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Research Article

Sealing Capacity of Different Materials used as Cervical Barrier during Internal Walking Bleaching Technique

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Abstract

Objectives: This study evaluated the sealing ability of different temporary restorative materials used as a barrier in the passage of oxygen generated during internal bleaching technique mediated by different time intervals.

Material and methods: 30 bovine teeth stored in thymol solution 0.1%, were prepared, sealed and randomly assigned into 3 groups (n = 10), in accordance with the sealing material: Riva Self Cure (RIV), Bioplic (BIO), and Coltosol (COL). The teeth were submitted to bleaching using walking bleach technique (Whiteness perborate), then were fixed with composite (Filtek Z350 XT, 3M ESPE) in a number 7 orthodontic wire and adopted in a plastic container so that only 2mm below the amelocementary junction would stay submerged in distilled water. The samples were analyzed by an oximeter (Digimed) for measuring oxygen release after 7, 14, 21 and 28 days, always maintaining samples stored in a laboratory incubator at 37°C. The data was submitted to 2-way ANOVA and Turkey test (p = 0.05).

Results: Both material (p = 0.0154) and time (p <0.000) had an effect on the result of oxygen level. Over all Bioplic showed the highest and Riva the lowest ability, while Coltosol presented intermediate results. All materials showed lower levels of oxygen release within the first 7 days. From 14 to 28 days, there was no statistically significant increase in the release of oxygen.

Conclusion: All materials seemed to present the best sealing performance within the first 7 days. The highest ability of sealing capacity was shown by Bioplic.

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INTRODUCTION

The sealing in the access cavity during endodontic treatment is important in order to prevent the entrance of saliva and microorganisms into the root-canal system [1]. However, studies showed that coronal microleakage can occur around temporary restorations [2]. If the coronal restoration becomes defective or is lost, the coronal leakage can compromise the success of root canal therapy. Coronal microleakage introduces the oral microflora into the root canal system, which can eventually lead to the failure of the endodontic treatment [3,4].

To reduce microleakage author suggested placing a coronal seal in the orifice of the root canal immediately after root canal filling [5]. According to Schwartz and Fransman [6] orifice barriers provide a second line of defence against the leakage of bacteria. In relation to the temporary filling coronary studies have shown that Coltosol was significantly better in preventing micro leakage other temporary materials [2,7]. However, the hygroscopic expansion of Coltosol in a cavity may lead to cusp deflection, infraction development and fracture. Furthermore, *in vivo* masticatory forces will aggravate this unfavourable

condition. Therefore this material is not recommended for temporary filling in root-filled teeth [8].

Adhesive dentistry concepts have increasingly been applied to endodontics to prevent coronal leakage. Some characteristics as ease and speed of placement, sealing efficacy, and high bond strength qualify the ideal restorative material to barrier [9], and the use of dentin bonding agents has been advocated to help provide a better intracoronal seal [10].

However no work has shown the ability of these temporary restorative materials in relation to release of oxygen by the whitening gel in a given period of time it takes to perform the whitening technique.

There is no consensus on how much oxygen is released and crosses the intracoronary barrier at a certain interval of time creating the need for more precise information, which justifies this study that aims to evaluate the ability of marginal sealing using different sealing materials such as Riva Self Cure, Bioplic and Coltosol, in roots of bovine teeth as a barrier to passage of oxygen generated by the mediate internal whitening technique in different time intervals of 7, 14, 21 and 28 days.The hypothesis is that there is no statistically significant difference between the materials tested, neither throughout the evaluation period.

MATERIALS AND METHODS

Thirty (30) bovine teeth were selected according to the following inclusion criteria: good state of preservation, healthy condition, single-rooted, crowns and roots similar in size and volume, and absence of cracks. After being cleaned, were stored in a thymol 0.1% solution until use.

The specimens were cleaned in current water. The area to be worked was standardized in 8.0 mm being 2 mm of root below the cervical line (amelocemetary limit), and 6 mm of crown above the cervical line (amelocementary limit), taking as a reference the buccal surface. The crowns were worn in a plaster trimmer to the delimed mark, and the roots were sectioned with a diamond flexible disc (KG Sorensen, Cotia - SP - Brasil) attached to the slow-speed turbine. There was no need for endodontic treatment because the roots were cut almost in its entirety, leaving only 2 mm to be filled by sealant. The remaining 2 mm of the conduits as well as the 6mm of the crown, were prepared with a 1016 diamond bur (KG Sorensen, Cotia - SP - Brasil) in a high-speed rotation in order to standardize the crown-root orifices.

The samples were measured with a digital caliper (Western, São Paulo -SP - Brasil) in order to ensure the proper thickness of 8 mm.

All specimens were then sealed with a layer of dark nail polish (*Risqué*®, São Paulo – SP- Brasil) and a layer of ethyl cyanoacrylate (*SuperBonder*® – Loctite – Henkel Ltda, São Paulo – SP- Brasil) in its entire outer surface, leaving a millimeter less than the edge of the access.

Thirty teeth were randomly divided into 3 groups (n = 10), in accordance with the sealant: (1) RIV - Riva Self Cure (SDI, Bayswater - Victoria - Australia); (2) BIO - Bioplic® (Biodinâmica, Ibiporã - PR - Brasil); [3] COL - Coltosol® (Vigodent, Rio de Janeiro – RJ- Brasil).

The materials were manipulated according to the recommendations of their respective manufacturers and the sealing of the cavity was made 2 mm below the cemento-enamel limit. After the solidification of the material, the quantity of the material was measured with a periodontal probe so that it could mark 6 mm, this way knew that the material filled in the desired amount.Samples which demarcated a larger amount, underwent a slight friction with a 2135 diamond bur (KG Sorensen, Cotia - SP - Brasil). Each sample filled with their respective sealant material was submitted to walking bleach technique by using Whiteness Perborate (FGM, Joinville – SC – Brasil).The amount of 0.2 mm of the gel was placed in the pulp chamber and this remained for a time of 40 minutes in each sample. After the elapsed time, the gel was aspirated with an endodontic cannula and washed with water. The cavity without material was sealed in its coronal portion with Coltosol. The finished samples were attached to a 0.7mm orthodontic stainless steel wire with composite (Filtek Z350 XT, 3M ESPE – Itapetininga – SP - Brasil) and adapted in a plastic container containing distilled water, so that only the root portion stayed submerged. After 7, 14, 21, and 28 days of inserting the bleaching material, samples were submitted to measurement of the oxygen release by an oximeter (Digimed, Santo Amaro – SP - Brasil). The oximeter is able to measure atmospheric oxygen and oxygen dissolved in water.

Each sample container was opened only at the time of analysis. The device was polarized for 7 minutes and the oximeter electrode was inserted into distilled water, providing data on the amount of oxygen in mm/l diluted in the environment. This procedure was repeated for all samples, always washing the electrode with distilled water between one sample and another. During 28 days, the samples were stored in an incubator at 37°C.

Statistical Analysis

Descriptive statistics data including mean, standard deviation, and confidence intervals were calculated for each group. Two-way analysis of variance (ANOVA) and Tukey multi-comparison tests were used to compare SBS among groups (p = 0.05).

RESULTS

Analysis of variance (ANOVA) showed statistically significant differences for the material factor (p=0,0154)and for the factor period of evaluation (p<0,000). Both material (p = 0.0154) and time (p <0.000) had an effect on the result of oxygen level. Overall Bioplic® showed the highest and Riva Glass® the lowest ability. All materials showed lower level of oxygen release within the first 7 days. From 14 to 28 days, there was no statistically significant increase in the release of oxygen (Table 1).

DISCUSSION

Studies have shown that gutta-percha and root canal sealers cannot prevent the passage of saliva and bacteria to the periapical tissues [4,11,12].Therefore, after obturation of the root canal system, the occlusal access cavity should be properly sealed to improve the prognosis of endodontically treated teeth. Seek for an ideal material to provide a temporary hermetic coronal and pulp chamber sealing has been topic of many studies (Table 2).

Several types of filling materials are used today. Glass ionomer cement (GIC) has been successfully used in dental field for more

Table 1: Results ANOVA and Tukey tests for the oxygen levels of among the three groups, measured in different times*.

	RIV		BIO		COL	
Time	Mean	SD	Mean	SD	Mean	SD
28d	3.4	± 1.4Ba	2.4	± 1.1Bb	2.5	± 1.1 Bab
21d	2.7	± 1.0Ba	2.4	± 0.6Bb	2.7	± 1.0 Bab
14d	2.8	± 1.1Ba	2.1	± 0.3Bb	2.4	± 0.4 Bab
7d	1.7	± 0.3 Aa	1.5	± 0.3Ab	1.8	± 0.2Aab

*Different capital letters means difference among lines (difference among times); different lower case letters means difference among columns (among materials). Statistically significant at 5%.

Table 2: Mean values of infiltration in millimeters.

Material	7 days	14 days	21 days	28 days
RIVA	1,71	2,81	2,71	3,42
COLTOSOL	1,79	2,43	2,74	2,52
BIOPLIC	1,53	2,10	2,41	2,36

The group 2 showed lower level of oxygen evolution at all time intervals. As for the groups 1 and 3 its average release varied according to time.

than 40 years. Despite the numerous advantages of GIC, low bond strength and slow setting rate have limited conventional GICs to be used only at low stress-bearing areas [13]. Already the glass ionomer Bioplic, have a resinous matrix-based composed of BIS-GMA, silicon dioxide, groups of dimethacrylates and organic filler particles. According to the manufacturer, polymerization shrinkage is minimal and it does not influence sealing, however, besides the possible minimal shrinkage, they do not present any type of dentin adhesion that could avoid marginal leakage [14]. On the other hand, Coltosol is a zinc oxide/zinc sulphate-based, noneugenol, self-setting, single-component cement used as a temporary restorative material. It can be applied quickly and is easily removed in large bulks. It cures by absorbing water, and this is associated with a hygroscopic expansion of 17–20% according to the manufacturer [15].

Based on the results obtained, the null hypothesis that there were no differences of sealing capacity among three restorative temporary materials was rejected, sinceeach filling material showed a different behavior according to the release of oxygen. Bioplic showed the best performance in sealing capacity during walking bleach procedure, Coltosol showed an intermediary result, and Riva Self Cure exhibited the lowest ability to seal. For immediate bleaching technique, Riva Self Cure and Bioplic presented with similar sealing performances, while Coltosol showed statistically significant lower sealing capacity [16].

et al [17] evaluated the coronal micro infiltration of four temporary materials (Dental ville, IRM,Bioplic e o Vitremer), using thermal cycling and solution of nickel sulfate 5%, demonstrating their study that all temporary cements tested allowed marginal infiltration. However, Bioplic was the cement with the lowest amount of infiltration, in accordance with this research.

Contrarily to our findings, Mattos et al. [18], who analyzed the sealing ability of three temporary sealing materials Tempit, Bioplic, and Citodur, performing thermal cycling, methylene blue dye at 5% and submitted to vacuum, Bioplic was inefficient as a temporary restorative materials, since it was unable to prevent coronary micro infiltration.

According to Cunha et (2014) [19], the sealing capacity under thermal cycling, methylene blue dye at 2%, Bioplic used as cap associated to Sealerplex was similar to an association of Sealer 26 (filling material) and restorative glass ionomer cement (cap). Both groups exhibited less microleackage than a group sealed with AH PLUS (filling material) and IRM (cap).

In accordance to our findings, Couto [20] showed that Coltosol, when compared to other materials, such as Zinc Oxide Eugenol Cement (IRM) presented greatest sealing efficacy. On the other hand, when Coltosol was compared to Bioplic, the farther showed better sealing capacity.

Studies from Bittencourt [21,22] and Gil [23], where tested Bioplic and Coltosol, observed that the highest percentage of infiltration occurred in Bioplic disagreeing with the findings of this study since the Bioplic was the sealer that showed better results in relation to oxygen release during the technique used. However, Fachin [24] tested Coltosol, IRM, Bioplic and other materials, and the obtained results corroborate with those found in this study, since the author's research presented Bioplic as more efficient than Coltosol. However both Bioplic and Coltosol were compared to IRM at Fachin [25] and Carvalho [26] studies, and they demonstrated that IRM obtained worst results.

Bleaching agents act primarily through the oxidation of organic compounds. These agents are highly unstable and, when in contact with the tissue, release free radicals (mainly nascent oxygen) that oxidize the pigments. The released oxygen penetrates the dentinal tubules and acts on compounds with carbon rings that are highly pigmented, converting them into lighter compounds Furthermore, it converts compounds of pigmented and double bond carbon in hydroxy groups to feature no color [21].

No work has shown the ability of these temporary restorative materials in relation to the release of oxygen during a certain period of time it takes to perform the whitening technique. This fact justifies the importance of this research, which aimed to analyze different sealing materials (Riva-glass ionomer, Bioplic and Coltosol) when used to seal the root canal orifices in order to

bar the transition of the whitening gel. The form used to identify these flows was through the passage of oxygen, generated by internal walking bleach technique in different time intervals (7, 14, 21 and 28 days).

Regarding the release of oxygen during a certain period of time this study showed that of all different intervals evaluated, in 7 days happened the minor oxygen release, unlike other times; and from 14 days, there was no statistically significant increase of oxygen. However, considering the limitations of an in vitro study and a still little known methodology, more clinical trials are needed to evaluate the impact of the release of oxygen that passes through the sealing materials used in root canal entrance.

CONCLUSION

According to the methodology used, all materials presented the best sealing performance within the first 7 days. The highest ability of sealing capacity was shown by Bioplic.

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