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Discoloration of MTA Filled Teeth With and Without Dentine Bonding Agent.

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ABSTRACT

Background: Mineral trioxide aggregate (MTA) is a biocompatible material with high sealing ability that has been applied for various uses in endodontics. However, its tooth discoloration effect is a factor of major concern that limits MTA application in aesthetically sensitive areas. Objective: This study aimed to investigate the effect of applying Dentine Bonding Agent (DBA) before MTA sealer, on preventing -or reducing- its tooth discoloration potential. **Methods**: A total of 40 teeth crowns were used for the study. Specimens were randomly divided into two experimental (MTA and DBA + MTA) and two control (amalgam and distilled water) groups (n=10). Pretreatment color was recorded and color difference was measured using Vita Easyshade® spectrophotometer at periods of 3, 10, and 30 days. Data were analyzed by one-way analysis of variance (ANOVA) and LSD post hoc tests. **Results**: The mean tooth discoloration produced by DBA +MTA was significantly lower than that produced by MTA alone. **Conclusion**: Application of DBA before MTA may prevent tooth discoloration.

Keywords: Dentine Bonding Agent, Discoloration, MTA.

INTRODUCTION

Coronal discoloration of endodontically treated teeth is one of the main challenges for dentists.The most important reason for tooth discoloration after endodontic treatment is the sealer remnants in pulp chamber and its distribution into dentinal tubules.[1] Thus, in addition to the ideal properties of sealers, their discoloration potential could play a significant role in choosing the appropriate root canal sealer in clinic.[2,3]

Mineral Trioxide Aggregate (MTA) is a biocompatible material with high sealing ability, thus it has various applications in endodontic treatment, including sealing of perforations, pulp capping, root canal filling and stimulation of apical plug formation.[4,5] MTA cement contains different oxide compounds, including sodium, potassium, calcium, silicon, magnesium, aluminium and ferric oxides. It was introduced to dentistry by Torabinejad and White in the mid 1990s.[6,7] MTA was firstly introduced in grey color, which caused severe tooth discoloration, raising esthetic concerns about the material. More recently, a tooth colored formula –white MTA- was introduced to avoid this short coming. Except for lower concentrations of metal oxides in white MTA, the chemical properties and mechanism of action are somewhat unchanged in comparison to grey MTA.[7-9] Despite all efforts employed to produce non-discoloring MTA, studies have reported tooth discoloration after application of both kinds of the material. This discoloring potential limits MTA application in treatment of aesthetically sensitive areas.[9-14]

Although many studies have reported the discoloration potential of MTA,[2,3,9,14-18] only a few studies have been interested in finding a solution for this issue.[11,12,14] Thus, the current study was conducted to investigate the effect of applying Dentine Bonding Agent (DBA) before MTA sealer in an attempt to reduce its tooth discoloration effect.

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MATERIALS AND METHODS

Specimens' preparation and grouping

A total of forty freshly extracted incisors and canines were selected for the current study. The teeth were free of caries, cracks, restorations, and/or pathologic discoloration. Teeth were cleaned up by the use of rubber cup and pumice to remove debris and extrinsic stains, and then stored at 37°C in sterile saline which was changed every 7 days throughout the experiment.

The roots were resected 2 mm below the cemento-enamel junction using a diamond disc and the pulp chamber of each crown was mechanically cleaned using K-files (Dentsply Maillefer, Tulsa, Okla, USA) and gates-glidden drills (Dentsply Maillefer, Tulsa, Okla, USA). In order to eliminate the smear layer, the pulp chamber was irrigated with 3% sodium hypochlorite solution and 17% ethylene diamine tetra acetic acid (EDTA) (Pulp dent, Watertown, MA, USA), washed with distilled water and dried with paper point. Specimens were then randomly assigned to two experimental and two control groups, 10 specimens each. In Group I (MTA), PD MTA White™ (Produits Dentaires SA, Vevey, Switzerland) was mixed according to manufacturer's instructions and placed into the pulp chambers via cervical access. In Group II (DBA + WMTA), two layers of DBA (Clearfil SE Bond, Kurary, Okayama, Japan) were firstly applied in the pulp chamber and light cured for 40 seconds, and then 3mm of WMTA was placed in the same manner as in Group I. In group III (positive control), the pulp chamber was filled with amalgam (Megalloy EZ, Dentsply Maillefer, Okla, USA) while in group IV (negative control), the pulp chambers were only washed out with distilled water and dried.The apical access of specimens was sealed with sticky wax and stored in an incubator at 37°C.

Evaluation of tooth Discoloration

Vita Easyshade® spectrophotometer (Vita Zahnfabrik H. Rauter GmbH & Co. KG, Bad Sackingen, Germany) was used in ''tooth single'' mode for evaluation of the color coordinates (L*a*b*). The spectrophotometer was calibrated according to manufacturer's instructions, and the active point was placed at right angle to the middle third of the facial surface of the crown, measuring color for three times, which were averaged. Pretreatment color readings were taken and considered as baseline data to which subsequent readings at 3, 10, and 30 days were compared. The color difference (ΔE) at each time interval was calculated according to the following formula:

$\Delta E = [(\Delta L^*)\ 2 + (\Delta a^*)\ 2 + (\Delta b^*)\ 2\ ]½$

Where L* is the color value (lightness), a* and b* denote chromaticity. ΔE value equal or larger than 3.5 was considered a clinically perceptible color change.[19]

Statistical analysis

The values of ΔE were submitted to the Kolmogorov-Smirnov normality test. Data were then analyzed by one-way analysis of variance (ANOVA) and LSD post hoc tests for individual comparisons between groups, at a significance level of 5%.

RESULTS

Means and standard deviations of ΔE are shown in [Tables 1 & 2] and graphically represented in [Figure 1]. The highest color change was recorded for group III (positive control) after 30 days of application (7.23 ± 1.00), while the lowest value was observed for group IV (negative control) group after 3 days of the experiment (0.12± 0.07). One-way ANOVA was applied to compare the results of the three time intervals in each group. Significant differences were found between the three time intervals of all groups ($p \leq 0.05$), except the negative control one ($p = 0.592$). Further analysis by LSD test for group I (MTA) among the three time intervals revealed a significant difference in ΔE between each of them ($p \leq 0.05$). Regarding group II (DBA + MTA), a significant color change was recorded between 10 and 30 days ($p= 0.002$), while the change between 3 and 10 days was insignificant ($p= 0.261$). In general, it was noticed that the highest color change took place at the 30 days period in each group.

Table 1: Comparison of color changes (ΔE) between time intervals for each group

Time intervals	ΔE values (mean ±SD)			
	I-MTA	II- DBA + MTA	III- positive	IV- negative
a. 3 days	0.74 ± 0.18c	0.51± 0.22b	5.62 ± 0.99b	0.12± 0.07a
b. 10 days	2.71± 0.87b	0.84± 0.09b	5.94 ± 0.82a, b	0.16 ± 0.05a
c. 30 days	4.69 ± 1.16a	1.59± 0.73a	7.23 ± 1.00a	0.16± 0.09a
p-value	0.000	0.007	0.045	0.592

Means with the same superscripted letter in the same column are not significantly different at $p \leq 0.05$. SD: Standard deviation

Table 2: Comparison of color changes (ΔE) between groups at each time interval

Groups (materials)	ΔE values (mean ±SD)		
	a. 3 days	b. 10 days	c. 30 days
I-MTA	0.74 ± 0.18b	2.71± 0.87b	4.69 ± 1.16b
II- DBA + MTA	0.51± 0.22b	0.84± 0.09c	1.59± 0.73c
III- positive	5.62 ± 0.99a	5.94 ± 0.82a	7.23 ± 1.00a
IV- negative	0.12± 0.07b	0.16 ± 0.05c	0.16± 0.09d
p-value	0.000	0.000	0.000

Means with the same superscripted letter in the same column are not significantly different at $p \leq 0.05$. SD: Standard deviation

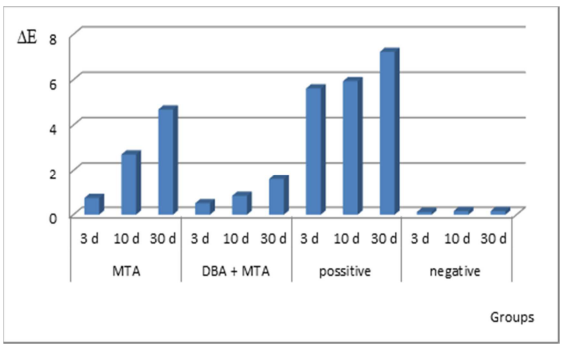

Figure 1: Mean ΔE values of the studied groups

To analyze the differences in color change between the tested materials at each time interval, one-way ANOVA test was applied again.Significant differences were recorded between the four groups at each time interval (p= 0.000). Multiple comparisons by LSD test at the first period (3 days) showed insignificant differences between groups I and II (p= 0.502), I and IV (p= 0.08) and also between groups II and IV (p= 0.253). On the other hand, the positive control group showed a significant increase in ΔE when compared to each of group I, II and IV (p=0.000). Regarding the second period of 10 days, significant differences were observed between each of the four groups, except for that between group II and IV which showed an insignificant difference (p=0.091). At 30 days period of the study, the color changes of the four groups were significantly different from each other ($p \leq 0.05$).

DISCUSSION

One of the most common causes why patients seek dental care is teeth discoloration, especially after endodontic treatment.[2,20] In spite of the high biocompatibility and sealing ability of MTA, its discoloration potential remains a factor of major concern.[3,21,22] The composition of MTA is similar to that of Portland cement, with addition of bismuth oxide for radiopacity.[7,23,24]

The present study was designed to investigate the effectiveness of DBA application prior to MTA, to prevent its discoloration effect on endodontically treated teeth.

Spectrophotometers are highly sensitive devices which can determine minute color changes that may not be clinically detectable.[25,26] Therefore, Vita Easyshade ® digital spectrophotometer was employed in the current study to evaluate tooth discoloration by determining CIE L*a*b* variables and ΔE. It was selected because it provides accurate shade determination.[27]

The current results indicated that coronal discolorations produced by MTA, either with or without DBA, were not clinically detectable ($\Delta E < 3.5$) during the periods of 3 or 10 days of materials' application. This could be because the sealers did not show immediate chemical changes that could affect their colors. These results came in agreement with previous studies in which tooth discoloration occurred after longer periods.[1,10,28,29]

After 30 days of placement, ΔE value of MTA sealed teeth exceeded the clinical perception threshold of 3.5, and the coronal discoloration became clinically observable. These results were coinciding with other studies that showed tooth discoloration after using MTA.[30-33] According to previous studies, this discoloration potential of MTA has been attributed to the bismuth oxide content of the material, or to other elements such as Fe, Mn and Cu which are known to have strong colors in oxide form.[16,23,34] In contrast to the present results, Ioannidis et al,[35] concluded that MTA did not induce clinically perceptible crown discoloration, even after 3 months of placement. These different results could be explained by the differences in materials and methodology utilized in the study.

On the other hand, teeth in which DBA was applied before MTA, showed only mild discoloration which was not visually detectable till the end of the experiment. The role of DBA in reducing the discoloration effect of MTA can be attributed to the sealing ability of dentin bonding agent that seals dentinal tubules before MTA application, as described in previous researches.[11,31]

CONCLUSION

Within the experimental conditions of this study, it can be concluded that the application of DBA prior to MTA had a significant role in reducing the tooth discoloring effect of the material. Accordingly, it can be recommended to seal dentinal tubules by DBA before using MTA to prevent further tooth discoloration. However, since DBA may interfere with the sealing ability of MTA, it is advisable to conduct further studies to investigate the effect of DBA on other properties of MTA.

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