Color Stability of White Mineral Trioxide Aggregate in Contact with Hypochlorite Solution

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Abstract

Introduction: One of the uses of white mineral trioxide aggregate (MTA) is as an apical barrier in immature teeth. Although this treatment has been reported to have high success rates, a number of cases of discoloration have been noted. The aim of this research was to investigate the color stability of white MTA in contact with various solutions used in endodontics. **Methods:** The change in color of white MTA after immersion in water, sodium hypochlorite, or hydrogen peroxide was assessed by viewing the color change on digital photographs and also by using a spectrophotometer. White MTA, white Portland cement, and bismuth oxide were assessed. The changes in the material after immersion in the different solutions were assessed by x-ray diffraction analysis and Fourier transform infrared spectroscopy. **Results:** Immersion of white MTA and bismuth oxide in sodium hypochlorite resulted in the formation of a dark brown discoloration. This change was not observed in Portland cement. X-ray diffraction analysis and Fourier transform infrared analysis displayed the reduction of sodium hypochlorite in contact with bismuth oxide and MTA to sodium chloride. **Conclusions:** Contact of white MTA and other bismuth-containing materials with sodium hypochlorite solution should be avoided. *(J Endod 2014;40:436–440)*

Key Words

Bismuth oxide, characterization, color stability, dental material, radiopacifier, root-end filling materials

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Mineral trioxide aggregate (MTA) is composed of a mixture of Portland cement and bismuth oxide (1). MTA was introduced for use as a root-end filling material and for repair of root perforations. However, it is currently used for a variety of applications including pulp capping, apexification procedures, as a dressing over pulpotomies, and many other endodontic procedures (2). Initially only gray MTA was available; however, because of potential discoloration effect of gray MTA, white MTA has been introduced into endodontic treatment for the same purposes. No difference was observed in the outcome of treatment (3) and biocompatibility (4) of the different variants of MTA. White MTA (MTA Branco; Angelus, Londrina, Brazil) has been used to seal root perforations where the gray version (MTA Angelus) had been reported to cause discoloration of the marginal gingiva (5).

Tooth discoloration has been reported with the use of both gray and white MTA (MTA Angelus). In fact, both types of MTA induced significant decreases in L*, a*, and b* values (Commission Internationale de l'éclairage), with the color change being greater with gray MTA. Gray MTA led to clinically perceptible crown discoloration after 1 month, whereas the total color change caused by white MTA exceeded the perceptible threshold for the human eye after 3 months. This suggests that the application of gray MTA in the aesthetic zone should be avoided, whereas white MTA should be used with caution when filling pulp chambers with the materials (6). Crown discoloration has been reported when MTA was used as a dressing for molar pulpotomies instead of calcium hydroxide (7), as an apical barrier after initial calcium hydroxide therapy (MTA Angelus) (8), for apexification procedures of replanted teeth (ProRoot MTA) (9), for treatment of fractured teeth (10), for treatment of root resorption (MTA Angelus) (11), and for revascularization of immature necrotic permanent teeth (12).

Attempts at removal of MTA from the root canal revealed a change in color of the MTA (13). After the removal of MTA from the tooth where it was placed as a dressing, a significant color change was observed in the tooth crown, which was further improved with internal bleaching (14). Application of dentin bonding agent before placement of MTA may prevent tooth discoloration (15).

The recommendations by clinicians to date have been to use MTA cautiously in the aesthetic zone. The aim of this research was to investigate the color stability of white MTA in contact with various solutions used in endodontics.

Materials and Methods

Materials used in this study included Portland cement (PC) (CEM 1, 52.5 N; LaFarge Cement, Birmingham, UK), ProRoot MTA (Dentsply Tulsa Dental, Johnson City, TN; lot number 09001920), and bismuth oxide (Sigma Aldrich, St Louis, MO). The cements were mixed at a liquid-to-powder ratio of 0.30.

The cements were cured for 24 hours at 37°C and 100% humidity, after which the cements and bismuth oxide powder were immersed in different solutions for 24 hours:

1. Water
2. Sodium hypochlorite solution (Milton; Laboratoire Rivadis, Louzy, France)
3. Hydrogen peroxide (Bells Sons & Co Ltd, Southport, UK)

The cements and bismuth oxide powder were then dried and tested.

Assessment of Color Stability

Cylindrical specimens 10 mm in diameter and 2 mm high were prepared for MTA and Portland cement by curing in the molds for 24 hours at 100% humidity and 37°C.

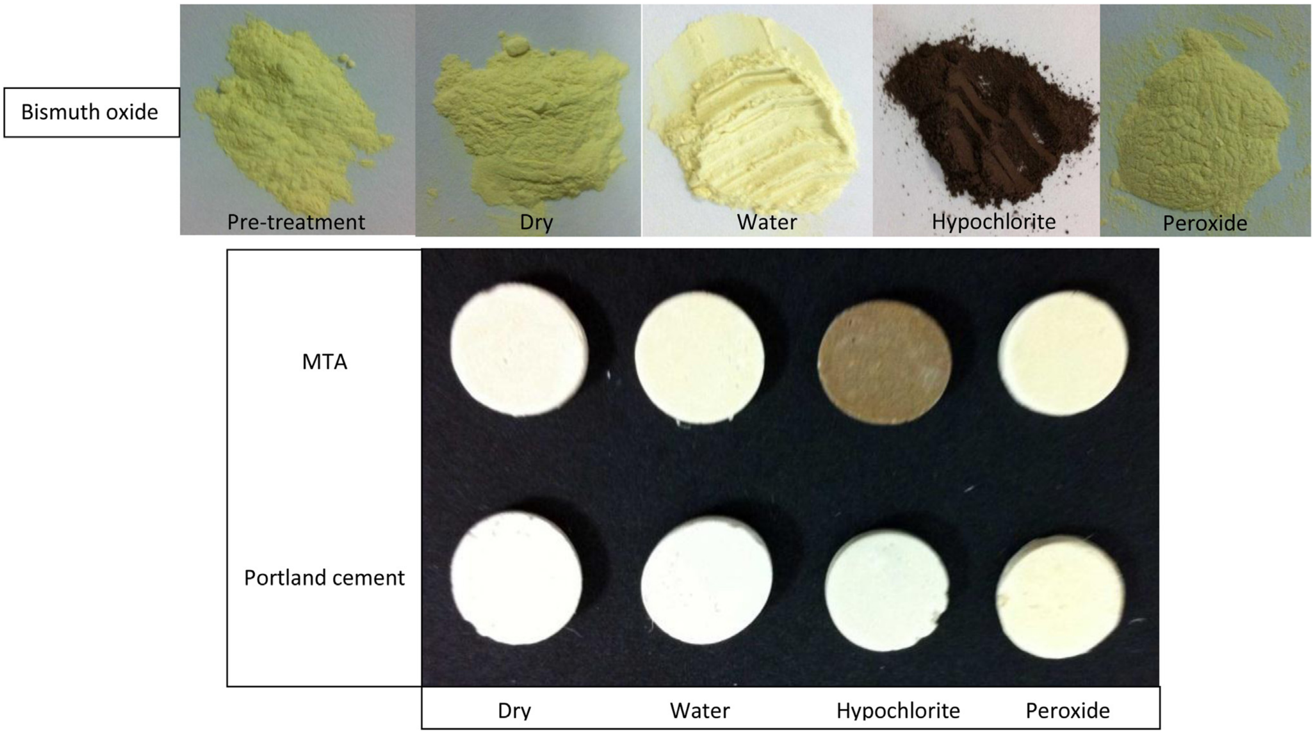

Figure 1. Photographs of bismuth oxide powder, ProRoot MTA, and Portland cement before and after immersion in the different solutions.

The color of the specimens was assessed by using a spectrophotometer (Minolta CM-50Bi; Minolta Co Ltd, Osaka, Japan). The Commission Internationale de l'éclairage system was used to calculate the difference in color. The value of the luminance (L) and the coordinates of the chromatic component (a and b) were measured before and after immersion in different solutions. Color photographs of the specimens

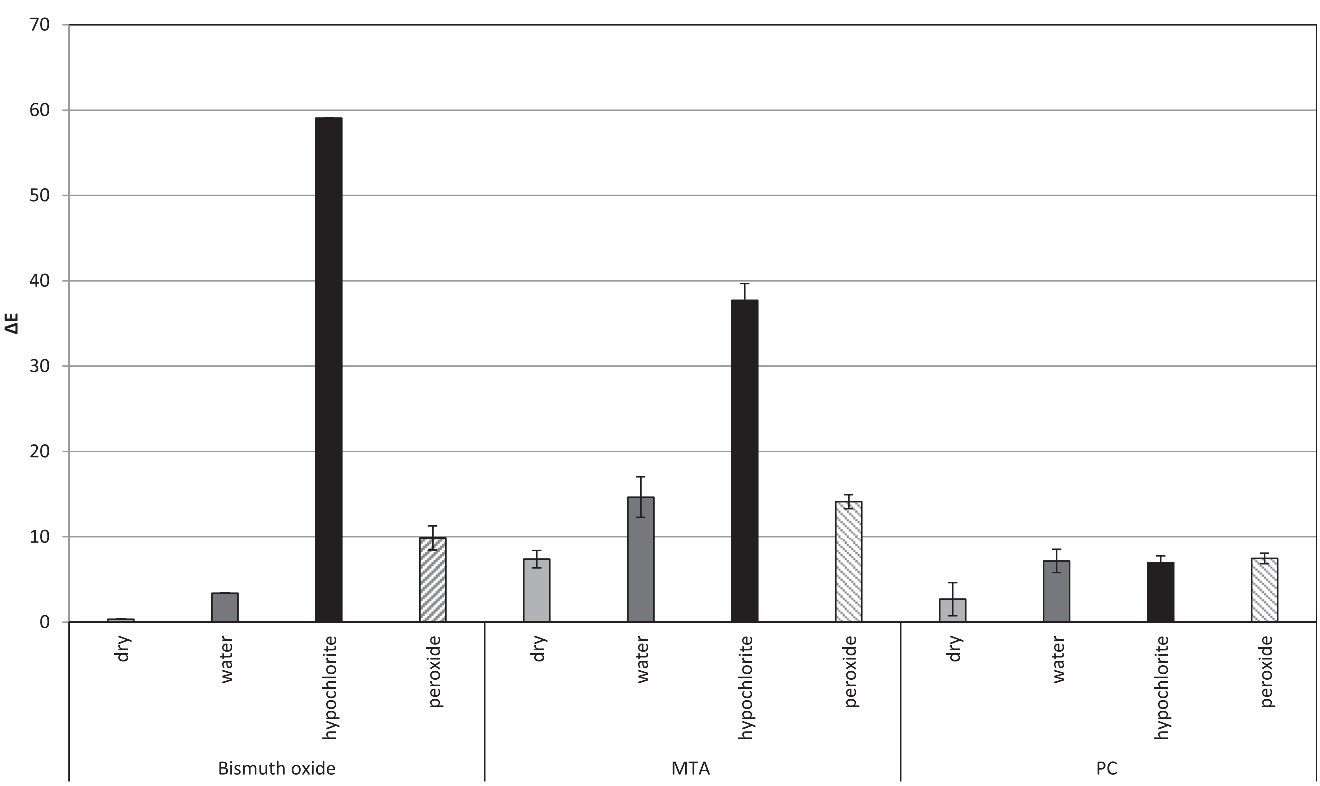

Figure 2. Color change recorded by spectrophotometer for the different test materials after immersion in different solutions.