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Commentary

Tissue Engineering for Bone Regrowth Using Biomaterials

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INTRODUCTION

The regenerative medicine is the interdisciplinary field that follows the principles of the biological sciences and engineering. It utilizes the natural healing mechanism to repair, reconstruct and replace the diseased or damaged tissues or organs. This approach is the advancement of research carried on tissue regeneration through the last decade. Regenerative medicine strategies involve a combination of biomaterials or scaffolds, cells and bioactive agents. The research on the tissue engineering showed special interest in bone regrowth and repairing of damaged bone. The bone is a dynamic and highly vascularized connective tissue that provides adequate physical and mechanical strength. It acts as a protective case for sensitive, delicate internal organs of the body. Bone has a high regeneration capacity especially in younger population. Small injuries and fractures can be healed by bone itself with no requirement of surgical intervention, but severe trauma, cancer, tumor resection causing large segmental defects in bone can only be repaired by bone grafting. With the development of the regeneration medicine strategies for bone repair, there has been more demand for bone biomaterials which are called as bone grafting substitutes. In terms of natural bone structure, it has a multi layered structure that is divided into cortical bone and cancellous bone. Cortical bone is located at the bone surface containing 99% of calcium and 90% of phosphate in a human body. This layer is dense and strong with low porosity. Cancellous bone is spongy structured tissue, located inside the bone distributed in entire length of the bone. The cancellous bone accounts for 20% of bone weight in human body. It has more surface area than cortical bone with high porosity. This specific structure and composition bestows bone with superior properties in accomplishment of various functions. Although, structure and composition can vary depending on the site of defect, age, hereditary and living conditions of an individual that puts forth demands for bone implants.

Bone biomaterials hold a very important role in bone repair. It provides adequate substrate for cell adhesion and differentiation and helps in modulating cell function. The immense efforts in the past decade in research to develop compatible bone biomaterials with the sole purpose of developing suitable biomaterials in combination with ideal mechanical and biological properties, to construct a microenvironment with a pore size ranging from Nano to Micro scale are important factors to consider to obtain the implants similar to the structure, composition and function of the natural bone. Bioactive ceramics, biodegradable polymers and metals are the developed bone biomaterials that are reviewed emphasizing their applications and characteristics. The biomaterials should foremost meet the safety requirements, like they should be non-toxic and not elicit immune responses. They should own a good level of biocompatibility, bioactivity and also controlled biodegradability. The bone biomaterials should not only cover the defects but also depict perpetual degradability in vivo. The bone biomaterial's degradation rate should match the growth rate of new bone. Immense research devoted to deliver new and improved biomaterials similar to bone natural structure, composition and function.

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