of biopolymers and cells to create three-dimensional structures that physiologically and morphologically resemble organs and tissues, defined as mini-organs. The materials used for 3D bioprinting of biological tissue must simultaneously meet both the biological and the physical and mechanical requirements of the cells that make up the various tissues. The most widely used bio-inks are the so-called hydrogels, which have similar properties to extracellular matrices and allow the encapsulation of cells in a 3D environment that is both highly hydrated and mechanically stable.

Recent advances in bioprinting provide a valuable tool for the fabrication of various biomimetic constructs that can be used in various fields of biomedicine and nanotechnology, such as tissue engineering and personalized medicine. The ultimate goal of 3D bioprinting is to develop constructs that can be used to restore tissue and organ function, which contribute significantly to advances in regenerative medicine. For example, given the growing interest in studying the effects of mechanical stimuli on cellular processes, 3D bioprinting offers the possibility of creating constructs that can mimic the extracellular environment with extreme precision, not only structurally but also mechanically.

3D bioprinting also offers interesting applications in the study of personalized pharmacological treatments for various cancers through the use of in vitro biological systems defined as organoids. Organoids represent one of the most promising study models for human tumors for the development of precise and personalized medicine. Because they replicate the genotypic and phenotypic characteristics of a particular patient's tumor, they enable more accurate prediction of tumor response to drugs than tumor cell lines and with lower cost and hassle than tumor xenografts in animals. Because they consist not only of tumor cells but also of stromal cells, organoids can also study the effect of drugs on the stromal component, such as immunotherapies and anti-angiogenics. The goal is therefore to develop 3D systems of tumor organoids that faithfully represent the biological properties of the tumor of origin in terms of histological type, microenvironment (stromal cells), immunohistochemical properties and somatic genomic alterations. Organoids with these properties can be used for subsequent preclinical pharmacology studies as the most accurate predictors of drug response to determine the most effective drug or combination of drugs against a particular tumor. The development of these models will therefore be able to improve cancer treatment selection, leading to very accurate personalization of therapies, increasing the likelihood of treatment response and reducing the use of ineffective therapies.