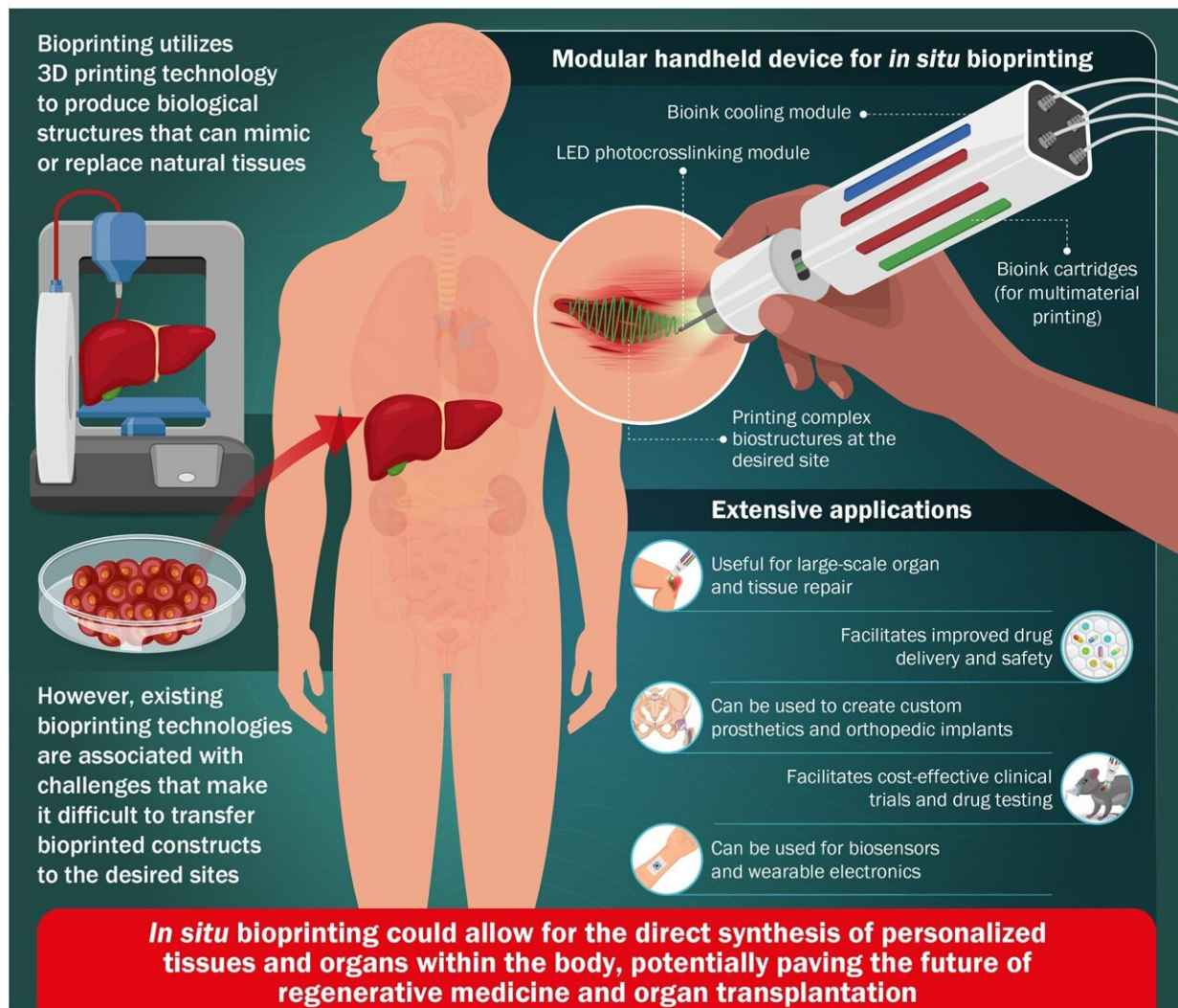


Bioprinting personalized tissues and organs within the body: A breakthrough in regenerative medicine

June 13 2023, by Cait Cullen

Printing Customized Tissues with a Handheld Bioprinter



Bioprinting utilizes 3D printing technology to produce biological structures that can mimic or replace natural tissues

Modular handheld device for *in situ* bioprinting

- Bioink cooling module
- LED photocrosslinking module
- Bioink cartridges (for multimaterial printing)
- Printing complex biostructures at the desired site

Extensive applications

- Useful for large-scale organ and tissue repair
- Facilitates improved drug delivery and safety
- Can be used to create custom prosthetics and orthopedic implants
- Facilitates cost-effective clinical trials and drug testing
- Can be used for biosensors and wearable electronics

However, existing bioprinting technologies are associated with challenges that make it difficult to transfer bioprinted constructs to the desired sites

***In situ* bioprinting could allow for the direct synthesis of personalized tissues and organs within the body, potentially paving the future of regenerative medicine and organ transplantation**

A Handheld Bioprinter for Multi-material Printing of Complex Constructs
Pagan et al. (2023) | *Biofabrication* | DOI: 10.1088/1758-5090/acc42c



IOP Publishing

Published open access through a transformative agreement

In situ bioprinting could allow for the direct synthesis of personalized tissues and organs within the body, potentially paving the future of regenerative medicine and organ transplantation. Credit: Pagan et al.

In situ bioprinting, which involves 3D printing biocompatible structures and tissues directly within the body, has seen steady progress over the past few years. In a recent study, a team of researchers developed a handheld bioprinter that addresses key limitations of previous designs, i.e., the ability to print multiple materials and control the physicochemical properties of printed tissues. This device will pave the way for a wide variety of applications in regenerative medicine, drug development and testing, and custom orthotics and prosthetics.

The emergence of [regenerative medicine](#) has resulted in substantial improvements in the lives of patients worldwide through the replacement, repair, or regeneration of damaged tissues and organs. It is a promising solution to challenges such as the lack of organ donors or transplantation-associated risks. One of the major advancements in regenerative medicine is on-site (or "in situ") bioprinting, an extension of 3D [printing technology](#), which is used to directly synthesize tissues and organs within the human body. It shows great potential in facilitating the repair and regeneration of defective tissues and organs.

Although significant progress has been made in this field, currently used in situ bioprinting technologies are not devoid of limitations. For instance, certain devices are only compatible with specific types of bioink, while others can only create small patches of tissue at a time. Moreover, their designs are usually complex, making them unaffordable and restricting their applications.

In a breakthrough study published in *Biofabrication*, a research team including Mr. Erik Pagan and Associate Professor Mohsen Akbari from the University of Victoria in Canada, developed a handheld in situ bioprinter with a convenient modular design, that allows the printing of complex biocompatible structures.

"Two decades ago, my mother was diagnosed with breast cancer, which eventually led to the removal of her breast. This affected her well-being considerably. It made me realize that a technology like handheld bioprinting could not only help develop personalized implants for breast reconstruction that match the shape and size of the patient's tissue, but also be used to create tumor models for the study of [breast cancer](#) biology. Such applications could significantly improve treatment outcomes for affected patients," says Prof. Akbari while discussing his motivation underlying this study.

A key feature of the handheld device is the presence of multiple bioink cartridges, each independently controlled by a pneumatic system. Owing to this, the device operator has ample control over the printing mixture, making it easier to develop structures with the required properties. Moreover, the device has a cooling module and a light emitting diode photocuring module, which provide additional control.

This versatile in situ bioprinter has several applications. Prof. Akbari elaborates, "In situ bioprinting is suitable for repairing large defects caused by trauma, surgery, or cancer, which requires large-scale tissue constructs. In the long term, this technology can eliminate the need for organ donors, while also lowering the risks associated with transplantation, allowing patients to enjoy longer and healthier lives."

Another notable potential application of this device is the production of drug delivery systems. An operator could construct scaffolds or structures that release a precise quantity of drugs as well as cells at

specific locations within the body. This would make drugs more efficient, minimize side effects associated with them, and improve their safety. The technology reported in this paper may also speed up the discovery of new drugs by allowing scientists to develop more accurate drug testing models.

What's more, it has the potential to develop custom prosthetics and orthopedic implants. Due to its portable nature, this bioprinter may help physicians match a patient's [tissue](#) anatomy with greater accuracy and convenience, thus enhancing the functionality and aesthetic of the bioprinted construct.

The findings of this study can significantly benefit researchers and physicians dedicated to improving the scope of regenerative medicine and enable [collaborative research](#), which can accelerate further development of this technology.

More information: Erik Pagan et al, A handheld bioprinter for multi-material printing of complex constructs, *Biofabrication* (2023). [DOI: 10.1088/1758-5090/acc42c](#)

Provided by IOP Publishing

Citation: Bioprinting personalized tissues and organs within the body: A breakthrough in regenerative medicine (2023, June 13) retrieved 29 April 2024 from <https://medicalxpress.com/news/2023-06-bioprinting-personalized-tissues-body-breakthrough.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--