An in vivo study of the effect of a 38 percent hydrogen peroxide in-office whitening agent on enamel

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ABSTRACT

Background. In an in vivo study, the authors tested the hypothesis that no difference in enamel surface roughness is detectable either during or after bleaching with a high-concentration in-office whitening agent.

Methods. The authors performed profilometric and scanning electron microscopic (SEM) analyses of epoxy resin replicas of the upper right incisors of 20 participants at baseline (control) and after each bleaching treatment with a 38 percent hydrogen peroxide whitening agent, applied four times, at one-week intervals. The authors used analysis of variance for repeated measures to analyze the data statistically.

Results. The profilometric analysis of the enamel surface replicas after the in vivo bleaching protocol showed no significant difference in surface roughness parameters ($P > .05$) compared with those at baseline, irrespective of the time interval. Results of the correlated SEM analysis showed no relevant alteration on the enamel surface.

Conclusions. Results of this in vivo study support the tested hypothesis that the application of a 38 percent hydrogen peroxide in-office whitening agent does not alter enamel surface roughness, even after multiple applications.

Clinical Implications. The use of a 38 percent hydrogen peroxide in-office whitening agent induced no roughness alterations of the enamel surface, even after prolonged and repeated applications.

Key Words. Enamel; tooth bleaching; hydrogen peroxide.

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Vital bleaching of discolored teeth with carbamide or hydrogen peroxide performed on external enamel, by means of either an at-home technique (nightguard vital whitening) or high-concentration bleaching agents available for in-office procedures (in-office power whitening), has become a popular clinical procedure.[1-3] The clinical effectiveness of in-office tooth whitening has been demonstrated extensively.[1-3]

Despite the many studies in which investigators have studied the potential morphological alterations in enamel caused by the use of high-concentration bleaching agents, these adverse effects are still controversial.[4-25] In previous in vitro studies, investigators reported that the use of high-concentration hydrogen peroxide–based products caused morphological alteration of the enamel surface,[4-9] characterized by increased porosity of the superficial enamel structure,[7] demineralization and a decrease in protein concentration,[10] organic matrix degradation,[11] modification in the calcium:phosphate ratio[12] and calcium loss,[13,14] thereby supporting the hypothesis that bleaching agents are chemically active components potentially able to induce substantial structural alterations in the human dental enamel. Surface alteration of enamel after whitening was confirmed indirectly by

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researchers reporting reduced enamel physical properties, among them microhardness, which investigators have studied thoroughly.[8,11,15-20]

The overwhelming majority of studies of bleaching are performed in vitro only, frequently leading to inconsistent results in relation to different testing conditions, morphological aspects and mechanical challenges.[26] Moreover, in vitro alterations might not correspond with alterations observed in vivo.[27] Indeed, only a few researchers have attempted to assess whitening effects in vivo,[24,28,29] by analyzing enamel replicas by means of scanning electron microscopy (SEM). However, these investigators studied mainly the enamel surface characteristics on the basis of morphologically subjective assessments of the enamel surface, rather than on the basis of precise measurements of the enamel surface profile.[24,28,29]

Our aim in this study was to evaluate the effect of a new high-concentration in-office bleaching agent applied in vivo on the enamel surface. The hypothesis we tested was that the whitening procedure would not alter the surface roughness of enamel.

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PARTICIPANTS, MATERIALS AND METHODS

We recruited for the study 20 participants (eight men, 12 women; age range, 22 to 43 years; mean age, 28 years) who were willing to receive tooth bleaching. Before recruiting them, we informed them about the protocol and received written informed consent from them, under a protocol that was approved by the ethics committee of the University of Trieste, Italy. All participants had anterior teeth of shade A3 or darker, as we determined by using a shade guide (Vita Classical, Vita Zahnfabrik, Bad Säckingen, Germany). Inclusion criteria were presence of all maxillary incisors and canines; absence of caries, restorations and periodontal disease; no previous tooth-whitening treatment; absence of smoking habits; and compliance with requirements to avoid use of staining food and beverages (such as tea, coffee, licorice and red wine) during treatment.

Participants underwent a professional prophylaxis one week before beginning the study and received oral hygiene instructions to brush their teeth twice a day with a toothbrush (Elmex InterX Sensitive toothbrush, Gaba International, Münchenstein, Switzerland) and a low-abrasion toothpaste (relative dentin abrasion value = 30) (Elmex Sensitive Plus, Gaba International), as well as to floss at least once a day.

The tooth-whitening material tested was a 38 percent hydrogen peroxide bleaching agent (Opalescence Boost PF, Ultradent Products, South Jordan, Utah) (hereafter called "PF"). We performed the bleaching treatment four times, at one-week intervals. We performed each treatment under rubber dam isolation. We cleaned the teeth with a brush mounted on a low-speed contrangle handpiece under water irrigation to remove residual biofilms from the surface and allow intimate contact between the enamel and the bleaching agent. We applied the bleaching agent in accordance with the manufacturer's protocol. We administered PF with two syringes: one syringe containing the potassium hydroxide activator and the other containing hydrogen peroxide. Before using the activator, we mixed it with the bleaching agent. We applied the activated PF whitening gel and allowed it to remain on the teeth for 10 minutes. We performed one application of the bleaching agent at each appointment. At the end of each treatment, we removed the bleaching agent and thoroughly rinsed the treated teeth with air-water spray for 30 seconds.

We took high-precision impressions of the maxillary right incisor by using a polyvinyl siloxane–based material (President Putty Light Body, Coltène/Whaledent, Altstätten, Switzerland) and the double impression technique. We obtained an initial putty impression and allowed it to set fully. Then we carefully applied a light-body material both into the first impression (that is, we used the first impression as a customized tray) and on the teeth of interest to obtain a precise final impression. We obtained the impressions of the maxillary right incisor at baseline and after each bleaching treatment. We prepared replicas by pouring impressions with an epoxy resin mixed in a vacuum (Eposs EL 20, Prochima, Pesaro, Italy).

We extracted two noncarious maxillary incisors from two patients (mean age, 63 years) for periodontal reasons. We etched each tooth's vestibular

ABBREVIATION KEY. SEM: Scanning electron microscope/microscopic/microscopy.