

**Research Article**

## **COMPARISON OF DISCOLORATION INDUCED ON CORONAL DENTINE BY AH PLUS AND MTA SEALER IN ENDODONTICALLY TREATED TEETH**

**Hengameh Akhavan<sup>1</sup>, Afsoon Motalebi<sup>2</sup>, Peyman Mehrvarzfar<sup>1</sup>, Mohammad Hasan Salari<sup>3</sup>, Sohrab Toursavakouhi<sup>1</sup> and \*Azin Sadighnia<sup>4</sup>**

<sup>1</sup>*Department of Endodontics, Dental Branch, Islamic Azad University, Tehran, Iran*

<sup>3</sup>*Department of Prosthodontics, Dental Branch, Islamic Azad University, Tehran, Iran*

<sup>4</sup>*Dental Student, Shahidbeheshti University, Tehran, Iran*

\*Author for Correspondence

### **ABSTRACT**

Tooth discoloration is one of the main cosmetic challenges for the patient and the dentist. Endodontic materials can result in crown discoloration and its main reason is the remained sealer in the pulp chamber and its distribution in dentinal tubules. This study evaluates the effect of AH plus sealers and MTA sealer on crown discoloration after the endodontic treatment of extracted teeth. 40 maxillary incisors were randomly divided into four groups, two experimental groups (each group 15 incisors) and two positive and negative control groups (each group 5 incisors). The experimental groups received endodontic treatment with AH plus and MTA sealers and the sealer remnants were removed by cotton pellet. In the next stage the access cavities of experimental groups and the negative group were filled with composite resins and the positive control group with amalgam. Immediately, initial shade of each tooth obtained by the use of Shade Pilot spectrophotometer on labial surface and again this procedure reduplicate one month later, then the discoloration rate ( $\Delta E$ ) for each tooth was calculated. Repeated measured ANOVA test was used for comparing the discoloration between two experimental groups. Results show that there is a significant difference between the levels of discoloring in these 4 groups. While between the experimental groups of AH plus and MTA sealer the discoloration did not have a significant statistical difference (P value > 0.05). Generally, the discoloration rate for both experimental groups was similar and clinically acceptable. Thus it is possible to use both sealers safely in esthetic regions.

**Keywords:** *Tooth Discoloration, Obturation, MTA Sealer, AH Plus Sealer, and Spectrophotometer*

### **INTRODUCTION**

During the recent years, tooth discoloration is a point of interest for patients and professional dentists (Grossman, 1981). Basically, tooth color consists of the contrast of light of dentine and reflecting features of enamel; thus any kind of changes in composition of enamel, dentine or coronal pulp could result in change of reflected light and consequently the tooth color (Ten, 1987).

Up to now, the unpleasant appearance of endodontic treated tooth is still a challenging issue. This appearance has a considerable effect on patient's satisfaction (Davis and Parsons, 1986).

A variety of materials that place in pulp chamber of tooth could result in tooth discoloration (Ingle and Joiner, 2004).

The most important reason for tooth discoloration of endodontically treated teeth is the sealer remnants in pulp chamber and its distribution in dentinal tubules (Davis, 1986). Thus, in addition to the ideal properties of sealers such as creating adequate seal and biological compatibility, sealers discoloration capability could have a significant role in choosing an appropriate root canal sealer in clinic (Cohen and Grossman, 2007).

AH plus sealer is a resin-based formula, and based on the claims of the manufacturer, unlike the AH<sub>26</sub> sealer, it does not result in any discoloration (Huang, 2002). MTA is one of the newly proposed sealers in dentistry and few studies have been conducted about the possibility of crown discoloration by MTA as an endodontic sealer (Torabinejad, 1993).

### Research Article

The aim of this study is determining the effect of AH plus and MTA sealer on crown discoloration after the endodontic treatment of extracted teeth.

### MATERIALS AND METHODS

In order to conduct this research, central and lateral maxillary incisors were collected, and 40 teeth were chosen by the use of radiography then evaluated with 10x magnification to not having any cavity, dental fillings, cracks, enamel defects and/or pathologic discoloring. Then all these 40 teeth were cleaned up by the use of rubber cup and pumice, and then were put into a saline solution until the examination day. The teeth were randomly put into 4 groups including two experimental groups (each group including 15 teeth) and two positive and negative control groups (each group including 5 teeth). Dental samples are shown in figure 1.



Figure 1: Teeth samples

In each of the provided teeth firstly an access cavity was prepared by the use of 008-diamond fissure bur and high-speed handpiece and then by the use of safe-end burs the pulp chamber roof and walls were completely removed. Canal preparation done by the use of Protaper rotary files (Maillefer, Switzerland) and conducted by F1 file in full length then canals flared by K-file up to No. 40. During the procedure, canals were washed out by the use of hypochlorite 2.5%. In order to eliminate smear layer of canals, respectively, EDTA solution 17% and hypochlorite 5.25%, were used, each for 1 minute. Then they were washed with distilled water and dried with paper point. Then AH-Plus and MTA sealers and Gutta-Percha with lateral condensation technique were used for obturation of canals. Gutta-Percha was removed to 1mm below CEJ and a cotton swab used to cleanse out the sealer remnant from the canal and pulp chamber. Then the access cavity was sealed by the use of resin composite (3M).

Test group 1: In this group according to the manufacturer's instructions, AH plus sealer was used as base and catalysts with equal amount.

Test group 2: The stages are similar to test group 1, by this difference that MTA sealer was used.

In positive control group, pulp chamber was filled with amalgam and the negative control group was only washed out with distilled water and dried.

#### Evaluation of Discoloration

Difference of color ( $\Delta E$ ) between two things could be calculated by CIE Lab color system. In fact, any change in hue, value or chroma of a tooth considered as a discoloration (Ruyter IE).

In order to evaluate the discoloration in the current study, shade pilot spectrophotometer (Degudent) was used. Spectrophotometer is a very sensitive device for detecting the slightest discoloration (Hassel, 2009). This device could record the imperceptible clinical discoloring; and at this time it is recognized to be the

## Research Article

most accurate and helpful device with high reliability for detecting discoloration (Hassel and Lehmann, 2010). In comparison with naked eye or traditional techniques, spectrophotometer shows 33% accuracy improvement and 93.3% scientific match (Paul, 2004). Based on the studies of Lehmann *et al.*, Shade pilot (Degudent) has more accuracy than the Vita easy shade (Lehmann, 2010).

Primarily shade pilot sets on the green and white surface of the device and then the photograph is taken from the labial surface of the teeth. Immediately after finishing these stages for each tooth shades were detected. Also all data related to hue, value and chroma of each tooth was recorded. Teeth were put into an incubator with temperature of 37°C and humidity of 90%, similar condition in the mouth (Shahrami, 2011). After one month again photos were taken from the labial surface of each tooth and the data related for each sample were recorded and they were compared with the previous photos, as it is shown in figure 2. Thus discoloration ( $\Delta E$ ) of each tooth was achieved.

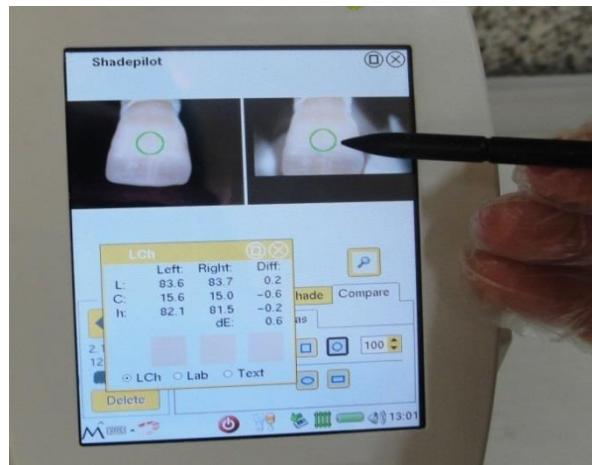


Figure 2: Comparing before/after photos

In order to compare the amount of changes for each of the color indicators of the evaluated groups, before and after the intervention in two groups, repeated measured ANOVA was used by considering intervention as repeated factor and type of sealer as the between subject comparison.

## RESULTS AND DISCUSSION

### Results

Thus the mean of discoloration ( $\Delta E$ ) was determined. For AH plus group the amount was  $2.05 \pm 0.74$  and for MTA sealer group it was  $2.34 \pm 0.68$ . Amounts of mean and SD of  $\Delta E$  for different statistical groups are shown in table 1.

The highest discoloration rate is shown in positive control group ( $\Delta E \geq 4$ ) and the lowest discoloration rate is shown in negative control group ( $\Delta E \leq 1$ ) and it shows the accuracy of the device.

Table 1: Mean and SD of  $\Delta E$  for different statistical groups

Group	No.	Minimum $\Delta E$	Maximum $\Delta E$	Mean of $\Delta E$
AH plus	15	1.10	3.60	$2.05 \pm 0.74$
MTA	15	1.00	3.60	$2.34 \pm 0.68$
Positive control group	5	4.20	7.80	$5.14 \pm 1.52$
Negative control group	5	0.30	1.20	$0.90 \pm 0.37$

Our findings have a normal distribution. One-way ANOVA test showed that there was a significant statistical difference between  $\Delta E$  of 4 studied groups ( $P \leq 0.05$ ).

It was shown that discoloration rate had a significant difference for experimental groups and control groups. Experimental groups showed less discoloration compared to positive control group and more

## Research Article

discoloration compared to negative control group ( $P<0.05$ ). Discoloration rate between experimental groups of AH plus and MTA sealer did not have a significant statistical difference ( $P>0.05$ ).

### Discussion

In this study the effect of two sealers (AH plus and MTA sealer) were studied on the crown discoloration after one month followed endodontic treatment. AH plus sealer is one of the most common sealers used in dentistry; and in the previous studies it has shown less discoloration compared to other materials. MTA sealer is one of the newly proposed sealers in endodontic treatment and there is no study available about the possibility of its discoloration. Thus in the current research this sealer is compared with AH plus sealer.

In this short-term study about discoloration, no significant difference was observed between these two sealers. AH plus and MTA discoloration was clinically acceptable ( $\Delta E \leq 3.3$ ) (Ruyter IE).

Several researches have been conducted in different periods of time related to the sealers' discoloration capability (Parsons *et al.*, 1986).

Study by Meincke *et al.*, (2012) on sealer 26, Endomethasone, Endofill, and AH plus also showed that during the first 24 hours after the treatment only AH plus sealer created clinically acceptable discoloration and AH plus had the lowest discoloration rate among other sealers. The reason to this difference is exposure time, method of research and the sealer remnant removal from the pulp chamber in this study.

Lenherr *et al.*, (2012) surveyed teeth discoloration caused by endodontic materials and they showed that AH plus sealer had the lowest discoloration capability among other endodontic materials such as 3mix, Ledermix, GMTA, WMTA, Blood, Calcium hydroxide and a few other materials.

These results are inconsistent with results of Elkhazin *et al.*, (2011). They showed that AH plus indicated the discoloration with mean= 5.68 visible to naked eye, after two weeks, which increased after 6 weeks and decreased in 8 weeks. Also results indicated that after 2 weeks, AH plus had the lowest  $\Delta E$  among other sealers and had the highest  $\Delta E$  after 4 weeks.

Previous studies reported highest discoloration for different endodontic sealers during 6 months, which are in inconsistent with the current research result. The reason to this difference could be explored by different methodology and cleaning the remnant sealer from the pulp chamber (Lenherr, 2012). Also another reason to this difference could be because of exposure time of this study; because based on Van der Burgt's study (Van and Plasschaert, 1986) teeth discoloring happens 7 weeks after canal obturation, other studies reported a few months (Davis and Parsons, 2002). Elkhazin *et al.*, observed the discoloration after two weeks for all groups. Also in another study, samples displayed a significant discoloration during the first 24 hours (Elkhazin, 2011).

Thus, there is no general agreement about the time of tooth discoloration followed endodontic treatment. Parson *et al* (2001) reported that tooth discoloration in the first phase of study (between first 0 to 3 months) occurred more quickly. Shahrami *et al.*, (2011) also made similar conclusion; and they also reported that perhaps observations with less time intervals could reveal a more accurate time pattern for tooth discoloration. This study was surveyed during a 1-month time period.

It has been reported that smear layer could clearly decrease the permeability of the dentine and result in occlusion of dentinal tubules (Elkhazin, 2011). Discoloration also depends on removing or leaving the smear layer; in some studies where smear layer was not removed, the discoloring was less or took longer time to happen (Davis and Grossman, 2002). Recent protocols for washing canals recommend removing smear layer in order to facilitate disinfection of root canal system (Van, 2007). Thus in this study for clinical similarity and providing optimal penetration of endodontic materials into the dentinal tubules the smear layer is removed. In order to remove smear layer from canals, 17% EDTA and 5.25% hypochlorite solutions were used, respectively each for 1 minute.

For evaluation the teeth discoloration, colorimeter device was used because of the inaccuracy of visual examination. Also it must be noted that factors related to the observer and the environment have an effect on visual examination (Cal and Cohen, 2006) (25). Recent technology progress of cameras has resulted in use of digital cameras for evaluating colors (Shahrami and ZareJahromi, 2011), so the repeated evaluation is not required.

### Research Article

Discoloration survey was conducted in cervical one-third area; because the previous studies (Davis, 2002) showed that most color changes happened in the cervical one-third of the tooth because of less thickness of enamel and the translucent structure in that area (Parsons, 2001). In previous studies about the teeth discoloration, endodontic materials (Davis, 2002) created an apical access hole that cannot be clinically created. But in the current study, for simulating clinical conditions, coronal access holes were created and after that root canal obturation was completed according to the clinical guidelines.

### Conclusion

The current study showed similar discoloration capability for both AH plus and MTA sealer after one month. Also in case of observing the defined clinical standards and by considering  $\Delta E \leq 3.5$  as the clinically accepted changes, the two surveyed endodontic sealers showed acceptable discoloration in clinic. Thus based on the required standards in clinic, both sealers are acceptable.

### REFERENCES

- Cal EGP and Kose T (2006).** Comparison of digital and spectrophotometric measurements of colour shade guides. *Journal of Oral Rehabilitation* **33**(3) 221-228.
- Cohen S and Grossman L (2007).** Obturation of the canal. In: *Lea and Febiger: Endodontic Practice*.
- Davis MCWR and Rivera EM (2002).** Sealer distribution in coronal dentin. *Journal of Endodontics* **28** 464-6.
- Elkhazin M (2011).** Analysis of coronal discoloration from common obturation materials. An in vitro spectrophotometry study (MSc Thesis) Cape Town, S. A. U. o. t. W. C.
- Grossman L (1981).** Obturation of the canal. In: *Lea and Febiger: Endodontic Practice*, t. E. P. 326-7.
- Hassel AJCE, Balke Z and Rammelsberg P (2009).** Intraexaminer reliability of measurement of tooth color by spectrophotometry. *Quintessence International* **40** 421-6.
- Huang FMTKW, Chou MY and Chang YC (2002).** Cytotoxicity of resin, zinc oxide-eugenol, and calcium hydroxide-based root canal sealers on human periodontal ligament cells and permanent V79 cells. *International Endodontic Journal* **35** 153-8.
- Ingle IJ, Backland LK and Baumgartner JC (2008).** *Ingle's Endodontics*. London.
- Joiner A (2004).** Tooth colour: a review of the literature. *Journal of Dentistry* **32**(Suppl 1) 3-12.
- Lehmann KMIC, Schmidtmann I and Scheller H (2010).** Four color-measuring devices compared with a spectrophotometric reference system. *Journal of Dentistry* **38** 65-70.
- Lenherr PAN, Weiger R, Filippi A, Attin T and Krastl G (2012).** Tooth discoloration induced by endodontic materials. *International Endodontic Journal* 1-8.
- Meincke DK, PM, Gomes BP, Della Bona A and Sousa EL (2012).** Effect of endodontic sealers on tooth colour. *Journal of Dentistry* 1-4.
- Parsons JWR and Ricks-Williamson L (2001).** In vitro longitudinal assessment of coronal discoloration from endodontic sealers. *Journal of Endodontics* **27** 699-702.
- Partovi MAH and Soleimani B (2006).** In Vitro Computer analysis of crown discolouration from commonly used endodontic sealers. *Australian Endodontic Journal* **32** 116-9.
- Paul SJPA, Rodoni L and Pietrobon N (2004).** Conventional visual vs spectrophotometric shade taking for procelain-fused-to metal crowns: a clinical comparison. *International Journal of Periodontics and Restorative* **24** 222-231.
- Ruyter IENK and Moller B (1987).** Color stability of dental composite resin materials for crown and bridge veneers. *Dental Materials* **3** 246-51.
- Shahrami FZM and Mesgarani A (2011).** Comparison of tooth crown discoloration with Epiphany and AH26 sealer in terms of chroma and value: an in vitro study. *Brazilian Journal of Oral Sciences* **10**(3) 171-4.
- Torabinejad MWT and Pitt Ford TR (1993).** Sealing ability of a mineral trioxide aggregate when used as a root-end filling material. *Journal of Endodontics* **19** 591-5.
- Van der Burgt TPMT and Plasschaert AJ (1986).** Tooth discoloration induced by endodontic sealers. *Oral Surgery, Oral Medicine, Oral Pathology* **61** 84-9.

**Research Article**

**Van der Sluis LWVM, Wu MK and Wesselink PR (2007).** Passive ultrasonic irrigation of the root canal: a review of the literature. *International Endodontic Journal* **40** 415-26.