Opinion

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Multi-Layered Tissue Engineering Scaffolds Printed in Three Dimensions

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Abstract

Tissue engineering has resulted in innovative therapies for the restoration of injured tissues and organs, which make use of biomimetic scaffolds that, mimic the mechanical and biological qualities of host tissue. The development of three-dimensional printing (3DP) technologies has enabled the fabrication of highly complex scaffolds that provide a more accurate replication of native tissue properties and architecture than was previously possible. Multi-layered scaffolds that target distinct regions of complex tissues are of particular interest to tissue engineers. Multiple interacting tissue types are found in musculoskeletal and dental tissues, such as the osteochondral unit and periodontal complex, and hence benefit from multi-layered scaffold creation. For the fabrication of scaffolds with gradient architectures and mixed material compositions, traditional 3DP technologies such as extrusion printing and selective laser sintering have been employed. Emerging bio printing technologies have also been utilised to print cells and chemical components directly and spatially, reflecting the body's complex complexity. Researchers built scaffolds made of a variety of materials, including natural polymers, synthetic polymers, and ceramics, to better simulate the varied and gradated properties of bigger tissues.

Keywords: Scaffolds; 3-Dimensions; Tissue engineering

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Introduction

Complex tissue engineering scaffolds can be created via three-dimensional printing (3DP) based on computer designs derived from patient-specific anatomical data. The early applications of 3DP were in the biomedical area, where it was utilised to create pre-surgical visualisation models and tooling moulds. Since its inception, 3DP has been used to create tissue engineering scaffolds, tissue analogues, and organs-on-chip for diagnostic purposes. A recent push to integrate stem cell technologies with custom three-dimensional (3D) scaffolds to establish the field of personalised regenerative medicine has been fuelled by a surge in public interest and the availability of low-cost printers [1]. However, a number of technological challenges must be resolved before 3DP can be used routinely to regenerate complex tissues including bone, cartilage, muscles, and blood vessels, as well as complicated organs with intricate 3D microarchitecture like the liver or lymphoid organs. Three-dimensional scaffolds are porous, biocompatible, and biodegradable materials that provide appropriate microenvironments, such as mechanical support, physical stimulation, and biochemical stimulation, for optimal cell development and function. 3D printing is a technology that allows you to create three-dimensional objects. Three-dimensional (3D) printing, also known as additive manufacturing or fast prototyping, is used in tissue engineering to create scaffolds that can be used to repair or replace damaged tissues and organs [2]. A bottom-up method is used in three-dimensional printing. Scaffolds are artificial or natural-material constructs that can be used to create new tissue to replace injured tissue. These scaffolds might be made outside the body, for example, to start growing a portion of bone in the lab before physically implanting it. Tissue engineering is made up of three main components: (1) reparative cells that can form a functional matrix; (2) an appropriate scaffold for transplantation and support; and (3) bioactive molecules like cytokines and growth factors that will support and choreograph the formation of the desired tissue. Porous scaffolds allow nutrients, oxygen, and waste products to diffuse freely [3].

Open porosity and linked networks are necessary for cell nourishment, proliferation, and migration, as well as tissue vascularization and tissue development. Closed and open pores of various sizes, shapes, geographical distribution, and mutual interaction determine the porosity of the scaffold. Scaffold–

tissue interaction, cell migration, vascularization, mechanical characteristics, diffusion, and fluid permeability are all affected by open porosity. Scaffolds, which are primarily constructed of polymeric biomaterials, provide structural support for cell adhesion and tissue formation. Commercial 3D printers, such as Polyjet 3D printers, are used in 4D printing technologies. A "smart substance," such as a hydrogel or a shape memory polymer, is used as the input. This means that 3D printed things will retain their 3D shape after printing. In the field of regenerative medicine, many scaffolds for tissues and organs have been 3D printed. Biocompatible polymers are commonly used to construct 3D scaffolds. To improve the bioactive qualities of the scaffolds, cells and bioactive compounds are frequently added [4].

The recent dramatic expansion of 3DP has been aided by the expiration of essential 3DP patents and the availability of affordable computer capacity for the processing of enormous 3D files. Complex 3D constructions with patient-specific macro- and microarchitecture can now be designed and manufactured thanks to technological advancements. Even at home, you may design and share parts using Free CAD open-source software and other CAD programmes. Low-cost, high-resolution 3D scanners are now available, and apps that promise to enable 3D scanning with a smartphone are now in development. The combination of these developments has boosted 3DP's popularity and accessibility to a much wider audience [5].

Despite significant progress in tissue engineering over the last five years, developing tissue innervation and vascularization remain difficult. Functional gradients of cells and biochemical substances that mirror the conditions during embryogenesis and wound healing must be produced to achieve a completely functional 3D-printed tissue that is integrated with the circulatory and neurological control systems. Furthermore, unlike processing settings involving UV radiation, heat, chemical solvents, or cytotoxic photoinitiators, cell deposition requires materials and processing conditions that are totally compatible with biomaterials. The creation of persistent growth factor release in controlled spatial-temporal release profiles is required for the incorporation of biological components. In order for the field to progress, the innovation that today drives 3DP must be put toward addressing these obstacles.

Conclusion

Three-dimensional printing is one of the most promising technologies for fabricating improved 3D scaffolds in tissue engineering and regenerative medicine. It enables for the creation of more defined and biomimetic scaffolds that contain bioactive ingredients to improve their functionality. Although various studies on 3D printing for biomedical purposes have been conducted, there is still much potential for advancement. The development of printable inks, the standardisation of printing procedures, and the improvement of reproducibility in mass manufacturing are all significant difficulties. 4D printing, which combines 3D printing with time, is a relatively new concept. When activated by external stimuli such as temperature, water, magnetism, or pH, this technique allows printed materials to change their physical shapes or functionality.

References

1. Chang JW, Park SA, Park JK, Choi JW, Kim YS (2004) Tissue-engineered tracheal reconstruction using three-dimensionally printed artificial tracheal graft: preliminary report. Artif Organs 38: 95-105.

2. Choi JW, Kim N (2015) Clinical application of three-dimensional printing technology in craniofacial plastic surgery. Arch Plast Surg 42; 267-277.

3. Qu H, Fu H, Han Z & Sun Y (2019) Biomaterials for bone tissue engineering scaffolds: a review. RSC Advances 9(1); 26252-26262.

4. Kilian D, Ahlfeld T, Akkineni AR, Lode A & Gelinsky M (2017) Three-dimensional bioprinting of volumetric tissues and organs. MRS Bull 42(1); 585-592.

5. Tarafder S, Balla VK, Davies NM, Bandyopadhyay A, Bose S (2013) Microwave-sintered 3D printed tricalcium phosphate scaffolds for bone tissue engineering. J Tissue Eng Regen Med 7(8); 631-641.