A Comparison of Coronal Tooth Discoloration Elicited by Various Endodontic Reparative Materials

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Abstract

Introduction: The purpose of this study was to evaluate coronal tooth discoloration of ProRoot MTA (Dentsply Tulsa Dental, Johnson City, TN), white ProRoot MTA, EndoSequence Root Repair Material (Brasseler USA, Savannah, GA), MTA Angelus (Angelus Solucoes Odontologicas, Londrina, Brazil), and Biodentine (Septodont, Saint Maur des Fosses, France) when used in an *ex vivo* pulpotomy model. **Methods:** Freshly extracted mandibular third molars were collected and stored in 1% chloramine-T solution. Teeth were randomly assigned into 6 groups ($n = 15$) and stored individually in phosphate buffered saline at 37°C in 100% humidity. A standardized endodontic access was made in 5 groups. A 3-mm-thick increment of reparative material was placed on the pulpal floor, covered by glass ionomer, and the access opening restored with composite. Color (Commission Internationale de l'eclairage L*a*b*) was recorded with the Vita Easy Shade spectrophotometer (VITA Zahnfabrik, Bad Säckingen, Germany) on the midbuccal surface at baseline; after access preparation; after material placement; and then after 1, 7, 30, and 60 days. Changes in Commission Internationale de l'eclairage L*a*b* were measured for each experimental group and compared with ProRoot MTA (positive control) and no treatment (negative control) using the following equation: $\Delta E = ([Li - L0^*]^2 + [ai - a0^*]^2 + [bi - b0^*]^2)^{1/2}$. The mean results were analyzed within each group and between groups using the Friedman 2-way analysis post hoc test ($P < .05$). **Results:** There were no significant differences between white ProRoot MTA, MTA Angelus, and the positive control group. EndoSequence Root Repair Material and Biodentine produced significantly less discoloration than white ProRoot MTA, MTA Angelus, and ProRoot MTA. **Conclusions:** Under the conditions of this study, EndoSequence and Biodentine had significantly less discoloration compared with white ProRoot MTA, MTA Angelus, and ProRoot MTA. The potential for discoloration may or may not correlate when materials are used clinically. *(J Endod 2016;42:470–473)*

Key Words

Biodentine, EndoSequence Root Repair Material, MTA Angelus, ProRoot MTA, tooth discoloration

Esthetics play an important role in dentistry, and discoloration of a single tooth can have a significant impact on one's quality of life (1). Many materials used in endodontic procedures can lead to tooth discoloration and an unesthetic outcome. Mineral trioxide aggregate (MTA; Dentsply Tulsa Dental, Johnson City, TN), composed of modified Portland cement with added bismuth oxide (2, 3), was introduced in 1993. In addition to its use as a root-end filling material, it has also been used for pulp capping and pulpotomies, root and coronal perforation repairs, apexification, apexogenesis, regeneration, and as a root canal filling material (4). It has been shown to be a biocompatible material with little cytotoxicity (5). Even with its many ideal characteristics as an endodontic reparative material, one area of concern with the use of MTA is tooth discoloration. Gray ProRoot MTA (Dentsply Tulsa Dental) has been shown in multiple reports to cause tooth discoloration (6–8). When occurring in the esthetic zone, this can be a significant area of concern for many patients. In response to the discoloration traits noted with MTA, White ProRoot MTA (wMTA, Dentsply Tulsa Dental) containing decreased amounts of iron, aluminum, and magnesium was developed (4, 9). ProRoot wMTA and MTA Angelus (Angelus Solucoes Odontologicas, Londrina, Brazil) are 2 commercially readily available products containing wMTA. Felman and Parashos (10) and Belobrov and Parashos (11) showed minor coronal discoloration with wMTA when used in regeneration procedures.

The potential tooth discoloration associated with the use of MTA has led to a search for an alternative endodontic reparative material similar in composition that will not cause tooth discoloration. Two of these materials are Biodentine (Septodont, Saint Maur des Fosses, France) and EndoSequence Root Repair Material (ERRM; Brasseler USA, Savannah, GA). Biodentine is a dentin restorative material composed of tricalcium silicate, calcium carbonate, zirconium oxide powder, and calcium chloride liquid (12). According to the manufacturer, Biodentine has similar indications for use as MTA along with a faster setting time (12). ERRM is composed of calcium silicates, zirconium oxide, tantalum pentoxide, calcium phosphate monobasic, and filler agents. In an animal model, Chen et al (13) showed that ERRM is a biocompatible material with good sealing ability and had a better tissue healing response than MTA.

None of these materials, MTA Angelus, Biodentine, or ERRM, has been examined regarding tooth discoloration compared with ProRoot MTA. Therefore, the purpose of this study was to compare the coronal discoloration of gray ProRoot MTA, ProRoot wMTA, MTA Angelus, Biodentine, and ERRM when used in a pulpotomy procedure.

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Published by Elsevier Inc. on behalf of American Association of Endodontists.

http://dx.doi.org/10.1016/j.joen.2015.10.013

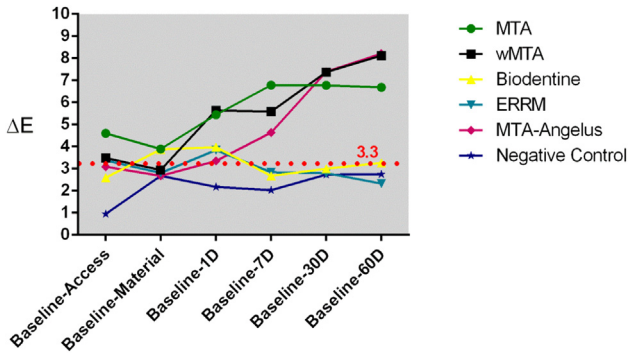

Figure 1. Mean ΔE value changes at each time interval. The *dotted line* represents clinically noticeable discoloration of $\Delta E \geq 3.3$.

Materials and Methods

Sample Preparation

Ninety mandibular impacted deidentified third molars treatment planned for extraction were collected and stored in 1% chloramine-T solution. All teeth were evaluated under a dental operating microscope (Global Surgical, St Louis, MO) at 12.8× magnification to be completely intact and free of restorations, cracks, and/or defects. Each tooth was stored separately in phosphate buffered saline solution at 37°C ± 1°C in 100% humidity throughout the study. The teeth were randomly assigned to 6 groups ($n = 15$). The teeth in groups 1 through 5 were endodontically accessed with #4 round (Brasseler USA) and Endo-Z burs (Brasseler USA) in a high speed handpiece with water spray under a dental operating microscope. The buccal enamel-dentin thickness was standardized to 3 mm using spring calipers. Teeth were irrigated with 6% sodium hypochlorite and dried. All materials were mixed according to manufacturer recommendations and placed to a 3-mm thickness above the orifice level and allowed to set. Groupings by material were as follows: group 1: ProRoot MTA (positive control), group 2: ProRoot wMTA, group 3: Biodentine, group 4: ERRM, and group 5: MTA Angelus; group 6 was not prepared (negative control). A 3-mm thickness of glass ionomer (ChemFil Rock shade A-1; Dentsply Caulk, Milford, DE) was placed over each material and allowed to set. The remaining access opening of each tooth was filled with a composite (Esthet•X HD, Dentsply Caulk). The shade of the composite was matched to the coronal tooth structure by a prosthodontist and confirmed with a spectrophotometer (VITA Easy Shade; VITA Zahnfabrik, Bad Säckingen, Germany).

Spectrophotometric Analysis

Color was recorded using the Commission Internationale de l'eclairage (CIE) L* a* b* color space. Changes in CIE L*a*b* were measured for each experimental group and compared with ProRoot MTA (group 1 [positive control]) and no treatment (group 6 [negative control]) using the equation $\Delta E = ([Li - L0^*]^2 + [ai - a0^*]^2 + [bi - b0^*]^2)^{1/2}$. ΔL represents the change in luminosity from black (0) to white (100), Δa represents the change in the red (−80) to green (+80) parameter, and Δb represents the change in the blue (−80) to yellow (+80) parameter. Color values were recorded on all 90 teeth using the VITA Easy Shade spectrophotometer under consistent lighting conditions by the same operator at all time intervals. The device was calibrated before each measurement per the device instructions. Each measurement was repeated 3 times on the midbuccal surface of each tooth (at baseline, after access preparation,

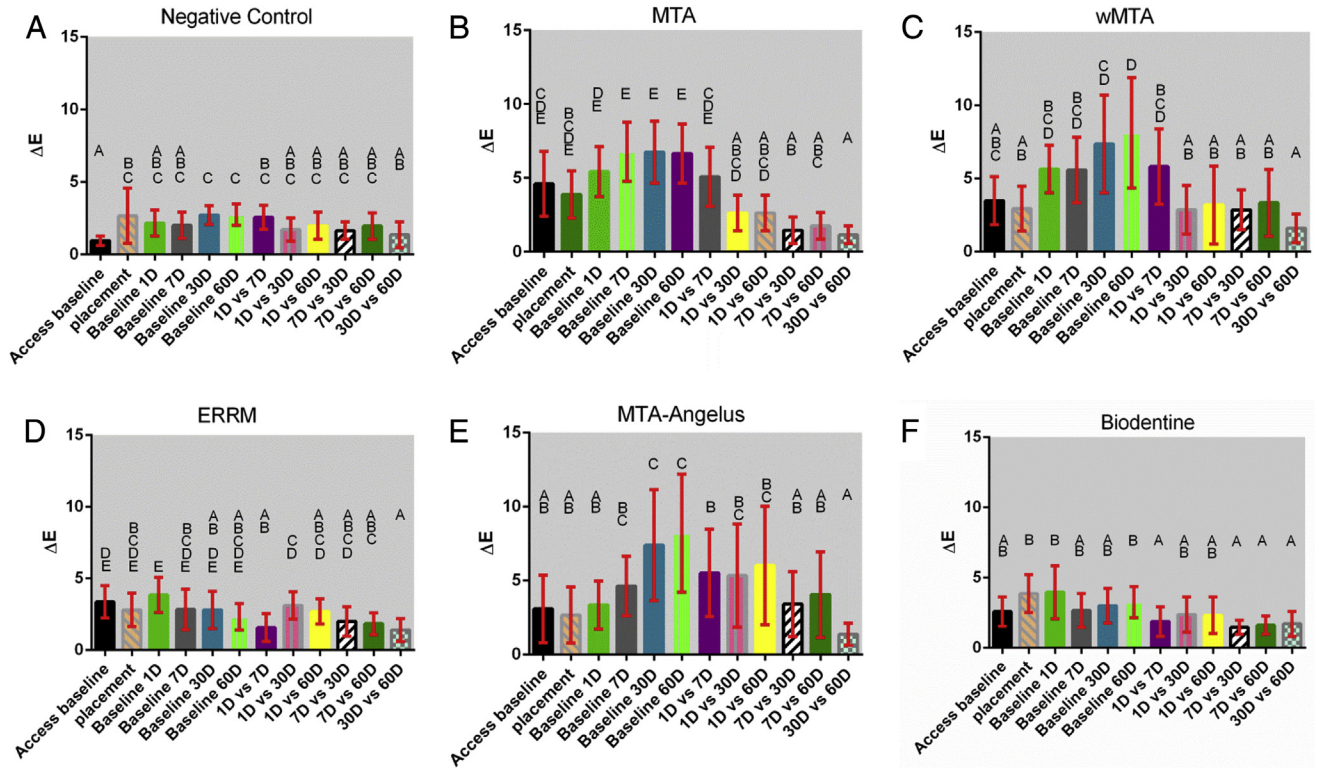

Figure 2. Mean ΔE changes between each time interval within each group: (*A*) negative control, (*B*) MTA, (*C*) wMTA, (*D*) ERRM, (*E*) MTA Angelus, and (*F*) Biodentine. The *vertical lines* represent the standard deviation. The capital letters above each interval represent statistically similar groups. Groups are statistically different if they do not have the same capital letter above them.