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Effect of Opalescence® bleaching gels on the elution of dental composite components

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ABSTRACT

Objectives. Bleaching treatments can affect on the polymer network of dental composites. This study was performed to evaluate the influence of different bleaching treatments on the elution of composite components.

Methods. The composites Tetric EvoCeram®, CLEARFIL™ AP-X, Tetric EvoFlow®, Filtek™ Supreme XT, Ceram X® mono+, Admira and Filtek™ Silorane were treated with the bleaching gels Opalescence PF 15% (PF 15%) for 5 h and PF 35% (PF 35%) for 30 min and then stored in methanol and water for 24 h and 7 d. The eluates were analyzed by gas chromatography/mass spectrometry (GC/MS). Unbleached specimens were used as control group.

Results. A total of 16 different elutable substances have been identified from the investigated composites after bleaching-treatment. Six of them were methacrylates: 1,10-decandioldimethacrylate (DDDMA), 1,12-dodekandioldimethacrylate (DODDMA), ethylenglycoldimethacrylate (EGDMA), 2-hydroxyethylmethacrylate (HEMA), triethylenglycoldimethacrylate (TEGDMA) and urethandimethacrylate (UDMA). Compared with the unbleached controls the composites Tetric EvoCeram®, CLEARFIL™ AP-X and Tetric EvoFlow® showed a reduced elution of UDMA, TEGDMA and HEMA after bleaching-treatment. Compared with the unbleached controls an increase elution of UDMA, DMABEE, BPA and TEGDMA for the composites Filtek™ Supreme XT, Ceram X® mono+, Admira and Filtek™ Silorane after bleaching-treatment has been detected. The highest concentration of UDMA was 0.01 mmol/l (Tetric EvoCeram®, water, 24 h, controls), the highest concentration of TEGDMA was 0.28 mmol/l (CLEARFIL™ AP-X, water, 7 d, controls), the highest concentration of HEMA was 0.74 mmol/l (Tetric EvoFlow®, methanol, 7 d, PF 35%), the highest

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concentration of DMABEE was 0.10 mmol/l (Ceram X® mono+, water, 7 d, PF 35%) and the highest concentration of BPA was 0.01 mmol/l (Admira, methanol, 7 d, controls).
Significance. Bleaching treatments can lead to a reduced or an increased elution of substances from the dental composites.
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1. Introduction

The consciousness of asthetic appearance in society is increasing: lots of patients are not satisfied with the color of their teeth [1]. There are various possibilities of whitening teeth, so personal esthetic expectations of the patient can be fulfilled [2]. Bleaching methods are based on carbamide- or hydrogen peroxide gel: (1) over-the-counter products (maximum 10% peroxides); (2) home bleaching methods (15% peroxides); (3) in-office-bleaching methods (35% peroxides) and finally chairside-bleaching methods (38% peroxides) [3,4]. Bleaching trays are only used with the home bleaching and the in-office-bleaching method [5].

The use of resin based composites are rapidly evolving and patients are more aware of, and demanding of, esthetic tooth-colored restorations [6]. So in the past various studies were carried out to examine the reaction of dental composites on bleaching products: thereby the microhardness [7–10] and the surface texture [8,11–13] were tested. Further studies were carried out whether bleaching treatment have an influence on color of dental composites [14–16].

Patients undergoing bleaching treatment often have insufficient restorations which have to be replaced before starting the bleaching procedure preventing the contact of bleaching gel with the pulp which could result in pulp damage such as apoptosis of human dental pulp cells or irritation of the tooth [17].

Our earlier studies showed that bleaching treatments can affect the elution of monomers and other substances from dental composites [18–20]. (Co)monomers (methacrylates) besides initiators, stabilizers, additives and pigments are part of the organic resin matrix of unpolymerized composites [21]. The polymerization of composites is incomplete: the lower the conversion rate of a composite the more residual (co)monomers can be eluted [22]. Elutable residual (co)monomers (methacrylates) can cause allergic reactions [23] such as asthma, rhinoconjunctivitis allergica or contact dermatitis [24].

Numerous studies concerning the monomer elution from dental composites have been carried out so far [25–27]. Less data are available about the influence on the amount of elutable substances from dental composites after previous bleaching procedures. Bleaching treatments can have an effect on the three-dimensional polymer network of dental composites [19]. The aim of this study was to find out whether different bleaching treatments affect the time-related elution of components from various dental composites.

2. Materials and methods

The tested composites including manufacturers' data and the bleaching gels are listed in Tables 1 and 2.

2.1. Preparation of samples

For sample preparation the method of our earlier study [19] has been improved: the bleaching treatment of the samples has been performed excluding daylight, because light sources additionally can activate peroxides of bleaching gels. Thus the bleaching process could be accelerated [28].

The sample preparation is described in detail: about 100 mg of each unpolymerized composite (Table 1) was inserted in one increment in a Teflon ring (6 mm diameter, thickness 1.9 mm = surface 92.36 mm^3) placed on a plastic matrix strip (Frasaco, Tettnang, Germany). After covering samples with another plastic matrix strip, samples were polymerized according to instruction of manufacturer (Table 1) by using a dental manual light-curing unit (Elipar S10, 3 M ESPE, Seefeld, Germany) which was directly placed on the matrix strip. The light intensity of the LED lamp (1200 mW/cm^2) was checked using Demetron® Radiometer (Kerr, USA).

For bleaching procedure two concentrations of bleaching gel were used exactly according to the instructions of the manufacturer (Table 2): Opalescence® PF 15% Tooth Whitening Systems (PF 15%) (home bleaching procedure) and Opalescence® PF 35% Tooth Whitening Systems (PF 35%) (in-office-bleaching procedure). For each composite (Table 1) 3 groups with 4 samples each ($n = 4$) were prepared: (1) samples bleached with PF 15% for 5 h; (2) samples bleached with PF 35% for 30 min and (3) unbleached samples: control group. During bleaching process the samples were stored excluding daylight.

After bleaching process the bleaching gel was removed: (1) roughly remove by spatula; (2) carefully remove by absolute dry cotton sticks.

Subsequently samples were incubated in brown glass vails (Macherey-Nagel, Düren, Germany) with 1 ml of methanol (GC Ultra Grade, RATISOLV® ≥99.9%, Roth, Karlsruhe, Germany) at 37 °C and analyzed after 1 d and 7 d by GC/MS [19]. As internal standard caffeine (CF) solution (0.01 mg/ml) (HPLC ≥ 99.0%, Sigma–Aldrich, St. Louis, United States) was added.

Water (LC–MS-Grade, ROTISOLV®, Roth, Karlsruhe, Germany) elutions were carried out as outlined above. For GC/MS analysis water samples were extracted with ethyl acetate (1:1, v/v) (LC–MS-Grade, ROTISOLV® ≥99.9%, Roth, Karlsruhe, Germany).

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