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Marginal leakage of temporary restoration after intraradicular post preparation with or without waterproofing

Infiltração marginal de restauração temporária após o preparo de pino intrarradicular com ou sem impermeabilização

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ABSTRACT

Objective: This study evaluated the leakage volume of 1% Rhodamine B which received or not an internal waterproofing material. The hypothesis is that the waterproofing reduces microleakage. **Material and Methods:** Forty-two human teeth were selected for this study. After access, preparation, and filling of root canals, the teeth were divided into 3 groups: GI – sealed with Cimpat Blanc®, without intraradicular post/core preparation; GII - sealed with Cimpat Blanc®, with intraradicular post/core preparation, and GIII – sealed with Cimpat Blanc®, with intraradicular post/core preparation and internal waterproofing material with ethyl cyanoacrylate. T-test was used to analyze difference between initial and final weight and there was difference ($p < 0.05$). To analyze infiltration of the colorant, the volume was the comparison variable. **Results:** Shapiro Wilk-test was applied and showed normal distribution of the variables. ANOVA ($p = 0.0013$ / $p<5\%$) applied and determined a statistical difference between the groups. When comparing the groups together, GIII show the smallest leakage rate when compared with the other groups, being statistically different (Tukey test - $p < 0.5$). **Conclusion:** In endodontically treated teeth receiving temporary restoration, the use of ethyl cyanoacrylate as internal waterproofing material is effective in preventing microleakage.

KEYWORDS

Dental leakage; Endodontics; Dental restoration, temporary; Coloring agents.

RESUMO

Objetivos: Este estudo avaliou o volume de infiltração de Rhodamine B 1% com ou sem impermeabilização interna. A hipótese é que a impermeabilização reduz a microinfiltração. **Material e Métodos:** Foram selecionados 42 dentes humanos para este estudo. Após o acesso, o preparo e a obturação dos canais radiculares, os dentes foram divididos em 3 grupos: GI - sem preparo para núcleo intrarradicular e selado com Cimpat Blanc®; GII - com preparo para núcleo intrarradicular e selado com Cimpat Blanc®, e GIII - com preparo para núcleo intrarradicular, impermeabilizado internamente com cianoacrilato de etila e selado com Cimpat Blanc®. O teste T foi utilizado para analisar a diferença entre o peso inicial e o peso final ($p < 0,05$). Para analisar a infiltração do corante, o volume era a variável de comparação. **Resultados:** o teste de Shapiro Wilk foi aplicado e mostrou distribuição normal das variáveis. O teste ANOVA ($p = 0,0013$ / $p < 5\%$) foi aplicado e determinou uma diferença estatística entre os grupos. Ao comparar os grupos em conjunto, GIII mostra a menor taxa de vazamento quando comparado aos outros grupos, sendo estatisticamente diferente (teste de Tukey - $p < 0,5$). **Conclusão:** Nos dentes endodonticamente tratados com restauração temporária, o uso de cianoacrilato de etila como material impermeabilizante interno é eficaz na prevenção da microinfiltração.

PALAVRAS-CHAVE

Infiltração dentária; Endodontia; Restauração dentária temporária; Corantes.

INTRODUCTION

Temporary restoration are sometimes necessary after root canal filling, e.g. between appointments during the prosthesis manufacturing, requiring or not intraradicular post and core. Without a hermetic sealing, bacterial microleakage might occur, leading the endodontic treatment to failure [1-4]. Therefore, ideally, temporary restorative materials should provide a hermetic coronary sealing, thus preventing microleakage [5,6].

This is particularly important when intraradicular post and core are indicated because it requires more than one appointment to be completed [7-9]. Structurally compromised teeth need to receive an intraradicular post and core to restore their function in mouth; however, the time between appointments may lead to salivary and bacterial contamination, which will consequently compromise the cleaning obtained during the endodontic treatment [5,6,10,11]. Thus, some materials (adhesives and cyanoacrylates) have been used to improve the sealing of these cavities [11].

Many studies have assumed that there is a correlation between bacterial penetration and dye penetration, although these methods had not been tested simultaneously with the same samples until nowadays. To analyze the sealing capacity, some dyes (methylene blue, eosin, and Rhodamine B) are used, in vitro, to measure microleakage [12-15]. Researches reported that all restorative materials underwent microleakage [5-7,16]. While others afirmed that the use of waterproofing materials (ethyl cyanoacrylate) associated with temporary restorative materials would decrease the microleakage [17-19].

As, the longevity of provisional restorations is related to, a perfect adaptation and a strong, long-term union between restoration and teeth structures, therefore, evaluation of marginal leakage of provisional restorative materials luted with cements using the standardized procedures is essential. This study aimed to evaluate, in vitro, the leakage of Rhodamine B 1%, in provisional restorations, after intraradicular post preparation with and without internal application of waterproofing material (ethyl cyanoacrylate). The hypothesis of this study is that the waterproofing reduces microleakage.

MATERIAL AND METHODS

This study was submitted and approved by the Institutional Review Board regarding ethical aspects (protocol no. #026/2010). Forty-two teeth single-rooted human maxillary teeth were selected from the teeth bank of the institution, including incisors and canines and maxillary. All teeth were examined at 10X magnification, and those with microcracks were excluded. The teeth were cleaned with running water, immersed in 0.5% sodium hypochlorite solution (NaOCl) (Rioquimica™, São Jose do Rio Preto, SP, Brazil) for 72 hours to desinfect the surface, and immersed in wather for 48 hours for hydration. During the experimental period the teeth were maintained in a recipient containing a sponge soaked in water, to ensure humidity. Subsequently, the endodontic access was performed with spherical diamond drills (KG Soresen™, Cotia, SP, Brazil), at high-speed, under refrigeration. The convenience shape of pulp chamber was obtained using Endo Z drills (Maillefer™, Petropolis, RJ, Brazil).

The middle and cervical thirds of the root canal were prepared and cleaned using Gates-Glidden size #3 and #4 drills (Denstsply™, Maillefer, Petropolis, RJ, Brazil) and the contents of the apical third were removed using Hedströen and K files (Dentsply™, Maillefer, Petropolis, RJ, Brazil) with copious irrigation using NaOCl 2.5% all teeth. The working length was established at approximately 1mm short of the radiographic apex, which was confirmed by periapical radiograph. The apical preparation was standardized using #40 K-files. The final irrigation of the root canals was performed with 5 ml of ethylenediaminetetraacetic acid

17% (EDTA, Formula e Ação™, São Paulo, SP, Brasil), followed by 5ml of NaOCl 2.5% solution all teeth. Next, root canals were dried with the aid of absorbent paper points. Root canal filling was perfomed using gutta-percha points (Dentsply™, Maillefer, Petropolis, RJ, Brazil) compatible to the final file diameter (size #40) and endodontic cement (AH Plus™, Dentsply™, Constança, DE, Germany) without lateral compactation.

All teeth received only 2 layers of ethyl cyanoacrylate (Henkel™ Ltd., São Paulo, SP, Brazil), applied with 60 seconds interval between each layer, on all root extension, to avoid dye external leakage. Then, the teeth were randomly divided into three experimental groups, as follows:

-Group I (n = 14): the teeth were sealed with a layer of temporary restorative material (Cimpat Blanc™, Septodont™, Saint-Maurdes, FR, France) without intraradicular preparation (control group).

-Group II (n = 14): after intraradicular post preparation, the teeth were sealed with a layer of temporary restorative material (Cimpat Blanc™, Septodont™, Saint-Maurdes, FR, France).

-Group III (n = 14): after intraradicular post preparation, two layers of ethyl cyanoacrylate with 60 seconds interval between each one, and the teeth were sealed with a layer of temporary restorative material (Cimpat Blanc™, Septodont™, Saint-Maurdes, FR, France).

The teeth were weighed on precision scale, using the double sampling method, to establish the initial weight (IW). Then, the teeth were immersed into test tubes with Rhodamine B 1 % (Interlab™, São Paulo, SP, Brazil) and maintained in a dry kiln at 37ºC and 100% relative humidity for 48 hours. Following, the roots were washed with running water to remove any excess of dye and dried with absorbent paper sheet. The teeth were weighed again, using the double sampling method, to establish the final weight (FW). For each group, the formula FW - IW determined the dye-infiltrated weight. FW-IW values were then transformed into volume using the formula V=W/D, where D is Rhodamine B 1% density (d = 1.0657).

RESULTS

To analyze the difference between final and initial weight of the sample, paired t test was performed, the variable analysis, which showed no statistical difference between the initial and final weight ($p < 0.05$) (Figure 1). To analyze infiltration of the colorant, the volume was the comparison variable. Shapiro Wilk- test was applied and showed normal distribution of the variables. ANOVA ($p = 0.0013$ / $p < 5$ %) was also applied and determined a statistical difference between the groups. To check which groups differed from each other, Tukey test was applied (Figure 2)

It was observed that Group I infiltrated a smaller amount of Rhodamine B 1% as compared to group II. Group III (internally waterproofed with ethyl cyanoacrylate) showed the smallest leakage rate when compared with the other groups, being statistically different ($p < 0.05$).

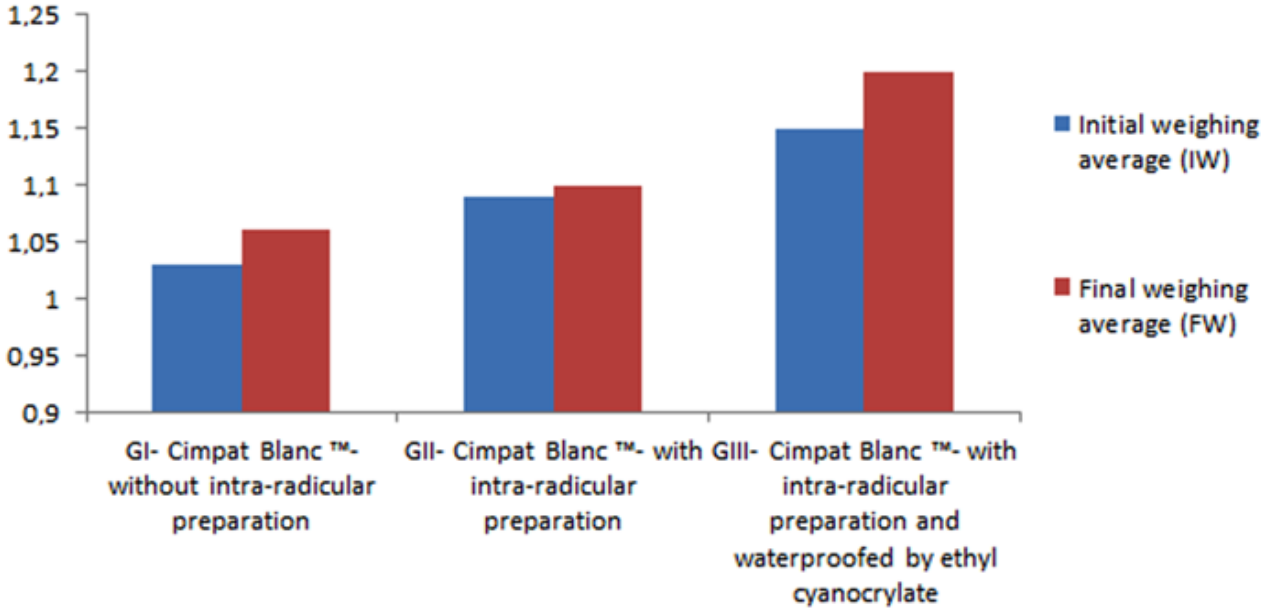
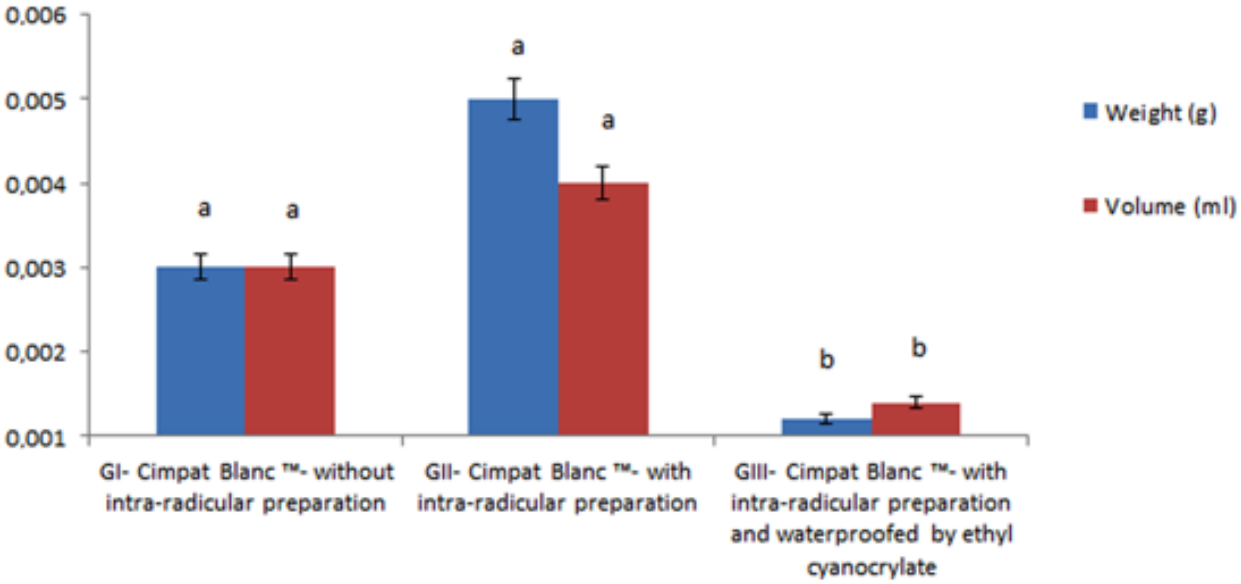


Figure 1 - Initial and final mean weight (g) of the groups.



*a, b Different letters represent statical differences in columns

Figure 2 - 1% Rhodamine mean infiltration values evaluated by weight and volume.

DISCUSSION

Microleakage is the passage of bacteria, fluid, and chemicals to the root canal3. If the temporary restorative material used between endodontic treatment sessions does not provide the hermetic sealing of the cavity, bacteria can reach the root canal affecting the desinfection obtained in the previous sessions of the treatment. These materials when subjected to leakage tests were susceptible to recontamination and likely to increase the failure rate between sessions during the treatment [3,6,10,15,16]. The requirement of provisional restorative materials is to provide an effective and durable seal between sessions of the root treatment.

However, the efficiency of temporary restorative materials is widely discussed and the literature reaches consensus that none is capable of sealing thoroughly [2,20]. To minimize microleakage, researchers have used ethyl cyanoacrylate to promote a waterproofing layer [21-23].

The use of cyanoacrylate is efficient in preventing microleakage [21-24], specifically on teeth requiring prosthetic reconstruction, i.e., teeth demanding more than one appointment to be treated. Some studies reported that cyanoacrylate can be safely used in Medicine and Dentistry. In this study, the ethyl cyanoacrylate was used because it adheres to the dentin walls providing the inner sealing the conduct and our results showed that the group sealed with this adhesive was statistically better in preventing microleakage of Rhodamine B 1% when compared with the groups without waterproofing, accepting the hypothesis of this study.

However, after its application a thick film of adhesive is formed inside the root canal. Although this formed film will not interfere with the prosthesis adaptation , since the flue molding is performed after the sealing. The use of dyes such as methylene blue, eosin, and Rhodamine B 1% are often used for infiltration analysis of restorative materials and this methodology is widely used for studies with this purpose, besides the facility of reproducing it [13-15].

This study used Rhodamine B 1% as it has small particle size, better penetration, water solubility, diffusability, and hard tissue nonreactivity [25,26]. The temporary restorative material (Cimpat™) used in this study is made of zinc oxide and zinc sulfate. The use of these substances in restorative materials is excellent because of the masticatory resistance to compression and abrasion. However, temporary restorative materials do not have good marginal sealing ability, favoring microleakage, which justifies the use of a waterproofing agent.

In this study, the group subjected to intraradicular preparation without internal waterproofing (Group II) showed the highest dye-infiltrated weight and volume, while the group which was waterproofed with ethyl cyanoacrylate (Group III) showed the lowest dye-infiltrated weight and volume. The results of this study corroborate the literature by emphasizing that sealing with only temporary restorative material is not enough to avoid microleakage in endodontically treated teeth [5,6,9.13].

CONCLUSION

It can be concluded that the use of ethyl cyanoacrylate as internal waterproofing agent after intraradicular post preparation prevented Rhodamine B 1% microleakage.

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