

# ***Loss of weight of materials used in mechanical sealing of non-vital teeth submitted to bleaching agents***

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## ***Abstract***

***To evaluate the loss of weight of two glass ionomers (GIC) Vidrion R® (VR) and Vitremer® (VT) which were submitted to bleaching agents 37% Carbamide Peroxide (CP) and 35% Hydrogen Peroxide mixed with Sodium Perborate (PP) using Zinc Phosphate (ZP) cement as control. The influence of the storage time since the sample preparation until the whitening application (used right after the restoration or 24 hours later). Seventy (70) samples were divided into 10 groups in the odd the materials were utilized immediately after the sample preparation; in the even, 24 hours later with the following distribution. The weight change of these specimens were measured before the immersion in bleaching agents and 21 days after using the analytical balance. Mean value and SD was calculated and data was analyzed using ANOVA/Kruskal-Wallis test at a 0,01 significance level. VT proved to be less soluble than VD R and not show any estatistically significance difference in comparison with ZP.***

***Keywords: Dental materials; Glassionomer cements- Solubility; Dental bleaching***

## ***INTRODUCTION***

***One of the most frequent causes of blackened teeth is associated to endodontic therapy, because of the canal obturator materials, or because of the necrotic components and pigments from red cell breakage with consequent hemosiderin liberation (MONDELLI, 1998). Intracoronal bleaching of nonvital teeth is a conservative treatment and a simple technique for discolored teeth when carried out correctly as indicated, they can give a satisfactory result. However, some care is necessary to optimize***

***and guarantee more safety during the bleaching treatment, avoiding fluids passing to the periodontium, as the literature reports permeability occurrence in CEJ, even in teeth with mechanical bar (DEZOTTI; SOUZA JÚNIOR; NISHIYAMA, 2002). External reabsorptions are associated to whitening with peroxides. Nevertheless, the existence of a previous trauma or the biologic sealment absence and/or mechanical is often associated (HARRINGTON; NATKIN, 1979).***

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*The great incidence of structural defects and/or dentin exposure in the cervical area, physiologically found (NEUVALD, 1997) increases the permeability and facilitates the propagation of substances used for the bleaching (ROTSTEIN; TOREK; MISGAV, 1991; WEIGER; KUHN; LÖST, 1994; KOULAOU-ZIDOU et al., 1996) via dentinal tubules, to the cervical region of periodontium causing a considerable decline in the local pH and denaturing the dentin (LADO; STANLEY; WIESMAN, 1983), which will behave like a strange body being attacked by the osteoclasts causing the reabsorption at the cervical level (HO; GOERIG, 1989). This emphasizes the importance of a correct mechanical sealing of cervical area in order to prevent whitening agents infiltration until the apical portion of the radicular canal and laterally until the periodontal tissues (COSTAS; WONG, 1991). The solubility study of materials used for this protection is more and more necessary as the disintegration of them can determine a way for the whitening agents to access the periodont of cervical region (DEZOTTI; SOUZA JÚNIOR; NISHIYAMA, 2002).*

*For the mechanical sealment of the third radicular cervical, different materials are recommended, and the glass ionomers are one of the most utilized, once they have acceptable resistance, biocompatibility and adhesion to the dental structures (BAPNA; MUELLER, 1999). Since their emergence, they have been refined to improve their properties, mainly mechanical and related to technical sensitivity (QUA-CKENBUSH; DONKLY; CROLL, 1998). However, the chemical composition and the type of set reaction make these materials present different physical and chemical characteristics, interfering in their properties*

*Thus, the purpose of this study was to:*

- evaluate the loss of weight of a conventional GIC (Vidrion R<sup>®</sup> - VR) and reinforced with resinous particles (Vitremar<sup>®</sup> - VT) they are submitted to treatment with different bleaching agents using Zinc Phosphate (ZP) cement as control;*

- determine if the storage time from the chemical reaction start of the material until the moment in which it is put in contact with the bleaching interferes in its loss of weight.*

## **MATERIALS AND METHODS**

*Two cements of GIC were selected for this study: one conventional (Vidrion R<sup>®</sup> - VD\*) and one modified by resinous particles (Vitremar<sup>®</sup> - VT†). The zinc phosphate cement - ZP was used as control and the manipulation of the materials was determined according to the manufacturers' instructions. The bleaching agents studied were carbamide peroxide 37% (Whiteness‡) and 35% Hydrogen Peroxide mixed with Sodium Perborate§*

*The most common laboratory test of loss of weight is the ADA specification # 8 (AMERICAN DENTAL ASSOCIATION, 1907 apud PAFFENBARGER; SWEENEY; ISAACS, 1934). Thus, this study investigates weight changes of two glass ionomer cements and other dental material during bleaching agent's immersion by a modification of the conventional specification test.*

*Seventy (70) specimens were prepared a circular matrix of acrylic resin, (3 mm thickness and 4 mm in diameter). The materials were put into the matrix with a Centrix syringe to avoid air bubble formation and to guarantee a smooth surface. They were prepared between two glass plates put in by a polyester matrix and kept under a standard weight, until verification of the initial setting of the material.*

*The sample was divided into 10 groups (n=7), according to the tested material and storage time of setting until contact with the bleaching agents (TABLE 1).*

*To verify if the storage time since chemical reaction interfered in the materials' loss of weight, the samples of the odd groups (G1; G3; G5; G7;), were put in contact with the bleaching agents immediately after their preparation and the even ones (G2; G4; G6; G8;) after 24 hours*

\* SS White

† 3M-ESPE

§ Synth laboratory

**Table 1- The summary of 8 tested groups and 2 control groups**

GROUP	MATERIAL	BLEACHING AGENT	STORAGE TIME
1	VD	PP#	Immediately
2	VD	PP	24 hours
3	VD	CP##	Immediately
4	VD	CP	24 hours
5	VT **	PP	Immediately
6	VT	PP	24 hours
7	VT	CP	Immediately
8	VT	CP	24 hours
9 – control	ZP***	PP	Immediately
10 – control	ZP	CP	Immediately

**Notes:** \* Vidrion R cement  
 \*\* Vitremer cement  
 \*\*\* Zinc Phosphat cement  
 # Hydrogen Peroxide 35% mixed with Sodium Perborate  
 ## Carbamide Peroxide 35%

Previous to the contact with the bleaching agents, the samples were washed with neutral soap, swilled out with 'Mili Q' water and dried for 30 minutes at a temperature of around 50°C until they obtained a constant weight, which was verified after a 3-time repetition of the same weight. To avoid a quick saturation of the whitening substances in each group, the specimens were divided into three Deppendorff flasks and then immersed in the substances. Seven groups were put in contact with 37% CP (CP) and the other seven were submitted to 35% hydrogen peroxide + PP (PP). The loss of weight was verified before the tests and 21 days after using the comparison between the initial and final weight of the specimens, measured with an accuracy analytical balance GEHARA (A6-200). After the weight verification, the results were submitted to ANOVA/Kruskal-Wallis statistical test ( $\bar{n} < 1\%$ ).

## RESULTS

The statistical analyses showed that on the 21<sup>st</sup> day:

-Vidrion® presented loss of weight significantly bigger than Vitremer® and Zinc Phosphate in contact right after the PP bleaching agent (G1>G5>G9;) and in contact right after

**Table 2- Weight, means values and SDs for all groups**

Groups	21 <sup>st</sup> days			
	Initial		21 <sup>st</sup> days	
	Wt	Means±SD	Wt	Means±SD
G1	0.0416	0.097±0.024	0.0246	0.057±0.015 <sup>ab</sup>
G2	0.0390	0.091±0.020	0.0277	0.064±0.016 <sup>a</sup>
G3	0.0408	0.095±0.026	0.0351	0.081±0.024 <sup>abd</sup>
G4	0.0443	0.103±0.027	0.0401	0.093±0.025
G5	0.0508	0.118±0.029	0.0506	0.118±0.030 <sup>a</sup>
G6	0.0505	0.116±0.002	0.0483	0.112±0.034 <sup>a</sup>
G7	0.0496	0.115±0.030	0.0483	0.112±0.003 <sup>b</sup>
G8	0.0473	0.110±0.024	0.0463	0.108±0.025 <sup>f</sup>
G9	0.0605	0.140±0.033	0.0641	0.149±0.036 <sup>f</sup>
G10	0.0645	0.150±0.039	0.0636	0.127±0.042 <sup>df</sup>

Notes: mean±Std.Dev, n=7

Data followed by the same superscripted letter mean statistical difference ( $p > 0,01$ )

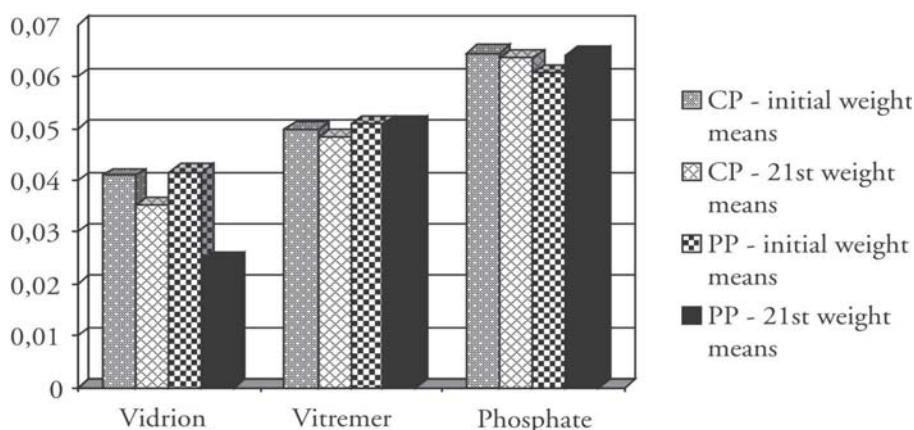
the CP bleaching agent (G3>G7>G10) (GRAPHIC 1). The same happens 24 hours later with the PP bleaching agent (G2>G6) and with the CP bleaching agent (G4>G8) (GRAPHIC 2).

-Considering the setting time, Vitremer proved to have less loss of weight than Vidrion when in contact with two bleaching agents immediately after its manipulation (G5/G7<G1/G3) ( $\bar{n} < 1\%$ ) but it did not show any statistically significant difference in comparison with the Zinc Phosphate (G5/G7H" G9/G10) ( $\bar{n} > 1\%$ ) (GRAPHIC 3)

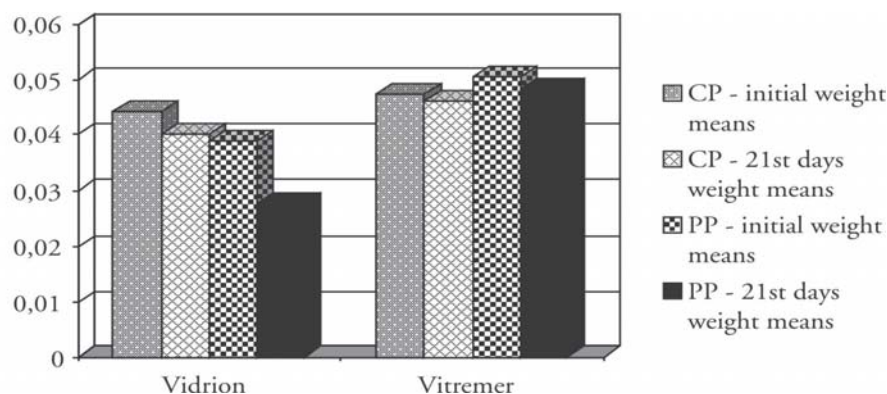
## DISCUSSION

The loss of weight of the GIC Vidrion R was statistically greater than Vitremer ( $p < 1\%$ ). The greater difficulty of manipulation, reduced time of work and long time of setting of the conventional GICs, allied to a greater sensitivity to water, especially during the early stages, can explain these differences. In addition, VT is a GIC modified by resinous particles. Its sensitivity to water decreased quickly when exposed to light and started the photopolimerization process (IWAMI et al., 1998), providing better results of this material compared to VR.

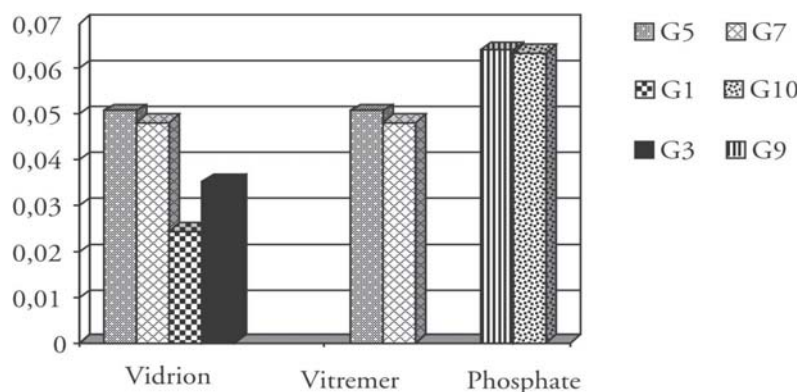
Although there was no statistical significant difference, the analyses of the weight variation in absolute numbers of the VD R samples right after the restoration or after 21 days showed that the samples, when in contact with whitening



**Graphic 1 - Weight means (mg) of the different materials in contact right after with CP an PP on the 21<sup>st</sup> days and initial weight**



**Graphic 2 - Weight means (mg) of the GIC in contact 24 hours after and phosphate right after with CP an PP on the 21<sup>st</sup> days and initial weight**



**Graphic 3- Vitremer/Vidrion X Vitremer/Zinc Phosphate**

*Notes: Vitremer proved to be less loss of weight than Vidrion when in contact with two bleaching agents immediately after its manipulation (G5/G7<G1/G3) ( $\bar{n}<1\%$ ) but did not show any statistically significant difference in comparison with the Zinc Phosphate (G5/G7H" G9/G10) ( $\bar{n}>1\%$ )*

*\* The same superscripted letter are not different ( $p>1\%$ )*



agents immediately after the mixture (G1, G3), suffered a great degradation when compared to those treated after 24 hours of manipulation (G2, G4). This fact can be explained based on the chemical reaction that happens in a slow and gradual way, presenting a big ionic modification and being more susceptible to water absorption, specially during the early stages. This can easily cause the most superficial layer disintegration (UM; ØILO, 1992; CARVALHO-JUNIOR et al., 2003). Not only the paste, but also the gel presented more viscosity that increases the contact angle between the referred substances and the samples' surface. There is also the neutral pH, demonstrating the low aggression power of these components that can help to explain the contradictory results mentioned.

Concerning VT, the fact of being in contact with the whitening right after the manipulation did not have any influence on its loss of weight. The VT is an ionomer reinforced with photosensitive resinous particles which have a larger resistance because with the light incidence there is a conversion of the monomers into polymers. This improves the properties in the initial phase, including a reduced solubility (UM; ØILO, 1992).

At the end of the studie, it was possible to observe that VT suffered a small weight alteration at the beginning. The initial weight alteration can be explained by the fact that some monomeric molecules were not totally polymerized by the light incidence (FERRACANE, 1994; CHEN et al., 2001), so they could be easily loosened or solubilize the material surface. In addition, the chemical reaction phase of VT also happens in a gradual way, making the material more susceptible to physical, chemical and mechanical phenomena of degradation during this period. The stabilization after may be a consequence of the water absorption that can compensate for the mass loss caused by the solubility. This phenomenon seems to be a dependent product and influenced by the HEMA content that exists in the materials, including VT (YAP; LEE, 1997; KNOBLOCH et al., 2000). There was a new sample weight change after 21 days, and this may be a consequence of the solubility of some monomers of the superficial layer. The sensitivity to absorption and solubility of resinous materials seem to have a relation with the organic matrix

hydrophilicity (ÖRTENGREN et al., 2001). In this study, the paste used as immersion agent presents in its composition 35% of hydrogen peroxide and a CP gel, which dissociates itself into hydrogen peroxide and urea. The hydrogen peroxide degrades into oxygen and water (MONDELLI, 1998). The HEMA monomer, (highly hydrophilic, is present in the VT composition,) when in contact with the water liberated during the chemical reaction of the whitening substances it may have suffered solubilization during the treatment time, explaining the new sample weight change after 21 days.

In this work, the ZP cement was used as control, when this material presented predictable results, amply available in dentistry literature (YOSHIDA; TANAGAWA; ATSUTA, 1998). Its setting time is between 5 and 9 minutes. This fact was considered when it was not added to a group evaluating its solubility after 24 of setting in contact with the whitening.

New research is necessary, utilizing the available 'gloss' of the VT kit on the samples surfaces, because the monomer used is BIS-GMA, with hydrophobic characteristics and low solubility (SCHUURS; GRUYTHUYSEN; WESSELINK, 2000). This way, the non-react hydrophilic monomers that are present in the internal layers of the material would have a bigger protection against the solubilization.

The solvent pH is also one of the important factors to be considered during the loss of weight tests (CRISP; LEWIS; WILSON, 1980; MESU, 1982; WALLS; McCABE; MURRAY, 1988). Many types of cements, specially the recently developed ones, can present an insignificant solubility in distilled water, but when in contact with acid media, the occurrence of a set increases solubility and erosion (BAPNA; MUELLER, 1999). In addition, the mechanical properties and superficial texture of the materials are altered when they are immersed in solution with low pH (ABU-BAKR et al., 2000). Our work used a 37% CP gel and a paste composed of PP and 35%, hydrogen peroxide both presenting a pH close to 7, therefore almost neutral, probably without an active participation in the degradation process of the materials.

*No statistical significant difference between the two tested types of whitening agents was observed although it was possible to observe that the paste with a PP + hydrogen peroxide composition had a bigger effect on the loss of weight of ionomeric materials than the CP. The presence of hydrogen peroxide in larger proportions in the paste allied to the hydrophilic of the ionomeric cements may be responsible for this effect.*

## **CONCLUSIONS**

*According to the obtained data in the present study, we can verify that:*

*- the chemical reaction after the beginning of the chemical reaction until the contact with the bleaching agents did not have a statistically significant difference, although a bigger weight*

*loss of VD when put in contact with the whitening immediately after its manipulation was observed.*

*- the GIC with resinous particles showed to lose less weight to the whitening agents when compared to the conventional. When VT was compared to the control group (ZP cement), there was no statistically significant difference when the bleaching products were applied immediately after the materials manipulation,*

*- Despite not showing statistically significant difference, the materials lost more weight when the sodium perborate + hydrogen peroxide paste was used, when compared to the carbamide peroxide gel, in absolute values*

*Based on the results found, we can suggest that Zinc Phosphat and Vitremer should be the first chosen materials in cases of mechanical selament to nonvital teeth whitening*

## ***Perda de peso de materiais usados para o selamento mecânico de dentes não vitais submetidos a agentes clareadores.***

### **Resumo**

O presente trabalho avaliou a solubilidade do cimento de ionômero de vidro quimicamente ativado Vidrion R® -SS White- (VR) e do reforçado com partículas resinosas Vitremer® -3M- (VT) submetidos ao tratamento com diferentes substâncias clareadoras, empregando o fosfato de zinco como controle. Os agentes clareadores utilizados foram o peróxido de carbamida (PC) e uma pasta composta por perborato de sódio + peróxido de hidrogênio (PP), ambos a 37%. Também foi avaliada a influência do tempo decorrido desde o preparo do corpo-de-prova até o momento de aplicação do clareador (se o mesmo for utilizado imediatamente após a restauração ou 24 horas depois). Foram confeccionados, com matriz padronizada, 70 corpos de prova divididos em 10 grupos (n=7) sendo que nos grupos ímpares os materiais foram utilizados imediatamente após o preparo dos corpos-de-prova e nos pares, 24 horas depois. Previamente à imersão nos clareadores, os corpos de prova foram lavados em água "Mili Q", enxaguados e secos a uma temperatura média de 50°C durante 30 minutos até a obtenção do peso constante. Após, foram pesados em Balança Analítica de Precisão GEHAR A6-200 e imersos nos agentes clareadores sendo novamente lavados, secos e pesados no período de 21 dias, tempo final do experimento. Os resultados foram analisados através do teste de Kruskal-Wallis ( $\tilde{n}<1\%$ ). De acordo com a metodologia empregada, foi possível verificar que o Vitremer demonstrou ser menos solúvel aos agentes clareadores quando comparado ao Vidrion R. Quando comparado com o Fosfato de zinco nenhuma diferença estatisticamente significante foi encontrada.

**Palavras-chave:** Materiais dentários; Cimentos de ionômero de vidro- Solubilidade; **Clareamento dentário.**

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