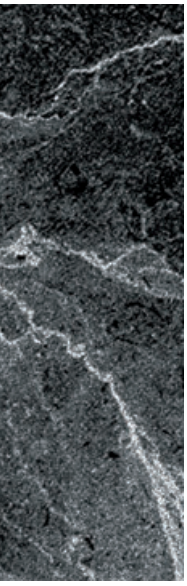

Critical Appraisal

EFFECTS OF BLEACHING ON TOOTH STRUCTURE AND RESTORATIONS, PART IV: EFFECTS ON RESTORATIVE MATERIALS

Author and Associate Editor

Edward J. Swift Jr., DMD, MS

Tooth whitening has become a common treatment over the last 15 years, and much research has been reported on the effects of bleaching procedures on enamel, dentin, and restorative materials. We are presenting a series of Critical Appraisals covering recent research in this area. This final installment describes studies regarding the effects of bleaching agents on various types of restorative materials.

THE EFFECT OF DIFFERENT BLEACHING AGENTS ON THE SURFACE TEXTURE OF RESTORATIVE MATERIALS

O. Polydorou, E. Hellwig, T.M. Auschill
Operative Dentistry 2006 (31:473–80)

ABSTRACT

Objective: The purpose of this study was to evaluate the effects of an in-office and an at-home bleaching agent on six different esthetic restorative materials.

Materials and Methods: The restorative materials used in the study were all A3 shade and included a hybrid composite (Tetric Ceram, Ivoclar Vivadent, Schaan, Liechtenstein), a flowable composite (Tetric Flow, Ivoclar Vivadent), a microhybrid (Enamel Plus HFO, Micerium, Avegno, Italy), a nanofill composite (Filtek Supreme, 3M ESPE, St. Paul, MN, USA), an ormocer (Definite, Dentsply, Konstanz, Germany), and a CAD/CAM ceramic (Vitablocs Mark II, Vita Zahnfabrik, Bad Sackingen, Germany). Specimens were 4.5 mm in diameter and 2-mm thick. The composite and ormocer specimens were divided into unpolished and polished groups (the latter accomplished with the 3M ESPE Sof-Lex disk series). Each subgroup (for every testing period and bleaching agent) included three specimens.

The bleaching materials used were Opalescence Xtra Boost (Ultradent Products, South Jordan, UT, USA), which contains 38% hydrogen peroxide, and Opalescence PF (Ultradent Products), which contains 15% carbamide peroxide. Fifteen percent carbamide peroxide is roughly equivalent to 5% hydrogen peroxide.

Specimens were examined using scanning electron microscopy (SEM) at various intervals. SEM evaluations were done at magnifications of 60×, 200×, and 2,000×. For the in-office material, SEM examinations were performed before bleaching, after 15, 30, and 45 minutes of bleaching, 24 hours later, and 1 month later. For the at-home material, the examinations were done before bleaching, after 8 and 56 hours of bleaching, 24 hours later, and 1 month later. The specimens were stored in distilled water except during treatment.

DOI 10.1111/j.1708-8240.2008.00179.x

The SEM evaluations were done by one blinded examiner, who classified surface changes as being none, minor, or major. Minor changes were defined as observable but negligible changes in surface texture. Major changes were defined as being a loss of resin or cracking in the surface in addition to any changes in surface morphology.

Results: No major changes were observed for any of the polished specimens using either bleaching agent. With Opalescence PF, major changes occurred only on unpolished flowable composite. Minor changes were observed with all of the other unpolished materials and were more likely after the longer bleaching period.

With Opalescence Xtra Boost, major changes were observed on Tetric Flow and Filtek Supreme. Some minor changes were observed in the ceramic material with this bleaching gel but not with the other.

Conclusions: The effect of bleaching agents on the surface morphology of esthetic restorative materials is material and time dependent but can be reduced by polishing the materials before bleaching.

COMMENTARY

This study showed, as have others, that application of bleaching gels to some tooth-colored restorative materials can cause surface changes that are observable with high-magnification microscopy. Using the high-concentration in-office bleach, minor surface changes could be seen even in the ceramic material. However, it is not clear whether the changes in composite or ceramic materials have any clinical relevance whatsoever. Perhaps the same, or worse, changes would be seen if the materials were subjected to common foodstuffs or beverages. Possibly, the most clinically relevant finding of this study was that polishing reduces any potential effects of bleaching agents on the surface texture of tooth-colored restorative materials. Therefore, it might be a good idea to repolish any old restorations prior to bleaching.

In many cases, this is a moot point anyway because bleaching will not observably alter the color of existing restorations.

SUGGESTED READING

Attin T, Hannig C, Wiegand A, Attin R. Effect of bleaching on restorative materials and restorations—-a systematic review. Dent Mater 2004;20:852–61.

Campos I, Briso AL, Pimenta LA, Ambrosano G. Effects of bleaching with carbamide peroxide gels on microhardness of restoration materials. J Esthet Restor Dent 2003;15:175–82.

Wattanapayungkul P, Yap AU, Chooi KW, et al. The effect of home bleaching agents on the surface roughness of tooth-colored restoratives with time. Oper Dent 2004;29:398–403.

EFFECT OF HOME-USE BLEACHING GELS ON FLUORIDE-RELEASING RESTORATIVE MATERIALS

Z.C. Cehreli, F. Yazici, F. Garcia-Godoy

Operative Dentistry 2003 (28:605–9)

ABSTRACT

Objective: The purpose of this study was to evaluate the effects of at-home bleaching agents on the surface roughness of fluoride-releasing restorative materials.

Materials and Methods: The restorative materials used in this study included a high-viscosity conventional glass ionomer (Fuji IX, GC America, Alsip, IL, USA), two resin-modified glass ionomers (Fuji II LC, GC America; Vitremer, 3M ESPE), four polyacid-modified composite resins or "compomers" (Compoglass F, Ivoclar Vivadent; Dyract AP, Dentsply Caulk, Milford, DE, USA; élan, Kerr, Orange, CA, USA; F2000, 3M ESPE), and two composite resin

controls (Tetric, Ivoclar Vivadent; Valux, 3M ESPE).

Thirty 10-mm-diameter specimens of each material were fabricated, finished, and polished by one operator using the Sof-Lex (3M ESPE) disk series. Specimens of each material were divided into a control group (untreated) and two experimental groups, which were treated with 10% carbamide peroxide (NiteWhite Excel, Discus Dental, Culver City, CA, USA) or 15% carbamide peroxide (Contrast PM, Spectrum Dental, Culver City, CA, USA). The bleaching regimen was the equivalent of 8 hours daily for 15 days. The experimental specimens were stored in deionized water when they were not being treated, and the controls were stored continuously in deionized water. Surface roughness was measured before and after treatment using a profilometer (Surftest-402 Surface Roughness Tester, Mitutoyo Corporation, Tokyo, Japan).

Results: In the control groups, the glass ionomers Vitremer, Fuji IX, and Fuji II LC had the greatest surface roughness. The other materials had lower surface roughness and were similar to each other.

Bleaching *increased* the surface roughness of F2000, Dyract AP, élan, Valux, and Tetric, but it *decreased* surface roughness for Fuji IX, Fuji II LC, Vitremer, and Compoglass F. The 15% carbamide gel caused slightly greater surface roughening for some of the materials.

Conclusions: The effects of at-home bleaching agents on the surface texture of tooth-colored, fluoride-releasing restorative materials appear to be material dependent.

COMMENTARY

As reported in the study reviewed earlier, bleaching affects composite materials only in minor ways. However, glass ionomers and related materials have components that make them more hydrophilic and potentially more susceptible to bleaching.

The findings of this study are difficult to apply directly to the clinical situation. Changes in surface roughness after bleaching were statistically significant for each material. However, those changes occurred in either direction—-with some materials becoming rougher, and some becoming smoother. The only apparent pattern here is that the materials that became rougher were composites and compomers, whereas the materials that became smoother were (with one exception) glass ionomers.

Furthermore, although these changes were measurable by a laboratory instrument and were statistically significant, their clinical significance is unclear. It is not known whether minor changes in the surface texture contribute to decreased longevity or other problems for a given restoration. The most important thing for clinicians to remember is that restorative materials do not change color in any meaningful way (except in some circumstances, as the next paper reports). Secondarily, some changes in surface texture *might* occur, but the clinical significance of any such changes is unknown.

SUGGESTED READING

Mujdeci A, Gokay O. Effect of bleaching agents on the microhardness of tooth-colored restorative materials. J Prosthet Dent 2006; 95:426–9.

Yalcin F, Gurgan S. Bleaching-induced colour change in plastic filling materials. J Biomater Appl 2005; 19:187–95.

Yap AUJ, Wattanapayungkul P. Effects of in-office tooth whiteners on hardness of tooth-colored restoratives. Oper Dent 2002;27:137–41.

EFFECT OF BLEACHING AND REPOLISHING PROCEDURES ON COFFEE AND TEA STAIN REMOVAL FROM THREE ANTERIOR COMPOSITE VENEERING MATERIALS

L.S. Türkün, M. Türkün

Journal of Esthetic and Restorative Dentistry 2004 (16:290–301)

ABSTRACT

Objective: The purpose of this study was to compare the color change of three composite materials exposed to staining solutions as well as to evaluate stain removal by three polishing systems and a 15% hydrogen peroxide bleaching gel.

Materials and Methods: The composite materials used in this study were Clearfil ST (Kuraray, Osaka, Japan), Esthet-X (Dentsply Caulk), and Filtek A110 (3M ESPE). Clearfil and Esthet-X are hybrid composites, and A110 is a microfill. The A3 shades of Esthet-X and A110 and the "universal light" shade of Clearfil ST were used. For each composite, 45 specimens were fabricated in Teflon molds and polished using medium, fine, and superfine Sof-Lex (3M ESPE) disks, the Enhance (Dentsply Caulk) polishing system (including the fine and superfine aluminum oxide pastes), or the one-step PoGo polishers (Dentsply Caulk). Baseline color measurements (CIELAB system) were made using a spectrophotometer after the specimens were stored in 100% humidity for 24 hours. Five specimens from each group (composite type + polishing system) were immersed for 1 week in coffee, tea, or distilled water (as a control). Color measurements were repeated after 1, 3, 5, and 7 days of immersion. One surface of each specimen was repolished with the same system used before, and one surface was bleached with an in-office 15% hydrogen peroxide gel (Illumine, Dentsply De Trey, Konstanz, Germany) for 1 hour. The color was measured again after these treatments.

Results: Specimens stored in distilled water did not have a significant color difference (ΔE) during the 7-day period. Coffee and tea made the composites darker, redder, and more yellow. Filtek A110 was the most color-stable material, and Clearfil ST was the least. All three composites returned to normal color (similar to baseline) after bleaching with the 15% hydrogen peroxide material. Repolishing returned them approximately to the 1-day immersion color and was less effective for removing stain.

Conclusions: Most staining that occurs with composite resin restorations is superficial and can be removed by repolishing or bleaching, but the latter is more effective.

COMMENTARY

Some studies have shown that bleaching can change the color of composite resin materials. However, differences in color that can be measured electronically are not always visible to the human eye. That has certainly been the case with bleaching, as clinically, the color of existing composite restorations is typically not changed.

However, the present study reports that the color of stained composite materials can be changed using a 15% hydrogen peroxide in-office bleaching system. This information might be useful for treating patients with, for example, old resin veneers that have acquired bulk staining over the years. Repolishing also can remove some stain but is less effective than bleaching, which, of course, suggests that the stain is not only on the surface but also within the composite material.

Either procedure, bleaching or repolishing, is far more likely to work if the staining is relatively superficial.

SUGGESTED READING

Canay S, Cehreli MC. The effect of current bleaching agents on the color of light-polymerized composites in vitro. J Prosthet Dent 2003;89:474–8.

Yalcin F, Gurgan S. Effects of two different bleaching regimens on the gloss of tooth-colored restorative materials. Dent Mater 2005;21:464–8.

FACTORS AFFECTING MERCURY RELEASE FROM DENTAL AMALGAM EXPOSED TO CARBAMIDE PEROXIDE BLEACHING AGENT

I. Rotstein, Y. Avron, H. Shemesh, H. Dogan, C. Mor, D. Steinberg
American Journal of Dentistry 2004 (17:347–50)

ABSTRACT

Objective: The purpose of this study was to assess the effects of aging, polishing, and treatment duration on mercury release from dental amalgam exposed to 10% carbamide peroxide at two pH levels.

Materials and Methods: Sixty-four specimens of a zinc-free, palladium-rich high-copper dental amalgam (Valiant PhD, Dentsply Caulk) were fabricated in silicone molds. They were sealed in glass assay tubes containing saline and were stored in an incubator for 6 months at 37°C. At that time, half of the specimens were polished using rubber disks, and the others were left unpolished. An additional 64 specimens were freshly fabricated, with half of those being polished and half left unpolished. All 128 specimens were stored in a desiccator for 7 days.

The specimens were sealed in test tubes containing 10 mL of 10% carbamide peroxide at a pH of either 4.5 or 6.5, or phosphate-buffered saline at the same pH levels. Specimens were placed in an incubator at 37°C and were removed after 1, 4, 7, 10, and 13 days. At each interval, the mercury content of each test tube solution was measured using a cold-vapor atomic absorption mercury analyzer system (MAS-50D, Bacharach, Inc., Pittsburgh, PA, USA).

Results: Generally, amalgam specimens exposed to 10% carbamide peroxide released significantly more mercury than specimens stored in the phosphate buffer. Aged amalgam released significantly more mercury than fresh amalgam. Also, unpolished amalgam tended to release more mercury than polished amalgam, and lower pH tended to cause more mercury release, but these findings were not statistically significant for every comparison.

Conclusions: Dental amalgam exposed to 10% carbamide peroxide released significantly more mercury into the solution than amalgam stored in phosphate-buffered saline, and increased with storage time. Mercury release was greatest in aged amalgam than in fresh amalgam. Mercury release tended to be greater from unpolished amalgam and at lower pH.

COMMENTARY

This is not the first study to report that exposure of dental amalgam to carbamide peroxide bleaching agents increases the mercury release from amalgam. Earlier studies have shown that the amount of mercury released is related to factors such as the peroxide concentration and the brand of amalgam.

The present study identified other factors that affect mercury release. Duration of treatment, age of the amalgam, the presence of unpolished surfaces, and acidic pH all have the potential for increasing the release of mercury.

Although the use of tooth-colored materials continues to increase, amalgam is still widely used to

restore posterior teeth. In addition, many patients have amalgam restorations that have been in place for years. Therefore, dentists are routinely bleaching the teeth of patients who have amalgam restorations. Such patients probably are best advised to confine the bleaching gel to anterior portions of the tray, but this is easier said than done.

So, assuming that peroxide bleaching gel contacts amalgam restorations, what are the clinical implications? Fortunately, most bleaching treatments involve limited application times of an hour to a few hours for perhaps 2 to 3 weeks. It is unlikely that increased mercury release from amalgam over a relatively short period of time would have any adverse health effects. In addition, there is some evidence that dental biofilm reduces the release of mercury from amalgam exposed to peroxide.

SUGGESTED READING

Al-Salehi SK, Hatton PV, Miller CA, et al. The effect of carbamide peroxide treatment on metal ion release from dental amalgam. Dent Mater 2006;22:948–53.

Hummert TW, Osborne JW, Norling BK, Cardenas HL. Mercury in solution following exposure of various amalgams to carbamide peroxides. Am J Dent 1993;6:305–9.

Rotstein I, Dogan H, Avron Y, et al. Mercury release from dental amalgam after treatment with 10% carbamide peroxide in vitro. Oral Surg 2000;89:216–9.

Steinberg D, Blank O, Rotstein I. Influence of dental biofilm on release of mercury from amalgam exposed to carbamide peroxide. J Biomed Mater Res B Appl Biomater 2003;67:627–31.

THE BOTTOM LINE

The literature contains many research reports concerning the effects of peroxide-based bleaching agents on dental restorative materials. Generally, these reports indicate that the effects of bleaching agents are minor and clinically insignificant, for example, slight roughening of composite resin surfaces. The clinical implications of some effects, for example, increased mercury release from amalgam restorations, are not known.

Clinicians should remain aware that contemporary bleaching agents do not perceptibly change the shade of tooth-colored restorative materials. For patients who have anterior restorations of any type, this fact must be considered during treatment planning.

Also, to the extent possible, bleaching agents should not be applied directly to teeth containing amalgam restorations. Because this is not possible in many cases, patients with large or numerous amalgam restorations should be advised to limit the frequency and duration of application. There is no obvious danger to the increased mercury release caused by peroxide exposure, but limiting mercury release is never a bad idea.

Editor's Note: We welcome readers' suggestions for topics and contributors to Critical Appraisal. Please address your suggestions to the section editor:

Critical Appraisal—Dr. Edward J. Swift Jr.
Department of Operative Dentistry
University of North Carolina
CB#7450, Brauer Hall
Chapel Hill, NC 27599-7450
Telephone: 919-966-2773; Fax: 919-966-5660
E-mail: Ed_Swift@dentistry.unc.edu