

Evaluation of the use of mineral trioxide aggregate and light curing glass ionomer cement in coronal bleaching

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SUMMARY

The aim of this study was to compare the effectiveness of white mineral trioxide aggregate and gray mineral trioxide aggregate with different thicknesses and light curing glass ionomer cement when used as a barrier material in intracoronal bleaching procedures. In this study, 130 freshly extracted, caries free human permanent single rooted maxillary canine teeth were used. The teeth were randomly divided into six experimental groups, and positive and negative control groups. The specimens in the experimental groups 1, 2 and 3 received white mineral trioxide aggregate, gray mineral trioxide aggregate and light curing glass ionomer cement with a thickness of 2 mm, respectively. The specimens in the experimental groups 4, 5 and 6 received white mineral trioxide aggregate, gray mineral trioxide aggregate and light curing glass ionomer cement with a thickness of 5 mm, respectively. The positive control group received no barrier material and the negative control group did not undergo bleaching. There was no difference in leakage between gray mineral trioxide aggregate and white mineral trioxide aggregate ($p>0.001$). In conclusion, both gray and white mineral trioxide aggregate provided good coronal seal and decreased the amount of coronal leakage.

Key words: Coronal bleaching, mineral trioxide aggregate, light curing glass ionomer cement

ÖZET

Mineral trioksit agregat ve ışıkla sertleşen cam iyonomer simanın devital ağartma işlemlerinde kullanımının değerlendirilmesi

Bu çalışmanın amacı farklı kalınlıklarda yerleştirilen beyaz mineral trioksit agregat, mineral trioksit agregat, gri mineral trioksit agregat ve ışıkla sertleşen cam iyonomer simanın devital ağartma işlemlerinde bariyer maddesi olarak kullanımının etkinliğinin değerlendirilmesidir. Çalışmada 130 adet yeni çekilmiş, çürüksüz, daimi tek köklü insan üst çene kanin dişi kullanıldı. Dişler rastgele altı gruba ve pozitif ile negatif kontrol gruplarına ayrıldı. Deney grupları 1, 2 ve 3'deki örnekler sırasıyla 2 mm kalınlıkta beyaz mineral trioksit agregat, gri mineral trioksit agregat ve ışıkla sertleşen cam iyonomer siman yerleştirildi. Deney grupları 4, 5 ve 6'daki örnekler sırasıyla 5 mm kalınlıkta beyaz mineral trioksit agregat, gri mineral trioksit agregat ve ışıkla sertleşen cam iyonomer siman yerleştirildi. Pozitif kontrol grubundaki örnekler bariyer yerleştirilmedi ve negatif kontrol grubundaki örnekler ağartma işlemi uygulanmadı. Beyaz ve gri mineral trioksit agregatlar arasında sızıntı miktarı açısından farklılık bulunmadı ($p>0.001$). Sonuç olarak hem gri hem de beyaz mineral trioksit agregat iyi koronal kaplama sağlayıp, koronal sızıntı miktarını azaltmıştır.

Anahtar kelimeler: Devital ağartma, mineral trioksit agregat, ışıkla sertleşen cam iyonomer siman

Introduction

Non-vital bleaching is most commonly applied to endodontically treated discolored anterior teeth. Patients refer to dentists just for esthetic purposes, so clinicians should take care to avoid microleakage during the bleaching procedures. Microleakage is a reason of the failure of even a well-treated tooth. It is important to know that not only a hermetical apical sealing but also a tight coronal sealing are important for success. The main complication of intracoronal bleaching is external root resorption (1). Nutting and Poe reported that the application of intraorifice barrier is essential to prevent penetration of the liberated oxygen from the bleaching material into the dentin tubules and periodontal tissues, as well as into the periapical region causing a painful reaction (2). Additionally, in order to eliminate the incidence of external root resorptions, Friedman et al. recommended the placement of a protective cervical base (3). Many other authors also recommended the use of intraorifice barrier (4-7). Therefore, isolation of root-canal with an intraorifice barrier is essential to avoid bacterial recontamination and penetration of bleaching materials into the root-canal during the bleaching procedures (8). A myriad of commonly used temporary and permanent restorative materials have been studied as intracoronal barriers. Characteristics that qualify a restorative material as an ideal intracoronal barrier include ease and speed of placement, sealing efficacy, and high bond strength (9-12). The ideal properties of a coronal barrier have been proposed by Wolcott et al. to include the following characteristics: easily placed, bonds to tooth structure, seals against microleakage, distinguishable from natural tooth structure (13).

A variety of restorative materials have been used in attempt to produce a barrier (13,14). One of these materials, mineral trioxide aggregate (MTA) (Tulsa Dental, Tulsa, OK, USA) has been evaluated for a wide

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variety of applications (15). These applications include pulp capping, apical barrier, perforation repair and root-end filling material. Because of its superior sealing ability and resistance to microleakage, MTA has gained attention (16). MTA, composed mainly of tricalcic silicate, tricalcic alluminate, bismuth oxide, is particular endodontic cement. It is made of hydrophilic fine particles that harden in the presence of dampness or blood. It is biocompatible, radiopaque and it is harder to infiltrate, compared to classic materials such as amalgam, cements, Super-EBA, and IRM (17). Recently, gray color and white color MTA have been available in the markets. The only chemical difference between the gray and white MTA is the reduced iron content in white MTA, and physically the particul size of white MTA is smaller to enhance handling and placement characteristics (8).

Vitremer (3M ESPE, St. Paul, USA) light curing glass ionomer cement was proved to be an effective sealant to be used in moist environment such as root resections. This material presents no water sensitivity and has proved its biocompatibility (18). However, there are only a few studies that evaluate the material as a coronal barrier material.

The purpose of this study was to evaluate the coronal leakage of intraorifice barriers with different thicknesses; gray MTA, white MTA and light curing glass ionomer cement using a dye penetration model.

Material and Methods

One-hundred and thirty extracted, anterior human teeth were used in this study. All teeth were cleaned free of attached soft tissue and stored in normal saline solution. The roots were shaped with ProTaper (Dentsply Maillefer CH-1338 Ballaigues, Switzerland) to a size 30# and obturated with gutta percha (Dentsply Tulsa Dental, Tulsa, OK) and AH26 (Dentsply De Trey, Konstanz, Germany) sealer. After the removal of coronal gutta percha, the teeth were

randomly divided into 6 groups. In group 1, 20 teeth received 2 mm of gray MTA. In group 2, 20 teeth received 2 mm of white MTA. In group 3, 20 teeth received 2 mm of light curing glass ionomer cement (Vitremer). In group 4, 20 teeth received 5 mm of gray MTA. In group 5, 20 teeth received 5 mm of white MTA. In group 6, 20 teeth received 5 mm of light curing glass ionomer cement. The teeth in the positive control group received no barrier material, and the teeth in the negative control group were covered with nail polish. Each tooth was then bleached using sodium perborate and water. The bleaching agents were replaced every 7 days over three weeks. Following the bleaching procedures, teeth were decoronated, immersed in methylene blue dye for 48 hours, and then were decalcified, dehydrated, and cleared.

The maximum linear leakage in apical direction, through the interface between the dentin and barrier material, was recorded for each specimen. The leakage scores from 0 to 4 were assigned as follows: Score 0 no leakage, score 1 from 0.1 to 0.5 mm of leakage, score 2 from 0.6 to 1 mm of leakage, score 3 from 1.1 to 2 mm of leakage, score 4 from 2.1 mm to apical foramen.

The maximum amount of linear dye penetration was measured under a stereomicroscope and statistical analyses were carried out using the Mann-Whitney test.

Results

All controls behaved as expected (Table I). There was no statistically significant difference in leakage between gray MTA and white MTA ($p > 0.001$). Both groups that received 2 mm of gray and white MTA leaked significantly less than group 3 that received 2 mm of glass ionomer cement ($p < 0.001$). There was no statistically difference in leakage between the groups 4, 5 and 6 that received 5 mm of barrier material when compared with each other.

Table I. The leakage scores of coronal barriers

Coronal barrier	Microleakage values					n
	0	1	2	3	4	
Gray mineral trioxide aggregate (2 mm)	6	10	3	1	-	20
Gray mineral trioxide aggregate (5 mm)	8	11	1	-	-	20
White mineral trioxide aggregate (2 mm)	7	11	2	-	-	20
White mineral trioxide aggregate (5 mm)	9	10	1	-	-	20
Vitremer (2 mm)	2	7	6	3	2	20
Vitremer (5 mm)	5	10	4	1	-	20

Discussion

Penetration of bleaching agents towards the periodontal ligament may cause localized damage and initiate an inflammatory reaction resulting in bone and root resorption (5). The results of our study showed that although the placement of intraorifice barrier did not completely prevent the dye leakage through the dentin-barrier material interface, since significantly increased leakage was observed in the positive control group, the use of barriers during bleaching barriers is essential. This result is agree with that of Heller et al. who used different materials for the same purpose (19).

Coronal leakage can be evaluated with different methodologies. Among these we could mention fluid filtration (20) and bacterial leakage tests (21). However, we agree with Aqrawabi (22) and Xavier et al. (23) who stated that if root end filling materials were able to prevent the leakage of small particles such as dye, they would possibly prevent the penetration of bacteria and their sub-products. Therefore, the microleakage of all tested materials were evaluated with dye penetration method.

The ability of dye penetration methods to demonstrate microleakage has been emphasized in various studies (24,25). In our study the leakage of coronal barriers were compared using the dye penetration method. All specimens in positive control group leaked throughout the canal, thus confirming that coronal barrier material was necessary to prevent microleakage.

Smith et al. recommended that a minimum of 2 mm thickness of barrier material was required to prevent the oxygen liberated from the bleaching (6). Therefore minimum thickness of barriers evaluated in the present study was applied as 2 mm.

Previous leakage studies revealed various results. According to Matt et al. 5 mm thickness of gray MTA demonstrated less leakage than white MTA, apically (26). In contradistinction, Tselnik et al. evaluated the leakage of white MTA, gray MTA and resin-modified glass ionomer and found no difference between the groups which is similar to the results of the present study (8). Despite the various results, both studies recommended gray and white MTA as a coronal or apical barrier. Barrieshi-Nusair and Hammad reported the mineral trioxide aggregate may be preferred over glass ionomer instead of one step technique as a seal intracoronally following root canal treatment to prevent coronal microleakage (27). Analogously, the results of the present study showed that 2 mm thickness of both tested MTA leaked significantly less than light curing glass ionomer. Similar with the re-

sults of the present study, Brito-Júnior et al. reported that MTA presented higher sealing ability than glass ionomer based cement (28).

Vitremer presented the highest rates of dye penetration and in some samples it showed total penetration of methylene blue. Vitremer was tested by Pretorius & Van Heerden and presented excellent results (18). On the other hand, our results are in accordance with other studies in which glass ionomer cement was not good in preventing apical microleakage (29,30).

In conclusion, within the limitations of the methodology applied, the results indicated that regardless of the thickness of the barrier, both gray and white MTA provided good coronal seal and decreased the amount of coronal leakage that may lead to provide higher success rate.

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