

# Effect of Bioceramic Materials on Proliferation and Odontoblast Differentiation of Human Stem Cells from the Apical Papilla

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## Abstract

**Introduction:** In regenerative endodontic treatment (RET), practitioners favor the placement of bioceramics as sealing materials over blood clots. It is important to understand the interaction between sealing material and cells in the root canal. The purpose of this study was to compare the effectiveness of various bioceramic materials (ProRoot MTA [Dentsply, Tulsa, OK], Biodentine [Septodont, Saint-Maur-des-Fossés, France], and RetroMTA [BioMTA, Seoul, Korea]) as sealing materials in RET for the proliferation and differentiation of stem cells from the apical papilla (SCAPs). **Methods:** SCAPs were seeded at 20,000 cells/well and cultured with soluble agents of testing materials through a transwell culture plate. The proliferation of SCAPs was investigated using a 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay on days 1, 3, 7, and 14 of testing. Alizarin red staining and quantitative real-time polymerase chain reaction were used for SCAP differentiation at different time points (1, 7, 14, and 21 days). The odontoblast genes expressed are dentin matrix acidic phosphoprotein 1, dentin sialophosphoprotein, osteocalcin, and matrix extracellular phosphoglycoprotein, which were used in this study. The SCAPs were cultured in odonto/osteogenic induction medium and also contacted soluble agents from the testing materials. **Results:** All 3 tested biomaterials induced SCAP proliferation. The Biodentine, ProRootMTA, and RetroMTA groups showed significant SCAP proliferation on days 7 and 14 compared with the control. In regard to odontoblastic differentiation, only Biodentine showed positive alizarin red staining. The highest expressions of dentin matrix acidic phosphoprotein 1, dentin sialophosphoprotein, and matrix extracellular phosphoglycoprotein were found on day 21 in the Biodentine group. The expression of osteocalcin was found to be significant on day 7. **Conclusions:** Biodentine, ProRootMTA, and RetroMTA can induce

SCAP proliferation. Biodentine induced significant SCAP differentiation among the 3 materials. (*J Endod* 2018; ■:1–6)

## Key Words

Bioceramics, differentiation, proliferation, regenerative endodontic treatment, stem cells from the apical papilla

The advantages of regenerative endodontic treatment (RET) include the possibility of further root development, reinforcement of the dentinal walls by deposition of hard tissue, and posttreatment vitality response (1).

One of the most important aims in RET is to create a healing environment for regeneration so that sealing material can be placed on top of the blood clot. Thus, biocompatible sealing materials are essential. The sealing material should prevent bacterial or toxin leakage, show biocompatibility, and enhance cell proliferation and differentiation. Mineral trioxide aggregates (MTAs), bioceramics, and tricalcium silicate-based materials, such as Biodentine (Septodont, Saint-Maur-des-Fossés, France) and RetroMTA (BioMTA, Seoul, Korea), have been recommended for placement on top of blood clots as a sealing material (2). Bioceramics have several favorable properties, including the ability to induce hard tissue formation and biocompatibility; they are also nontoxic, nonresorbable, and unaffected by blood contamination (3). Moghaddame-Jafari et al (4) showed that white MTA can induce the proliferation of murine odontoblast-like and undifferentiated pulp cells. D'Antò et al (5) evaluated the ability of MTA to support human mesenchymal stem cell (hMSC) adhesion, proliferation, and migration. The results showed that MTA was able to enhance hMSC adhesion, growth, and migration. Biodentine has been reported to be biocompatible and bioactive and to be able to induce the osteogenic differentiation and mineralization of dental pulp and mesenchymal stem cells (6–11). An *in vitro* study showed that RetroMTA has a biocompatibility on human pulp-derived cells comparable with ProRoot MTA (Dentsply, Tulsa, OK) (12). This material is quite new, and only a few studies have investigated its properties.

## Significance

Guidelines on RET are underinvestigated. This study provides information for the selection of sealing materials for RET that should stimulate stem cell proliferation and differentiation, leading to pulp-dentin complex repair. SCAPs were used because they are more clinically relevant.

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