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Journal of Dentistry 109 (2021) 103655

Contents lists available at ScienceDirect

Journal of Dentistry

journal homepage: www.elsevier.com/locate/jdent

Potential of tailored amorphous multiporous calcium silicate glass for pulp capping regenerative endodontics—A preliminary assessment

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ARTICLE INFO

Keywords:
Tailored amorphous multiporous (TAMP)
Calcium silicate
Dentin-pulp
Dental pulp stem cells
Tissue regeneration
Regenerative endodontics
Bioactive materials

ABSTRACT

Introduction/Objective: The tailored amorphous multi-porous (TAMP) material fabrication technology has led to a new class of bioactive materials possessing versatile characteristics. It has not been tested for dental applications. Thus, we aimed to assess its biocompatibility and ability to regenerate dental mineral tissue.

Methods: 30CaO-70SiO_2 model TAMP discs were fabricated by a sol-gel method followed by *in vitro* biocompatibility testing with isolated human or mini-swine dental pulp stem cells (DPSCs). TAMP scaffolds were tested *in vivo* as a pulp exposure (pin-point, 1 mm, 2 mm, and entire pulp chamber roof) capping material in the molar teeth of mini-swine.

Results: The *in vitro* assays showed that DPSCs attached well onto the TAMP discs with comparable viability to those attached to culture plates. Pulp capping tests on mini-swine showed that after 4.5 months TAMP material was still present at the capping site, and mineral tissue (dentin bridge) had formed in all sizes of pulp exposure underneath the TAMP material.

Conclusions: TAMP calcium silicate is biocompatible with both human and swine DPSCs *in vitro* and with pulp *in vivo*, it may help regenerate the dentin bridge after pulp exposure.

1. Introduction

Regenerative endodontics has gained much attention in the past decade. Clinicians and researchers have explored clinical protocols that are conducive to endodontic tissue regeneration [1–5]. Furthermore, stem cell-based approaches to accomplish pulp regeneration have been experimented and tested in various animal models as well as in human clinical trials [6–9]. Such clinical concepts and observations have prompted more conservative managements of pulp, including direct pulp capping on cases that were considered for pulpectomy in the past. Direct pulp capping covers the exposed vital pulp with a material, to maintain the pulp vitality and preserve its biological and functional activities [10,11]. This conservatism has been promoted by the use of calcium silicate-based materials such as MTA (mineral trioxide aggregate) and Biodentine, which exhibit many superior properties such as improved sealing ability and biocompatibility over the traditional capping material calcium hydroxide ($Ca(OH)_2$) [12–15].

An effective and ideal pulp capping material should be biocompatible to provide a biological environment for dental pulp tissue repair inducing homogeneous reparative dentin formation, and having suitable

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https://doi.org/10.1016/j.jdent.2021.103655
Received 8 October 2020; Received in revised form 26 March 2021; Accepted 28 March 2021
Available online 30 March 2021