Chapter 11
Materials, Fabrication Techniques, Applications, and Limitations in Hydrogel Forming:
Rapid Prototyping for Tissue Engineering

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ABSTRACT

The 3D printing or organ printing is a continuous process for developing the cell cultures with the biomaterials supports to implant the organs or any other clinical treatments. In 3D bioprinting, hydrogels are the most appropriating method among the various methods, but this technique is mainly related with suitable bio inks, rheology, and compatibility. From the various analyzing of precursor materials, hyaluronic acid was the best combinations in the scaffolding process because it has sufficient biodegradability, hydrophilicity, superior biological properties, and biocompatibility, and it would be most eager hydogels over the other alginate, collage, polyvinyl alcohol, fibrin, etc. In this research, hydrogel scaffold materials with various types, importance of mechanical strength, fabrication techniques, processing of polymerization, application of hydrogels, bio inking process and its properties, microenvironment of biomaterial cells, properties of hydrogels, biomaterials scaffold, and limitations were reviewed.

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1. INTRODUCTION

Based on the life sciences and various engineering fields and working principle are utilized to form the collaborative usages for damaged human tissue, organs for human and animals. It is a biological alternate with combinations of design and fabrication in the area of tissue engineering which is full related to multi disciplinary scopes. The rapid prototyping method was utilized to produce the very complicated parts by the layer by layer deposition with appropriate materials. This rapid prototyping is common term for 3D printing or additive manufacturing. This additive technique composes the 3D based component as per the CAD design. There are various classification like powder based system which includes laser methods, solid based system and liquid based systems was accumulated in this additive manufacturing (Billiet et al., 2012).

In this tissue based fabrication, 3D bio printing method was used to produce the innovative biological materials with adhesive forms and layer by layer deposition process. The bio printing fabrication is a new biological process to fabricate the bionic structures with their combinations of biological based materials and 3D bio printing. In this printing, biological ink layer by layer deposition with the assist of scanning system to arrange implants through bionic products. It is also known as organ printing. The 3D printing of bio systems was extensively utilized in the following tissue engineering uses are bone system, nerves, vascular systems, skin etc. Because, this technique based products were easily prepared without any difficulties, continuous production, precise and accurate. In the modern revolution days, the fresh medicine which relate to humans tissues are easy to made with the 3D bio printing method for clinical usages, this is a decisive aim of this bio printing technology (Shirwaiker, Purser, & Wysk, 2014).

There are various major classifications like laser jet process; inkjet method and stereo lithography were included to produce the unique printing creation. It can be produced by the lonely method or else combined with any other these classifications. From the point of cost and quality based products were fabricated with extruding bio ink process was suitable for that. Therefore, this method is working with mechanical screw and pneumatic pumps to compose the bio ink product with extrusion technology. This extrusion process creates the products by the biological inks with broad varieties like easy manipulation; manage with porosity defects, required shapes for maintaining the maximum density deposition (Xu et al., 2014).

This bio ink method was ruled by the following control elements piezoelectric, electromagnetic or thermal drive and also it has major benefit of maximum resolution, rapid speed of printing and less production cost. The tissue transplantation was most significant to improve the life hope or renovate for human beings or animals. To the end period of 2011, the more than 100000 patients are waiting for the tissue transplant operation. Out of this, only 25 percentage patients were recovered in United States of America. The Organ Procurement and Transplantation Network with collaboration produces the annual based repot for transplanting patients. These situations are highly based on the shortages of donors and increasing the patient life span (Shirwaiker, Purser, & Wysk, 2014).