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Editorial OMICS International

Hydroxyapatite Scaffolds for Bone Tissue Engineering

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Editorial

The management of critical-sized bone defects offers a substantial clinical challenge in orthopaedic surgery. Critical sized bone defects, that does not heal spontaneously mainly due to inadequate blood supply, requires secondary intervention. During trauma and surgical disruption and also due to instability at the fracture site, there is possibility of formation of delayed or non-union bones. Tissue engineering was introduced in the early 1990s to address such critical problems and overcome the limitations of tissue grafting. This technique involves the combination of cells, scaffolds and biomolecules to develop functional substitutes. Ceramic scaffold is an essential component that serves as a template for formation of bone-extracellular matrix by virtue of cellular interactions with it and provide temporary structural support to the newly formed bone tissue. The scaffolds primarily play the role of osteoconductive moieties and promotes new sites for bone generation by osteogenesis that happens because of cell seeding before implantation. Moreover, these scaffolds have further been functionalized with cells having osteogenic potential to enhance the guided-tissue regeneration. The application of cells-scaffold constructs incorporation in critical bone defects appears to present identical conditions of natural bone healing processes. The biocompatibility and resemblance of hydroxyapatite (HA) to the mineral composition of the bone has rendered HA a potential candidate in bone tissue engineering (BTE).

The pore size and morphology in HA scaffolds are crucial factors for better osteointegration. It is widely accepted that a pore sizes in the range of 100 to 150 μm is essential for both bone in-growth and angiogenesis, but even 50 μm pore size is sufficient for exhibiting osteoconduction. However, a higher pore size in between 200 and 500 μm is desirable for colonization of osteoblast, fibro vascular in-growth and apposition of new bone. Further, the lower mechanical strength of HA based scaffolds has so far restricted its use in non- load bearing sites because of conflicting requirements of porosity and strength. HA having controlled pore size distribution as well as the interconnecting porosity exhibits strong bone bonding ability. The interconnected pores provide the pathway for 3-D tissue ingrowth leading to a strong mechanical and biological fixation of the implant with the host tissue. Therefore, although porous HA is gaining importance in Tissue Engineering, the control of pore size and pore microstructure, pore interconnectivity and the mechanical load bearing capacity are critical factors for extending its use in higher number of cases treating musculoskeletal disorders. HA scaffold for bone regeneration should meet certain criteria, including similar mechanical properties to those of bone repair site, biocompatibility, biodegradability, and porosity.

Different fabricating techniques such as gel casting, slip casting, fiber compacting, freeze casting, gas foaming, solid free form fabrication, robocasting and other rapid prototyping techniques for preparation of HA scaffolds and different processing parameters that control its physico chemical properties such as pore size, morphology, its distribution and its protein adsorption capacities *in vitro* have been discussed so far. The mechanical performance of HA based scaffolds with respect to its physical properties has been compared and possibility of improvement of its mechanical strength has been highlighted. The osteoconductive as well as osteoinductive potential of different HA based scaffolds and its correlation with physico chemical and mechanical properties of such scaffolds have been the focus of the studies so far. Application of hydroxyapatite as a material to develop a 3-dimension scaffold or carrier to support mesenchymal stem cells *in vitro* has also been investigated. Thus, HA based scaffolds have tremendous potential in bone tissue engineering applications.

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