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REVIEW ARTICLE

Effects of bleaching agents on dental restorative materials: A review of the literature and recommendation to dental practitioners and researchers

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Abstract In recent years, there has been an increased demand for improvement in the appearance of natural teeth. The conservative technique of tooth bleaching has gained attention and acceptance from both patients and clinicians. Despite increased popularity, there is controversy surrounding the adverse effects of bleaching on dental restorative materials. This article reviews the effects of bleaching agents on major categories of dental restorative materials and provides evidence-based recommendations to the clinicians and researchers. Current literature reveal that bleaching might have a detrimental effect on restorative materials. However, because of the variability in experimental design, there is a lack of consensus concerning the bleaching effects on restorative materials. A standardized and reproducible guideline for assessment of bleaching effects on restorative materials needs to be established and verified by future studies.

Introduction

Tooth bleaching has become one of the most successful and well-accepted aesthetic dental treatments over the past decades. Although there are several methods available to manage discolored teeth, tooth bleaching has been

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reported to be the choice most desired by the patients seeking for dental aesthetic improvement.[1] Moreover, a survey conducted by the Clinical Research Associates reported that 91% of the dentists provided tooth bleaching in their dental practices and tooth bleaching treatment resulted in a success rate of 79%.[2]

Tooth bleaching was reported in the literature as an aesthetic treatment option as early as 1877.[3] Contemporary tooth bleaching products have evolved into three major categories: in-office bleaching (also known as power bleaching), at-home bleaching (also known as night guard vital bleaching), and over-the-counter (OTC) bleaching agents. In general, most in-office and at-home bleaching techniques have been shown to be effective, although results may vary depending on the factors including type of stain, bleaching agent, and treatment protocol.[4–6] In addition, OTC bleaching products are widely accessible all over the world as a potential low cost alternative to traditional bleaching agents. However, little clinical evidence is available on the safety and effectiveness of the OTC products.[7]

Contemporary tooth bleaching materials are based primarily on either hydrogen peroxide (HP) or carbamide peroxide (CP). CP is very unstable and will immediately degrade into about one-third HP and two-thirds urea on contact with tissues and saliva. HP acts as a strong oxidizing agent through the formation of free radicals, reactive oxygen molecules, and anions.[8] The fact that the bleaching agent is held in intimate contact with the teeth and potentially any associated restorations raises the possibility that the agent may cause undesirable changes, such as softening and degradation of the teeth and restorative materials. Therefore, concerns have been raised about the bleaching effects on dental restorative materials.[9–11] It has been reported that bleaching agents might change the properties of restorative materials, such as color, surface and subsurface microhardness, surface roughness, and surface topography. In stark contrast, other studies suggest that bleaching effects on restorative materials are clinically insignificant.[10,12]

Given the discrepancy in findings, the purpose of the present article is to review the effects of bleaching agents on dental restorative materials and to provide evidence-based recommendations to dental practitioners and researchers. To identify all original articles and reviews reporting the bleaching effects on restorative materials, a systematic search of the literature to January 2014 was conducted using PubMed, ISI Web of Science, and EMBASE. The main search terms were: (bleaching OR whitening) AND (restorative material OR amalgam OR alloy OR ceramic OR glass ionomer OR compomer OR composite resin). The studies were also hand-searched for additional relevant publications.

Effects of bleaching agents on properties of restorative materials

Amalgam

Different studies have reported widely discrepant results for the amount of metal ion leaching from amalgam. While Al-Salehi et al[13] found no significant change in the release of metal ions from bleached amalgam (10% CP for 24 hours), a number of studies reported a significant increase in the release of amalgam components (mercury and silver) after being exposed to CP (10—16%)[14,15] and HP (3.6%, 6%, and 30%)[16] for a longer treatment period. This controversy might be related to the variation in peroxide concentration and time period of application. An alternative hypothesis is that there is a positive correlation between the mercury release and peroxide concentration and the increased release of mercury is attribute to the age of the dental amalgam, the surface roughness of the amalgam surface and the acidity of the bleaching agent.[17,18] Importantly, the reported concentration of mercury leaching from amalgam is still below a level associated with possible health concerns.[10,19] Furthermore, no significant changes in the surface morphology and surface microhardness of amalgam were found after application of 10% CP and HP for 70—84 hours.[20,21]

Concerns regarding greening of the tooth—amalgam margin during extended 10% CP bleaching (7—10 months) has been raised by Haywood.[22] In this case report, carious lesions were noted in all areas of the tooth that contained the green discoloration after removal of the amalgam restoration. For the same patient, when other amalgam restoration that had no greening was removed, no decay was found. Therefore, the cause of this discoloration could be due to marginal discrepancies of the amalgam restoration.

Dental alloy

Microstructural evaluation and corrosion properties of dental alloys subjected to bleaching have been investigated in the literature. Surface microhardness and scanning electron microscope observations revealed no significant deleterious effects of HP bleaching on gold alloy surfaces.[21,23] Besides those studies revealing no alteration of gold alloys, a recent study showed that whitening toothpaste had different effects on surface roughness and microhardness of commercially pure titanium and titanium—tantalum alloys compared to toothpaste without peroxide. However, the observed bleaching effects were not statistically significant.[24] In another study, surface topographic alterations of gold, Ni—Cr, and Co—Cr alloys occurred as a result of the application of 10% and 35% CP simulating at-home bleaching and in-office bleaching during 14 days, respectively.[25] Moreover, the elemental release from a Ni—Cr alloy was found to be increased due to 10% HP or 10% CP treatment for 30 days.[26] Similarly, another study also showed that the HP bleaching agents (3%, 10%, and 30%) caused increased corrosion potential of Ni—Cr and Pd—Cu—Ga alloys. As a result, exposure of Ni—Cr and Pd—Cu—Ga alloys to HP solutions for 24 hours increased metal ion release of all the elements except gold alloy.[27]

Dental ceramic

Although conventional dental ceramics are considered the most inert among dental restorative materials, feldspathic porcelain exhibited surface deterioration in contact with 10% and 35% CP for 21 days.[28] After highly concentrated HP

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