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ORIGINAL ARTICLE

Effects of pre- and post-simulated home bleaching with 10% carbamide peroxide on the shear bond strengths of different adhesives to enamel

Aminah M. Elmourad [1], **Mohammed Q. Alqahtani** [2,*]

Restorative Dental Sciences Dept., College of Dentistry, King Saud University, Saudi Arabia

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KEYWORDS

Pre-bleaching, Post-bleaching;
Bond strength;
Etch-rinse adhesive;
Self-etch adhesive

Abstract *Aim:* This *in vitro* study was undertaken to investigate the effects of pre- and post-simulated bleaching procedures with 10% carbamide peroxide on the shear bond strengths of different adhesives to enamel and to determine the failure modes of tested specimens.
Materials and methods: The specimens were randomly divided into three groups (n = 30) according to the sequence of bleaching and bonding procedures (control non-bleach, pre- and post-bleach groups). Each group was then subdivided into three subgroups (n = 10) according to the three types of adhesives: OptiBond Solo Plus (Kerr) and Single Bond Universal (3M-ESPE) used as etch-and-rinse and self-etch techniques. Resin composite cylinders were then placed with Filtek Z 250 (3M ESPE). The specimens were stored in distilled water at 37 °C for 24 hours prior to being thermocycled for 1000 cycles (at 5 and 55 °C). The samples in the pre- and post-bleach groups were also immersed daily in artificial saliva at 37 °C, and for two weeks after completion of the bleaching process. Shear bond strengths were measured with a cross-head speeds of 0.5 mm/min. Failure modes of debonded specimens were determined by stereomicroscopy (30×). The interface margins of resin composite to the different enamel conditions were observed by scanning electron microscopy (1000×) before shear bond strength testing.

* Corresponding author. Address: Restorative Dental Sciences Dept., College of Dentistry, King Saud University, P.O. Box 60169, Riyadh 11545, Saudi Arabia. Mobile: +966 503486898.
E-mail address: malqathani@ksu.edu.sa (M.Q. Alqahtani).
[1] Demonstrator and Postgraduate Student.
[2] Associate Professor.

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Results: There were no significant effects of different enamel conditions (control non-bleach, pre-bleach and post-bleach) on the shear bond strengths of OptiBond Solo Plus Adhesive Agent or etch-and-rinse Single Bond Universal Adhesive Agent. Pre- and post-simulated home bleaching of enamel with 10% carbamide peroxide had an adverse effect on the shear bond strengths of self-etch Single Bond Universal Adhesive Agent.

Conclusion: In enamel, an etch-and-rinse approach with phosphoric acid remains the procedure of choice, since it guarantees the most durable bond to enamel. Therefore, selective phosphoric-acid-etching of enamel is highly recommended, followed by self-etching.

1. Introduction

Stained teeth are frequently seen in the dental office and are one of the major challenges faced by dentists. In fact, tooth discoloration creates a wide range of esthetic problems, and people often expend much time and money to improve the appearance of their discolored teeth.[37] Therefore, in recent years, the demand for esthetic dental procedures and tooth bleaching has increased dramatically.

In general, tooth staining can be classified into intrinsic stains, extrinsic stains, or a combination of both. Moreover, tooth discoloration might be limited to a single tooth or to several teeth in a single arch, or may be more generalized. In some cases, scaling and polishing of the teeth will improve the situation; however, more extensive treatment; such as vital and non-vital bleaching, microabrasion, resin composites, porcelain veneers, or all-ceramic crowns; is usually needed to achieve a more satisfying result. In some instances, these treatment measures are combined.[36]

Dental bleaching is considered to be the most conser vative treatment for discolored teeth. It can be defined as the process of removing stains or pigments from teeth by the application of chemicals, such as hydrogen peroxide or urea peroxide.[36] Tooth-bleaching materials usually contain a strong oxidizing agent, and their ability to whiten teeth is mainly due to oxidation reactions.[4] Hydrogen peroxide or one of its precursors (carbamide peroxide or sodium perborate) is a popular oxidizing agent used to whiten teeth.[4] Tooth bleaching occurs due to the decomposition of peroxide into free oxygen radicals, which can break down the large pigmented molecules that accumulate in teeth into smaller, less-pigmented molecules.[22]

The population's increasing demand for tooth bleaching has driven many manufacturers and researchers to develop bleaching products to be used either in the dental office or at home. It has been estimated that bleaching has been performed for more than one million patients in dental offices.[45] In addition, the fact that more than 35 million tooth-whitening kits have been sold worldwide from May 2001 to March 2005[35] indicates that large numbers of people have utilized self-applied at-home bleaching products.

Although tooth bleaching is considered to be a conser vative and economical method of treating discolored teeth, this procedure is known to have an effect on the natural tooth structure,[1,2,5,6,16,26] adhesive bonding,[40] and restorative materials.[7,9,13] The interaction of tooth bleaching with any previous or subsequent dental treatments should be considered.

The effects of bleaching agents on the bonding interface of resin restorations to tooth substrates with different adhesives are controversial. Most available research in the current literature documents enamel bleaching performed prior to adhesive and restorative procedures; however, analysis of the influence of bleaching agents on enamel, dentin, adhesives, and pre-existing resin restorations that are not indicated for replacement; has been of notable importance in obtaining useful information about tooth-restoration bond degradation and the possible need to replace these pre-existing resin restorations.

The objectives of this study were to investigate the effects of pre- and post-simulated bleaching procedures with 10% carbamide peroxide on the shear bond strengths (SBSs) of different adhesives to enamel, and to determine the failure modes of tested specimens.

The hypotheses tested were that:

(1) pre-simulated home bleaching will reduce the adhesive bond strength of resin-based composite material to enamel; and
(2) post-simulated home bleaching will not have an effect on the adhesive bond strength of resin-based composite material to enamel.

2. Materials and methods

A pilot study was conducted at the beginning of our experiment to investigate the reliability of the test that was used.

2.1. Tooth selection

Ninety sound human molars were selected for use in this study. All teeth were cleaned with an ultrasonic scaler and polished with non-fluoridated pumice in a rubber cup mounted in a slow-speed handpiece (Kavo EWL, No. 6412500, Germany). After being cleaned and polished, the teeth were stored in distilled water with 0.05% thymol solution in a dark container at room temperature until being mounted. The teeth selected for study were free of caries, cracks, abrasion facets, fluorosis, and damage due to extraction. Each tooth was examined under a stereomicroscope (Stereoscopic Zoom Microscope SMZ 1000, Nikon) to eliminate teeth with cracks or hypoplastic defects.

2.2. Preparation of specimens

Crowns of teeth were separated from the roots 2 mm apical to the cemento-enamel junction by water-coolant spray and a slow-speed diamond saw (Isomet 2000, Buehler, IL, USA). Self-cure acrylic resin was loaded in polyvinyl chloride (PVC) cylindrical molds (diameter, 34 mm; height, 20 mm), which