

## Original Research Article

# Comparison of the sealing ability of different types of glass ionomer cements in temporary restoration

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### Abstract

**Introduction:** Glass ionomer cement has been used for temporary restoration; however, several formulations are available. **Objective:** The aim of this study was compare the linear leakage of different types of glass ionomer cement – R, F, N and C. **Material and methods:** Forty-four third molars were used and prepared with standardized class I cavity preparations. By using gutta-percha, the cavity height was standardized in 5 mm. The samples were divided into 4 experimental groups (R, N, F and C), and 2 control groups (positive – not restored, and negative – restored using resin). The teeth were waterproofed and immersed in 2% methylene blue. After 7 days, they were sectioned and the measurement of the dye leakage was performed by stereomicroscopy (40X) using a calibrated periodontal probe. **Results:** Data were analysed by Kruskal Wallis and Dunn tests. There was statistically significant differences ( $p = 0.002$ ) between R and C, and R and N glass ionomer groups. C and N glass ionomer groups were similar. F glass ionomer group was similar to all other groups. **Conclusion:** It can be concluded that different types of glass ionomer formulations can influence the peripheral sealing of the restorative material. R glass ionomer was the most effective, while C and N glass ionomers were the least ones.

## Introduction

The success of the endodontic treatment is closely linked to the maintenance of the disinfection obtained by the chemical-surgical preparation. Studies have reported the periapical development of bacterias 24 hours after the root canal exposure to them [7], therefore justifying the provisional restoration between the appointments.

In this context, zinc oxide and eugenol cement is among the most used materials [19] and exhibits excellent properties of resistance to compression [10]; however, it presents high marginal leakage rate [1, 4]. On the other hand, glass ionomer cement has also been used for temporary restoration [19]; it shows high bonding to dentin [17], great resistance to abrasion, and low solubility [11]; it exhibits smaller microleakage values when compared with zinc oxide eugenol cement [3, 15, 20], fluoride release [2] and thermal-linear expansion coefficient similar to the tooth structure.

By comparing microleakage between glass ionomer cements commercialized both in Brazil (Vidrion) and worldwide revealed that the Brazilian trademarks has better sealing capacity with lower cost than worldwide ones [5].

The Brazilian glass ionomer cement is presented in four different specific formulations (R, F, N, and C) for specific indications (restoration, liner, filling and cementation).

The literature reports assessments of teeth restored Vidrion R comparing it with other restorative materials [14, 16, 18]. Also, assessments among restorations performed with other formulations of this material: cementation formulation – Vidrion C [9, 13] and N [12, 14] have been carried out, however, contradicting its indication. Notwithstanding, there were not studies comparing them.

Thus, the aim of this study was to compare the microleakage of different types of glass ionomer cement (R, F, N and C) during the sealing of endodontic access cavities.

## Material and methods

After the approval of the Ethical Committee on Research (protocol number 100/2011), 44 molars with crowns of similar sizes were kept in saline solution (LBS Laborasa, São Paulo, SP, Brazil) for hydration until the moment of its use. The specimens were washed in running water, and an access surgery was standardized as a class I cavity preparation by using a size 1014HL diamond bur (KG Sorensen, São Paulo, SP, Brazil) and Endo-Z bur

(Dentsply-Maillefer, Ballaigues, VD, Switzerland). The deepness of the pulp cavity was measured through millimetric periodontal probe (Trinity, São Paulo, SP, Brazil), and with the aid of a size 4 Paiva's condenser (JER, Belo Horizonte, MG, Brazil) the gutta-percha stick (Dentsply, Petrópolis, RJ, Brazil) was inserted and heated toward the pulp floor, resulting in a 5 mm deep cavity.

The samples were randomly divided into four groups of ten specimens each; and each group was restored with different types of glass ionomer:

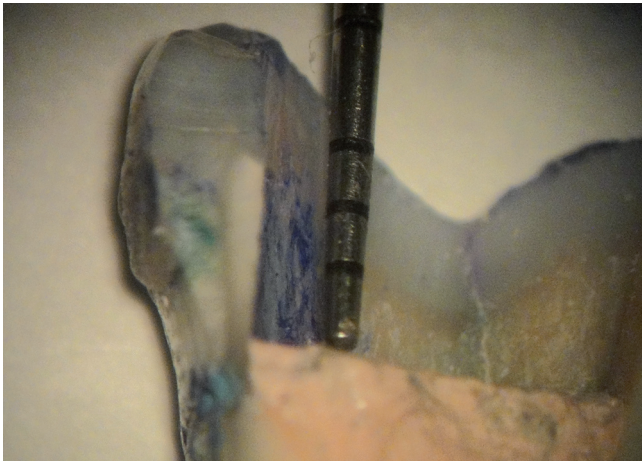
- Group 1 – glass ionomer cement – restorative type - R (Vidrion R, SSWhite, Rio de Janeiro, RJ, Brazil);
- Group 2 – glass ionomer cement – filling type to intraradicular post - N (Vidrion N, SSWhite, Rio de Janeiro, RJ, Brazil);
- Group 3 – glass ionomer cement – cementation type – C (Vidrion C, SSWhite, Rio de Janeiro, RJ, Brazil);
- Group 4 – glass ionomer cement – liner type – F (Vidrion F, SSWhite, Rio de Janeiro, RJ, Brazil).

The negative control group was composed by two teeth restored with resin composite (TPH, Dentsply, Petrópolis, RJ, Brazil) and covered with a layer of cyanoacrylate adhesive (Superbonder, Henkel, Jacareí, SP, Brazil); the positive control group was composed by two teeth which were not restored.

All root surface and the apex was sealed with two layer of colorless nail polish (Impala, Porto Velho, RO, Brazil). Next, the teeth were immersed in 2% methylene blue (O Graal Farmácia de Manipulação, São Paulo, SP, Brazil) for seven days at 37°C.

Following, the teeth were washed in running water to eliminate the dye excess and then cut at the mesial-distal direction through a sulcus on the enamel and cement by using a size 1062 diamond bur (KG Sorensen, São Paulo, SP, Brazil) at high speed and through a sulcus on dentin by using double-face diamond discs (KG Sorensen, São Paulo, SP, Brazil) at low speed.

With the aid of an endodontic explorator (JER, Belo Horizonte, MG, Brazil), the restorative material was removed and all cavity surface was analyzed through operating microscope (DF Vasconcellos, São Paulo, SP, Brazil) at x40 magnification. The linear microleakage was measured with the aid of a millimetric periodontal probe by using the occlusal edge as the initial landmark up to the longest point of leakage towards the apical direction (figure 1).



**Figure 1** - Linear microleakage measurement through millimetric periodontal probe

Data were tabulated and submitted to normality test, Kruskal Wallis test, and Dunn test for comparison among groups, with level of significance set at 5%.

## Results

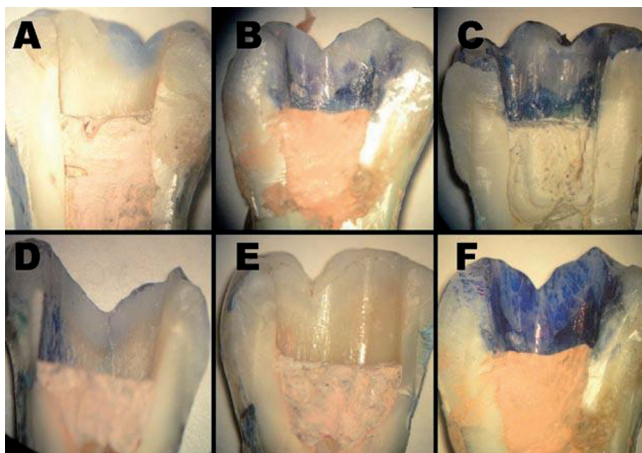
The analysis of linear leakage data showed statistically significant differences ( $p = 0.002$ ) between Vidrion R and C, and Vidrion R and N. Vidrion C and N were statistically similar. Vidrion F was similar to all other groups. Statistical data can be seen in table I.

**Table I** - Statistical data regarding to linear leakage (mm) of teeth restored by different types of glass ionomer cement

Type	n	Mean	Standard deviation	Minimum	Maximum
N <sup>B</sup>	10	3.0	1.05	1	5
R <sup>A</sup>	10	1.5	0.97	0	3
C <sup>B</sup>	10	3.2	0.91	1	4
F	10	2.2	1.22	0	3

\* Different superscript letters mean statistical significant differences ( $p < 0.05$ )

The images representing each group can be seen in figure 2.



**Figure 2** - Optical microscope assessment at  $\times 40$  magnification. A - Vidrion R (G1); B - Vidrion N (G2); C - Vidrion C (G3); D - Vidrion F (G4); E - negative control; F - positive control

## Discussion

The search for an appropriate material to seal an endodontic access cavity is still an issue little studied by the research community, nowadays [1, 3, 10, 15, 16, 18, 20]. Glass ionomer cement has been shown among the most used temporary material [19]; however, its modified formulation leads to different types of cements with different indications.

The simpler chemical composition of glass ionomer powder comprises sodium and calcium fluorsilicate and polyacrylic acid, which represents the cementation type material (C). The liner type glass ionomer cement (F) is composed by the addition of barium sulphate and ferric oxide pigment; the restorative type (R) has the ferric oxide replaced by a pigment ranging according to the color desired; the filling type of intraradicular post (N) has the most different formulation, comprising the F type formulation added by silver, copper, tin and zinc. For all types, the liquid composition is the same - tartaric acid and distilled water.

Considering the above information, we hypothesized whether the different formulations would influence on the sealing ability of the material when used for sealing the endodontic access cavity.

This present study employed third molars because of their easiest obtainment when compared with other teeth. The standardization of a class I cavity preparation for the access surgery was proposed so that different types of cavity preparations would not interfere in the results. The methylene blue dye was chosen because of its recurrent use in studies found in the literature [1, 3-6, 12-14, 20]. Also, it is a dye which results in well-defined evidences at the penetration site; it is of ease obtainment and of low cost. It is known that methylene blue favors the reading of marginal leakage when compared to rhodamine-B, which demands activation by ultraviolet radiation for either simple reading or reading through epifluorescent microscope with special filters [15].

The use of a temporary material thickness of 5 mm followed studies in which was observed a better effectivity of the provisional sealing thickness of 4 mm, and in which thickness smaller than 3 mm showed more leakage results [8, 21].

The cutting of the samples provided the analysis of all cavity walls without losing any of them, resulting in a more precise assessment of the level of the linear leakage.

The results confirmed the hypothesis that the formulation affects the sealing ability. The best results were verified with Vidrion R, which is indicated by direct restorations. Despite of the lack of studies comparing different types of glass ionomer cement (regarding to their indication), the R type is predominantly among them in literature [3, 5, 6, 11, 15, 16, 18, 20]. However, there is a great variety among the results because Raggio *et al.* [14], Ramos and Galn [15] and Pieper *et al.* [11] observed a good sealing quality of Vidrion R; and Formolo *et al.* [6] and Seixas *et al.* [18] found unfavorable results for this same product. Such disagreement among the results could be attributed to the assessment method; most of these studies used scores [5, 11, 14, 15, 18], which were subjective interpretations influencing on the results. The findings of this present study showed a leakage mean of 1.5 mm, which is considered small and superficial in this group. In some samples, none dye leakage was observed in all extension of the cavity and surfaces. This value is in agreement with the findings of Valera *et al.* [20], who found a linear leakage mean of 1.44 mm for the group restored with Vidrion R. Notwithstanding, these findings disagree with those of Ribeiro *et al.* [16],

who observed a mean of 5.7 mm, and those of Couto *et al.* [3], with mean of 3.41 mm. These differences could be explained due to methodological variations in the studies. Ribeiro *et al.* [16] obtained very high numbers, however, the authors performed the waterproofing of the specimens by leaving 3 mm of the coronal portion of the root remnant free of protection; this could have allowed the dye access through the dentinal tubules exposed. On the other hand, Couto *et al.* [3] employed an experimental time period of 21 days, which is three times the time used by this present study.

Concerning to the other groups, Vidrion F showed an intermediary mean value of 2.2 mm; none sample was capable of reaching the limit value to reach the pulp chamber.

Vidrion N, with mean value of 3 mm, showed values close to those of Vidrion C, with higher values of linear leakage. This finding is not in agreement with those found by Pilatti *et al.* [12] and Raggio *et al.* [14], who observed little leakage in their studies. This can be again explained by the experimental time period: 48 and 4 hours, respectively, and by the subjective assessment by scores. Another factor that should be taken into consideration is that Raggio *et al.* [14] employed class V cavity preparations, while this present study used class I preparations.

Vidrion C showed the worst results with leakage values greater than the other types of the material: 90% of the samples had leakage values of 3mm or more for the limit value of 5 mm. These results could be likely attributed to its simpler formulation; the other types of the material contain metallic components added to their formula. The C type shows a more fluid consistency, making it difficult to insert into the cavity, which may also contribute to these results.

It is worth noting that all specimens were immersed into the dye for seven days, which is the mean amount of time between two endodontic appointments. In these conditions, few samples would have reached very closer to the pulp chamber, which occurred only in Vidrion N or C groups. Notwithstanding, although the results showed better results for the other groups, it cannot be affirmed that these would be the same for longer time periods. Therefore, further studies are necessary to provide better information on the influence of different formulations of glass ionomer cement on the sealing ability of endodontic access surgery cavities for longer time periods.

Considering the results of this present study, we recommend that the dentists be alerted regarding to the specific indications of all types of glass ionomer cements, which may influence on the final quality of the product.

## Conclusion

According to the results obtained by this present study, it can be concluded that the different formulations of glass ionomer cement may influence on the peripheral sealing ability of the temporary restoration. Considering the immersion time period of seven days, R type was the most effective and the C and N types the least ones.

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