Poster: AI-aided design of 3D printed micro implant for an optimized drug release in ocular media

Correspondence Author

Arian Farokh

New Vistas

Volume 12, Issue 1, 2026, UWL Annual Doctoral Students' Conference 2025

Abstract

Tissue regeneration involves replacing, repairing, or regenerating damaged tissues using biological substitutes such as scaffolds or micro-implants that deliver therapeutic drugs or cells directly to affected sites. This innovative approach holds significant promise for addressing diverse medical conditions, from chronic wounds to organ-specific diseases like nerve and eye disorders. Despite notable advancements, current drug delivery methods face critical challenges, particularly in achieving precise control over drug release profiles and accurately targeting specific tissues.

3D bioprinting has emerged as an essential technique in tissue engineering, capable of creating complex, porous scaffolds designed as effective carriers for therapeutic agents. These structures facilitate controlled, localised drug release directly at targeted tissue sites. Extrusion-based 3D bioprinting is widely employed due to its affordability, adaptability, and compatibility with various biomaterials. However, achieving optimal scaffold printability and structural integrity requires careful optimisation of biomaterial properties, including their biological, mechanical, and rheological characteristics.

Traditional experimental methods to optimise these parameters are often resource-intensive and time?consuming. Artificial intelligence (AI), particularly machine learning, offers a powerful alternative to streamline this optimisation. By analysing extensive datasets on biomaterial characteristics, printing parameters, and drug release performance, machine learning can efficiently predict ideal printing conditions, significantly reducing experimental demands and enhancing scaffold quality.

We aim to leverage extrusion-based 3D bioprinting techniques to fabricate scaffolds with precise shapes and sizes for localised drug delivery applications. To accelerate the process and reduce experimentation costs, machine learning methods will be employed to identify optimal printing configurations, ultimately advancing the effectiveness and efficiency of scaffold-based drug delivery system

Keywords

AI, 3-D printing, Drug release implant