Chapter 4
Scaffolds and Tissue Engineering Applications by 3D Bio-Printing Process: A New Approach

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ABSTRACT

3D bio-printing is a revolutionary manufacturing process that is widely used in medical fields especially in preparing bone scaffolds and tissue engineering. With the help of new biocompatible material like polymers, bio-gels, ceramics, this technology has created a new site in advanced tissue engineering and scaffolds manufacturing area. Another important thing is that, with the use of CAD file software, any complex design can be prepared (i.e., this technology does not have any limited sites). But here it is very much essential to study and analyze machine printability characteristics, cross-linking time and biocompatibility of printing objects as well as bio-ink. However, mechanical properties like shear thinning, mechanical elasticity are also required. In this chapter, different types of scaffold-preparing methods and the bio-printing process are discussed, which are used in scaffold and tissue engineering.

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INTRODUCTION

Three dimensional printing is growing up innovatively in medical application especially in scaffolds preparing and tissue engineering are. 3D printing is nothing but a process of additive manufacturing process. As per ASTM-F42 Committee, Additive manufacturing is manufacturing method of joining materials to make an objects from 3D model data, normally layer upon layer, contradictory of traditional manufacturing process [ASTM F2792–10]. Basically the objects are made by different types of materials like metal, polymers, powders, ceramics, in case of bio-printing process, biocompatible materials like bioink even also living cells are also used for making scaffolds [Banks.,2013, Sun et al., 2005, Hornbeck,1997]. Bio-printing technique initially starts from collecting the image data from any patients' body through Magnetic Resonance Imaging (MRI) or Computed Tomography (CT) process [Mertz et al.,2013]. After collecting the image data, all data are converting the Computer Aided Design (CAD) file [Yandell,2013] through Digital Imaging and Communication Medicine (DICOM) directory [Science and society,2013]. A uniform process is exists for preparing the essential Standard Triangulation Language (STL) format of implants [Cheah et al., 2003]. After all this process, final objects is printed. Table 1 shows the time wise evolutionary list of 3D printing technology. On the increase bioactive three-dimensional (3D) scaffolds to hold up bone regeneration has consequently develop into a solution part of spotlight inside tissue engineering specially bone tissue. Three dimensional scaffolds that have effectively linked bone defects even as vigorously reminding bone regeneration will be emphasized. Most significant things is that the fast advances have been stimulated by the novel bio-printing manufacturing process, innovative features of bio-printers, printable biomaterials like bioinks and exhilarating applications for transplantable tissues or invitro models.

IDEAL SCAFFOLD CHARACTERISTICS

Basically, the idyllic three dimensional scaffold is compiled with biodegradable and biocompatible material, which have similar mechanical properties of tissue. Normally scaffold is not a planed to be constant position in implants, it will preferably assist the host cells for depositing in extracellular matrix (ECM)