

Coronal Discoloration Induced by Three Different Endodontic Sealers: An In Vitro Spectrophotometric Analysis

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ABSTRACT

Aim: To evaluate the coronal discoloration effect of three different endodontic sealers by using spectrophotometric analysis.

Materials and Methodology: Thirty extracted single-rooted mandibular premolar teeth were selected for the study. Access opening was done followed by cleaning and shaping with hyflex files. Prepared teeth were then divided into 3 groups: group A, B, C and obturated using MTA Fillapex, Roekoseal, Sealapex as endodontic sealers respectively. Color coordinates (L*a*b*) values were measured with a spectrophotometer before endodontic treatment (baseline), 24 hours and 1 month and 2 months after endodontic treatment. L*a*b* values were used to calculate color changes (ΔE). Data was subjected to statistical analysis using ANOVA test and Paired T test. **Results:** Greater discoloration is caused by MTA Fillapex between the baseline and 24 hours compared to Sealapex, which is statistically significant. Discoloration caused by MTA Fillapex between the baseline -24 hours and 24 hours-1 month time interval is statistically significant. Sealapex causes least coronal discoloration compared to MTA Fillapex between the baseline and 24 hours. Sealapex and Roekoseal didn't have significant discoloration at 24 hours whereas discoloration is statistically significant between baseline -24 hours and 24 hours-1 month time interval. All the endodontic sealers produced significant discoloration at 1-2 month time interval compared to baseline -24 hours. **Conclusion:** All root canal sealers have the potential to discolor over a period of time.

KEYWORDS: Coronal discoloration, In Vitro Techniques, MTA-Fillapex, Endodontic sealers, Spectrophotometer Fillapex.

INTRODUCTION

In today's modern world patient are more demanding in terms of esthetics and functioning of teeth as well. Discoloration of teeth is quite a common occurrence these days following endodontic treatment.¹ The reasons for discoloration of non-vital teeth could be due to hemorrhage into pulp chamber during trauma, disintegration of the pulp tissue and use of different irrigants, endodontic sealers and intracanal medicaments.^{1,2}

Main etiological factor for the occurrence of local intrinsic staining of crown of the tooth is the contact of root canal sealers with the coronal dentin of the pulp chamber.^{3,4,5}

In the long-term, endodontic sealer interacts with dentin and results in a change in the optical and chromatic properties of the dentin. In spite of recent advances in the material science in improving the physical properties, biocompatibility and handling characteristics, the problem of coronal discoloration still persists.

MTA Fillapex sealer is recently introduced in the market, so this study was conducted to evaluate coronal discoloration in human teeth following the use of root canal sealers such as Sealapex, Roekoseal, MTA

MATERIALS AND METHODS

Selection and Standardization of teeth: Thirty single rooted extracted human mandibular premolars were selected for the study. The teeth were divided into 3 groups of 10 teeth each. In Group A –MTA Fillapex (Angelus), In Group B –Roekoseal (Coltene), In Group C –Sealapex (Kerr) was used.

Access Cavity Preparation and Biomechanical preparation and obturation: The root canal was prepared using Hyflex rotary files (Coltene) according to the manufacturer's instruction and thorough irrigation was done with 2.5% sodium hypochlorite followed by 17% EDTA throughout the procedure according to the standard irrigation protocol. The canals were then dried with paper points followed by the obturation using the tested sealer and GP (Dentsply- Maillefer, Switzerland). The excess sealer was removed in the coronal third of the teeth and sealed with the composite resin filling material. Teeth were then stored in saline in individually marked vials in moist conditions.

Tooth color measurements: Spectrophotometer (Data color 600 USA) was used to measure the color quantitatively and qualitatively. The spectrophotometer

How to cite this article:

Gupta R, Kumari RA, Meena N, Sharma H, Murthy CS, Vikram. Coronal Discoloration Induced by Three Different Endodontic Sealers: An In Vitro Spectrophotometric Analysis. *Int J Oral Health Med Res* 2016;2(5):48-50.

was calibrated according to the manufacturer's instructions before taking each reading and then carefully placed at right angle to the middle third of the buccal surface of the crown of each tooth.

A custom-made index was fabricated for each tooth using silicone impression putty. The indices acted as a guide to ensure that the CIE L*a*b* reading can be recorded from the tooth by exactly placing in the same position every time the measurements were recorded.

The corresponding shades were noted from the computer screen which is attached directly to spectrophotometer and CIE L*a*b* values were recorded.

Pretreatment color shades and readings of the entire buccal surfaces were considered as baseline data to which all the recorded readings at 24 hours, 4 and 8 weeks were then compared.

$\Delta E = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$ is the formula is used for calculating the color change during different time intervals.

ΔL is the difference in lightness calculated from differences in the L* readings between the two time intervals. This was calculated for time interval between baseline and at 24 hours, 4weeks, and 8weeks. Δa and Δb refer to the difference in the chroma. The ΔE value equal or greater than 3.5 was considered as clinically perceptible color change (According to O Brien 2002).

Statistical Analysis: SPSS vs. 22 for windows was used for statistical analysis of data using ANOVA and Paired T test. Results with the P value less than 0.05 were considered statistically significant.

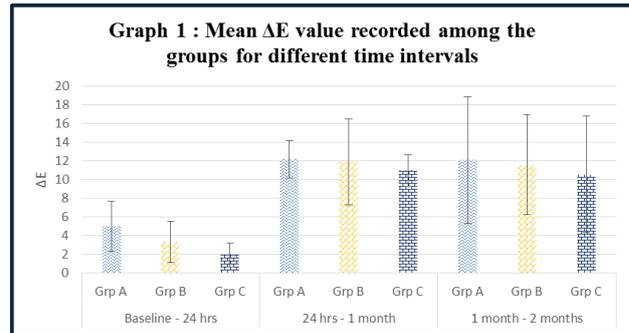
RESULTS

Table 1 and Graph 1 shows that greater discoloration was caused by MTA Fillapex between the baseline and 24 hours compared to Sealapex, which was statistically significant ($P < 0.05$). Discoloration caused by MTA Fillapex between the baseline -24 hours and 24 hours-1 month time interval was statistically significant ($P < 0.05$). Sealapex and Roekoseal didn't have significant discoloration at 24 hours whereas discoloration was statistically significant between baseline -24 hours and 24 hours- 1 month time interval ($P < 0.05$). All the endodontic sealers produced significant discoloration at 1-2 month time interval compared to baseline -24 hours.

Table 1: Mean ΔE values among the groups for different time intervals

	Group	Mean	Std Dev
Baseline - 24 hrs	Grp A	5.04087	2.688029
	Grp B	3.35542	2.173407
	Grp C	1.96211	1.302946
24 hrs - 1 month	Grp A	12.19315	1.980503
	Grp B	11.90113	4.565168
	Grp C	11.01411	1.689002
1 month - 2 months	Grp A	12.11737	6.772228
	Grp B	11.59782	5.359878
	Grp C	10.58676	6.2476

Grp: Group, hrs: Hours, Std Dev: Standard deviation



DISCUSSION

In today's world ultimate goal of a dental practitioner is fulfilling the desires and demands of the patients to have pleasant and bright white smile. Interestingly, it has been reported that poor aesthetic appearance of a treated tooth significantly affects the patient quality of life.⁶ One of the common reason for patient seeking dental care is the teeth discoloration, especially in the anterior region⁷. These changes compromise the appearance of the patients. Crown discoloration after endodontic treatment is considered a common esthetic problem for the patient and dentist, particularly for anterior teeth.

Main etiological factor for occurrence of local intrinsic staining of crown of the tooth, is the contact of root canal sealers with the coronal dentin of the pulp chamber.

In the study done by Van der Burgt et al⁸ and Parsons et al⁹ access cavity preparations were performed from an apical approach, which is not performed clinically. In this study a coronal access cavity is prepared followed by obturation, simulating the clinical scenario and the excess sealer in pulp chamber were not removed completely, the only sealer that interferes with the access sealing of tooth was removed.

Studies in past revealed that endodontic sealers when placed directly in contact with dentin of pulp chamber causes coronal tooth discoloration, which takes place from several weeks to several months after obturation.^{8,9,10} Very few articles are published till date on the exact time taken for discoloration following root canal therapy. Differences in the results of the previous studies could be attributed to the methodologies employed and the method of color analysis used.

In the present study, spectrophotometer was used which can readily record color changes that are not even clinically observable. These color changes were also detected much earlier when compared to the traditional visual assessment of tooth color.^{2,11}

MTA Fillapex causes discoloration which gradually increased with time and became maximum after one month ($\Delta E = 12.193$) when compared to the baseline data ($\Delta E = 5.041$) which is statistically significant. This may be due to increasing flowability of MTA Fillapex sealer and faster discoloration as compared to other sealers.¹²

This discoloration can also be attributed to the composition of MTA Fillapex. MTA Fillapex contains a trace amount of iron (0.0260 mg/kg) which has the potential of staining the tooth and it also contains bismuth oxide which is present as radiopacifier.¹³ Bismuth oxide is a yellow compound used as a pigment in paint and cosmetics and might account for the discoloration associated with the sealer.¹⁴ This bismuth oxide gets destabilized to bismuth carbonate which is light sensitive and results in tooth discoloration over a period of time.¹⁵

Roekoseal also causes discoloration which gradually increases with time and has discolored maximum after one month ($\Delta E = 11.901$) when compared to the baseline data ($\Delta E = 3.355$) which is statistically significant. These could be because there is a relationship between the radiopacifier, resinous component, the amine in causing tooth discoloration.¹⁵

Least discoloration was caused by Sealapex after one month ($\Delta E = 11.041$) as compared to MTA Fillapex and Roekoseal. This could be attributed to that, Sealapex does not contain silver and does not contain bismuth oxide which is a coloring pigment.⁹ But Sealapex also caused discoloration which increased over a period of a month after sealer application as compared to the baseline data ($\Delta E = 1.962$) which is statistically significant. This could be due to the presence of certain ingredients that will discolor over a period of time, and it may also be apparent that these ingredients are changing chemically with time.¹⁶ These results are in agreement with the previous studies done.^{8,9,10,16}

CONCLUSION

Within the limitations of this study-

- Greater discoloration is caused by MTA Fillapex between the baseline and 24 hours compared to Sealapex which is statistically significant.
- All the endodontic sealers produced significant discoloration at 1-2 month time interval compared to baseline -24 hours.

Hence to conclude, it is suggested to remove the root canal sealer completely from the pulp chamber before doing the post-endodontic restoration to prevent the discoloration induced by the root canal sealers used during treatment.

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Source of Support: Nil
Conflict of Interest: Nil