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Hydroxyapatite Based Porous Scaffold for Tooth Tissue Engineering

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Abstract : A key experimental trial in the regeneration of large oral and craniofacial defects is the neogenesis of osseous and ligamentous interfacial structures. Currently, oral regenerative medicine strategies are unpredictable for repair of tooth supporting tissues destroyed as a consequence of trauma, chronic infection or surgical resection. A different approach combining the gel-casting method with Hydroxy Apatite HA-based scaffold and different cell lineages as a hybrid system leads to successively mimic the early stage of tooth development, in vitro. HA is widely accepted as a bioactive material for guided bone and tooth regeneration. In this study, it was reported that, HA porous scaffold preparation, characterization and evaluation of structural and chemical properties. HA is the main factor that exists in tooth and it is in harmony with structural, biological, and mechanical characteristics. Here, this study shows mimicking immature tooth at the late bell stage design and construction of HA scaffolds for cell transplantation of human Adipose Stem Cells (hASCs), human Bone Marrow Stem Cells (hBMSCs) and Gingival Epitelial cells for the formation of human tooth dentin-pulp-enamel complexes in vitro. Scaffold characterization was demonstrated by SEM, FTIR and pore size and density measurements. The biological contraction of dental tissues against each other was demonstrated by mRNA gene expressions, histopatologic observations and protein release profile by ELISA tecnique. The tooth shaped constructs with a pore size ranging from 150 to 300 µm arranged by gathering right amounts of materials provide interconnected macro-porous structure. The newly formed tissue like structures that grow and integrate within the HA designed constructs forming tooth cementum like tissue, pulp and bone structures. These findings are important as they emphasize the potential biological effect of the hybrid scaffold system. In conclusion, this in vitro study clearly demonstrates that designed 3D scaffolds shaped as a immature tooth at the late bell stage were essential to form enamel-dentin-pulp interfaces with an appropriate cell and biodegradable material combination. The biomimetic architecture achieved here is providing a promising platform for dental tissue engineering.

Keywords : tooth regeneration, tissue engineering, adipose stem cells, hydroxyapatite tooth engineering, porous scaffold
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