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Investigation

Effect of tooth whitening on dental restorative materials

*Susana Marto**, *Catarina Coito, Ana Pequeno, Alexandre Cavalheiro*

Faculdade de Medicina Dentária da Universidade de Lisboa, Lisboa, Portugal

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ABSTRACT

Objective: To evaluate the effects of tooth whitening with 10% carbamide peroxide on the surface ultramorphology of three dental restorative materials.
Materials and methods: Three materials were tested: (1) a reinforced zinc oxide-eugenol cement (IRM® Powder Zinc Oxide Eugenol, Dentsply, Konstanz, Germany), (2) a high copper amalgam with spherical particles (Ventura Finest®, Madespa SA, Toledo, Spain) and (3) a nanohybrid composite (EvoCeram Tetric®, Ivoclar Vivadent AG, Schaan, Liechtenstein). 6 specimens of each material ($N = 18$) were inserted into silicone molds with circular cavities of 10 mm × 2 mm. 3 specimens of each material were randomly assigned into the whitening or control groups. In the whitening group, the specimens were exposed to a 10% carbamide peroxide gel (Opalescence® PF 10%, Ultradent, South Jordan, UT, USA) for 14 consecutive days, 6 h per day. In the control group, the specimens were exposed to distilled water. After 14 days stored at 37 °C, all specimens were analyzed by scanning electron microscopy.
Results: The specimens exposed to carbamide peroxide revealed an irregular surface, with cracks and pores. Specimens from all control groups showed a smooth surface.
Conclusion: The 10% carbamide peroxide gel may cause changes in surface ultramorphology of the materials tested: reinforced zinc oxide-eugenol cement, amalgam and composite.

Efeitos do branqueamento dentário nos materiais restauradores

Palavras-chave:
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Restaurações dentárias
Resina composta
Amalgama dentária
Cimento de óxido de zinco-eugenol

RESUMO

Objectivos: Avaliar os efeitos do branqueamento dentário com peróxido de carbamida a 10% na ultra-morfologia de superfície de materiais restauradores dentários.
Materiais e Métodos: Foram testados três materiais: 1) um cimento de óxido de zinco-eugenol reforçado (IRM® Powder Zinc Oxide Eugenol, Dentsply, Konstanz, Alemanha), 2) um amálgama de alto teor de cobre de partículas esféricas (Ventura Finest®, Madespa SA, Toledo, Espanha) e 3) um compósito nanohíbrido (Tetric EvoCeram®, Ivoclar Vivadent AG, Schaan, Liechtenstein). 6 espécimes de cada material (N = 18) foram inseridos em moldes de silicone com cavidades circulares de 10 mm x 2 mm. 3 espécimes de cada material foram distribuídos aleatoriamente para os grupos de branqueamento ou de controlo. No grupo de branqueamento, os espécimes foram expostos a um gel de peróxido de carbamida a 10%

* *Corresponding author.*
E-mail address: susanamarto@sapo.pt (S. Marto).

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(Opalescence PF 10%®, Ultradent, South Jordan, UT, EUA) durante 14 dias seguidos, 6 horas diárias. No grupo de controlo, os espécimes foram expostos a água destilada. Após 14 dias de armazenamento a 37 °C, todos os espécimes foram analisados através de microscopia electrónica de varrimento.
Resultados: Os espécimes expostos ao peróxido de carbamida revelaram uma superfície irregular, com fendas e poros. Os dos grupos de controlo apresentaram uma superfície regular.
Conclusão: O gel de peróxido de carbamida a 10% pode causar alterações na ultra-morfologia de superfície dos materiais testados: cimento de óxido de zinco-eugenol reforçado, amálgama e compósito.

Introduction

Tooth whitening is a popular technique used in esthetic dentistry,[1] being widely accepted as an effective clinical procedure.[2] Although considered relatively safe with regard to systemic effects, recently, some controversy has arisen related to its effects on restorative materials.[1] The effect of whitening agents on restorative materials should be analyzed for their potential deleterious consequences on physical, mechanical and corrosive properties. The changes on materials properties may have important clinical implications, since the prognosis and the longevity of a dental restoration may depend upon them.[3]

Rotstein et al. have concluded that both 10% carbamide peroxide (CP) and 10% hydrogen peroxide (HP) altered the surface ultramorphology of reinforced zinc oxide-eugenol cement fillings, through scanning electron microscopy (SEM) analysis, with differences on the zinc oxide levels.[4]

Regarding amalgam, the greatest point of interest and research has been the mercury, with several authors detecting an increased concentration after whitening on the: (1) restorative surface, (2) immerging water, and (3) whitening product.[1,5–8] Nevertheless, the mercury concentration was lower than the guidelines recommended by the World Health Organization (WHO) and National Academy of Sciences' Food and Nutrition Board (NASFNB).[1] The mercury release from fillings is dependent on the: (1) duration of the whitening treatment, (2) amalgam age, (3) surface polishing conditions, (4) composition and pH of the whitening agent,[7] and (5) surface area of the restoration.[7,9]

Concerning the surface changes, Rotstein et al.[5] and Gurgan et al.[7] concluded that slight differences in amalgam surface regularity can be observed on SEM micrographs, after application of CP and HP. Nonetheless, other two experimental studies[6,10] have not reported surface alterations after treatment with CP and HP.

Several studies have demonstrated an increase on the surface roughness of resin composites after whitening with 10% CP and/or 10% HP.[11–13] Furthermore, some authors[14] verified the existence of cracks visible to the naked eye with this material. Wattanapayungkul et al.[3] concluded that the effect of whitening agents on surface roughness of composites is dependent on the specific material tested and time, with higher concentrations of HP causing higher roughness. In these cases, repolishing or replacing these restorations may be necessary after long periods of whitening treatment to allow the reestablishment of the esthetic properties and to prevent the colonization of cariogenic microorganisms.[3,14,15]

The objective of the present study was to assess the effects of tooth whitening on the surface ultramorphology of reinforced zinc oxide-eugenol cement, amalgam and resin composite analyzed by SEM. The null hypothesis tested on this study was that tooth whitening using a commercially available 10% CP gel does not cause any changes on the surface ultramorphology of reinforced zinc oxide-eugenol cement, amalgam and resin composite when compared with the surface ultramorphology of specimens of these materials exposed to distilled water.

Materials and methods

Three restorative materials were studied: a nanohybrid composite (EvoCeram Tetric®, Ivoclar Vivadent AG, Schaan, Liechtenstein) with A4 color, a high copper amalgam with spherical particles (Ventura Finest®, Madespa SA, Toledo, Spain) and a reinforced zinc oxide-eugenol cement (IRM® Powder Zinc Oxide Eugenol, Dentsply, Konstanz, Germany). 18 specimens were prepared, 6 specimens of each material, according to manufacturer's instructions and using silicon molds of 10 mm diameter and 2 mm thickness.

Amalgam capsules were vibrated on an amalgam vibrator for 5 s and, with the aid of an amalgam carrier, the material was placed in the molds, being condensed with an amalgam condenser. For the reinforced zinc oxide-eugenol cement, powder and liquid were mixed with a spatula, in a glass plaque, and the material was inserted in the molds. After the material setting, the specimens were removed from the molds. The composite disks were obtained by the insertion of a single increment, with a spatula, into the molds. Each specimen surface was light-cured for 40 s with a curing light (XL 3000®, 3M ESPE, St. Paul, MN, USA). The disks were then removed from the molds, placed inside sealed test tubes containing distilled water and stored at 37 °C for 48 h. Three specimens of each material were randomly assigned into the whitening or control groups.

All the specimens were polished with a different standardized method for each material. The amalgam disks were polished using, sequentially, a green stone (Komet®, Gebr. Brasseler, Lemgo, Germany), and three amalgam rubber