Generation of anatomically shaped and dimensioned acellular tooth structures

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Technology description

Summary

Problem or Unmet Need:
Edentulism, periodontal disease, and tooth loss affect millions of people worldwide. Contemporary dentistry can restore missing teeth with dental implant procedures. However, dental implants have a number of drawbacks relating to poor integration especially when the underlying bone does not provide sufficient support and environment for integration. Emerging efforts in biomaterials and regenerative medicine research have demonstrated the ability to generate biologically-derived tooth-like structures which could potentially improve mechanical integration through improved tissue integration. However, none of these studies have demonstrated the ability to regenerate anatomically shaped and dimensioned human teeth in vivo. Furthermore, these studies required the delivery of cells, including dental and other stem cells. Due to the complex regulatory requirements regarding handling and processing of cells, cell-based approaches are more challenging to commercialize. There is a need for acellular approaches to tooth regeneration that achieve host integration and the anatomical shape and dimension of natural teeth.
Details of the Invention:
This technology consists of a tooth scaffold infused with bioactive cues. Specifically, the scaffolds are fabricated in 3D by reconstruction of either a generic or patient-specific tooth form, followed by rapid prototyping through layer deposition. A hybrid of bio-compatible polymers is co-melted and bioplotted into the anatomically-shaped tooth scaffolds containing internal interconnecting microchannels and infused with bioactive cues.
Dr. Mao has performed preliminary in vivo studies of the scaffold. In a first set of experiments, the infused scaffolds were implanted in the dorsum of Sprague-Dawley rats and, at five weeks, angiogenesis and tissue in-growth into the microchannels of the scaffolds was detected. The second set of experiments involved implantation of lower incisor-shaped, infused scaffolds. Results demonstrated orthotopic regeneration of lower incisor structures as well as integration with surrounding periodontal tissues.

Application area

Regeneration of tooth structures without cell delivery

Advantages

Bioactive cues promote native-like tissue integration
Acellular approach to tooth regeneration can greatly reduce the cost and complexity of commercializing the technology
Patient-specific tooth shape can be designed in 3D CAD software and easily constructed

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