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Effect of endodontic sealers on tooth colour

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ABSTRACT

Objectives: One of the goals of endodontic treatment is the adequate filling of the root canal, which is often done using gutta-percha and sealer. It has been reported that sealer remnants in the coronary pulp chamber cause tooth colour changes. Therefore, this study was designed to examine the effect of endodontic sealer remnants on tooth colour, testing the hypothesis that sealers cause coronal colour changes.

Methods: Forty single-rooted human teeth were endodontically treated leaving excess sealer material in the coronary pulp chamber. The specimens were divided into four groups ($n = 10$) according to the endodontic sealer used (AH, AH Plus; EF, Endofill; EN, endométhasone N; and S26, Sealer 26). Teeth were stored at 37 °C moist environment. Colour coordinates ($L^*a^*b^*$) were measured with a spectrophotometer before endodontic treatment (baseline-control), 24 h and 6 months after treatment. $L^*a^*b^*$ values were used to calculate colour changes (ΔE). Data were statistically analyzed using Kruskal–Wallis and Mann–Whitney-*U* tests.

Results: Colour changes were observed for all groups with S26 and EN producing the greatest mean ΔE values after 6 months.

Conclusion: Endodontic sealer remnants affect tooth colour confirming the experimental hypothesis.

Clinical significance: This study examined the effect of endodontic sealer remnants on tooth colour, and observed that after 6 months, the sealers produced unacceptable colour changes.

1. Introduction

Many of the materials placed in contact with dentine have the potential to cause discolouration, including amalgam, Cavit, and IRM.[1,2] A major cause of tooth discolouration may be endodontic sealer remnants in the pulp chamber.[3–5] Gutierrez and Guzman[6] evaluated endodontic materials and found the most severe discolouration to result from N2 pastes and polyantibiotic pastes, but did not identify which ingredients were responsible for the discolouration. Sealers have also been evaluated as to their discolouration potential. A study used extracted premolars to evaluate the staining capacity of eight sealers introduced into the pulp chambers. Results showed significant coronal colour changes within several weeks, with some sealers producing greater changes than others.[4]

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Table 1 – Description of the endodontic sealers used in the present study.

Group	Commercial name	Manufacturer	Material composition
S26	Sealer 26	Dentsply, Petrópolis, Brazil	Powder: bismuth trioxide, calcium hydroxide, hexamethylene tetramine, titanium dioxide. Resin: epoxy bisphenol
EF	Endofill	Dentsply, Buenos Aires, Argentina	Powder: zinc oxide, hydrogenated resin, bismuth subcarbonate, barium sulfate, sodium boroato. Liquid: eugenol and sweet almond oil
EN	Endométhasone N	Septodont, Saint-Maur des Fossés, France	Powder: zinc oxide hydrocortisone acetate, thymol iodide, barium sulfate, magnesium stearate. Liquid: eugenol
AH	AH Plus	Dentsply, Konstanz, Germany	Epoxy resin, zirconium oxide, iron oxide, calcium tungstate, and silicone oil

The literature is lacking reports on the use of spectrophotometers to evaluate the discolouration capacity of endodontic sealers. The use of such instrumentation minimises the subjectivity of colour determination resulting from the complexity of factors interfering with individual colour perception, and visual shade determination.[7–9] Furthermore, the interobserver congruence in the visual analyses is frequently far from optimum.[10]

Spectrophotometers, such as the Vita Easyshade, are commonly used in dental studies to quantify tooth discolouration (staining or bleaching effects)[11,12] and colour changes in dental materials such as ceramics,[9,13,14] but they have not been used to evaluate the coronal colour changes possibly caused by endodontic sealers. The objective of the present study was to examine the effect of endodontic sealer remnants on tooth colour, testing the hypothesis that sealers produce coronal colour changes.

2. Materials and methods

This study was approved by the local Ethics in Research Committee. Forty extracted human maxillary and mandibular single rooted incisors and canines free of caries, restorations, cervical lesions and coronal discolouration were selected from a tooth bank and used in the present study. The teeth were cleaned to remove debris and extrinsic stain, and then stored at 37 °C sterile saline solution (Basa, Industria Farmacêutica Basa Ltda, Caxias do Sul, RS, Brazil). The saline solution was changed every 7-day throughout the experiment. Teeth were divided into 4 groups ($n = 10$) and colour coordinates were recorded at baseline (A1, control). Teeth were accessed and the pulp tissues were extirpated. The root canals from all teeth were prepared with K-files using the step-back technique with 2.5% sodium hypochlorite and 17% EDTA for 3 min. After, the root canal was irrigated with saline solution and dried, lateral condensation technique was employed for root canal filling using guttapercha and a different sealer for each group (Table 1). The sealers were placed into the root canal and purposefully left in the coronal pulp chamber. No attempt was made to remove sealer from the pulp chamber. All teeth were sealed using composite resin (Filtek Z250™, 3 M ESPE, St. Paul, MN, EUA).

A second colour evaluation (A2) was done 24 h after endodontic treatment followed by a third evaluation (A3) 6 months later. For standardisation purposes, the same operator performed all colour evaluations.

A spectrophotometer (EasyShade Advance, Vita Zahnfabrik, Bad Säckingen, Germany) was used in ''tooth single'' mode for all evaluations (A1, A2, and A3) of the colour coordinates ($L^*a^*b^*$). The active point of the spectrophotometer was placed on the middle third of the coronal facial surface of each tooth measuring it for three times, which were averaged. The CIEL$^*a^*b^*$ colour coordinates were used to allow the determination of colour in the three-dimensional space.[9,15] The $L^*a^*b^*$ values were used to calculate the colour changes (ΔE), as follows:

$$\Delta E = [(\Delta L*)^2 + (\Delta a*)^2 + (\Delta b*)^2]^{0.5}$$

where L^* is the colour value (lightness), a^* and b^* denote chromaticity, in which red is −a, green is −a, yellow is +b, and blue is −b. The ΔE values were calculated as follows: $\Delta E1$, the colour difference between the baseline evaluation (A1, control) and the evaluation done 24 h after endodontical treatment (A2); $\Delta E2$, the colour difference between A2 and A3 evaluations; and $\Delta E3$, the colour difference between A1 and A3 evaluations.

Data were statistically analyzed using Kruskal–Wallis and Mann–Whitney-*U* tests ($\alpha = 0.05$).

3. Results

The mean and standard deviation values of ΔE between different experimental times for the evaluated sealers are shown in Table 2. The apparently high coefficient of variation values are similar to previous reports[8,11,16,19] and may be related to different teeth, mainly the tooth age, used in the present study.

Considering the endodontic sealers after 6 months, the tooth colour changes were as follows: S26 = EN > AH = EF. These data can be clearly observed in Fig. 1.

Table 2 – Mean and standard deviation (SD) values of ΔE for different experimental times and statistical groupings for the sealers evaluated.

	$\Delta E1$ Mean ± SD	$\Delta E2$ Mean ± SD	$\Delta E3$ Mean ± SD
S26	4.9 ± 3.6^{A}	5.6 ± 3.4^{A}	6.3 ± 2.1^{A}
EF	4.3 ± 4.5^{A}	2.7 ± 1.6^{B}	3.4 ± 3.1^{B}
EN	3.7 ± 1.3^{A}	3.6 ± 2.7^{AB}	5.6 ± 2.3^{A}
AH	2.4 ± 1.4^{B}	3.5 ± 1.8^{AB}	3.8 ± 2.2^{B}

Different letters within each column represent statistical groupings ($p < 0.05$).

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