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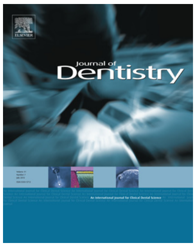

Effects of temperature and in-office bleaching agents on surface and subsurface properties of aesthetic restorative materials

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ABSTRACT

Objectives: To investigate the effects of in-office bleaching agents on surface and subsurface properties of dental materials at different environmental temperatures.

Methods: Four composite resins, a compomer, a conventional glass-ionomer cement (CGIC), and an industrially sintered ceramic material were evaluated in the present study. Four groups of each material ($n = 10$) were treated: bleaching with 40% hydrogen peroxide at 25 °C and 37 °C, stored in artificial saliva at 25 °C and 37 °C. The specimens from bleaching groups were bleached for two sessions, each of two 20 min application, at respective temperatures. After bleaching, the surface and subsurface (0.1–0.5 mm) microhardness were evaluated using a Vickers microhardness tester. The substance loss was determined by surface profilometry. The data were statistically analyzed with ANOVA and the Tukey's post hoc test.

Results: All materials were found to have surface softening after bleaching, and bleaching effects on surface micorhardness increased at 37 °C compared with 25 °C, except for the ceramic. After being bleached at 37 °C, the microhardness values of flowable composite resin significantly reduced at a depth of 0.1 mm compared with control specimen stored at 37 °C. No significant difference was found between the control and bleached specimens with respect to substance loss for any of the materials.

Conclusion: The influence of environmental temperature on the in-office bleaching effects on surface and subsurface microhardness of dental materials was material-dependent. However, no substance loss was detected due to the tested bleaching regimen.

Clinical significance: Environmental temperature should be considered when evaluating the possible bleaching effects on restorative materials. Moreover, dentists should be aware that there might be a need for polishing of restorative materials in clinical situations in which restorations are accidentally exposed to bleaching gels.

1. Introduction

Nowadays, tooth discoloration is becoming a greater concern as more emphasis is being placed on dental aesthetics. Generally, tooth colour can be improved by a number of approaches including whitening toothpastes, professional cleaning by scaling and polishing to remove stain and tartar, tooth bleaching, microabrasion of enamel with abrasives and acid, placement of crowns and veneers.[1] As a conservative

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technique to lighten natural teeth and to remove stains, tooth bleaching has become a popular procedure in dentistry.[2,3] Given the fact that over 40% of the population has at least one dental restoration,[4] the effects of bleaching on the restorative materials have been investigated by numerous studies.[5–13] As one of the most important physical characteristics of dental materials, surface and subsurface microhardness has attracted much attention in the literature (Table 1). However, the effects of bleaching agents on the microhardness of restorative materials remain controversial. It has been suggested that the inconsistency in these outcomes might be due to differences in bleaching regimens, bleaching agents, and the restorative materials used.[14,15] Moreover, previous laboratory investigations have confirmed that the environmental temperature played an important role in at-home bleaching agents on restorative materials, especially on polyacid-modified composite (compomer) and conventional glass-ionomer cement (CGIC).[13,16] It would be expected that the effects of in-office bleaching agents might be more pronounced on restorative materials. Nevertheless, there is no information published relating to environmental temperature when evaluating the effects of in-office bleaching on dental materials. Furthermore, limited data is available in literature regarding the potential effects of bleaching on substance loss of dental materials.

Therefore, the purpose of this study was to investigate the effects of highly concentrated hydrogen peroxide (HP) used for in-office bleaching on the surface and subsurface properties of aesthetic restorative materials at 2 different environmental temperatures. Two null hypotheses were proposed: (1) that highly concentrated HP has no effect on the surface and subsurface properties of restorative materials, and (2) that the environmental temperature has no influence on the effects of highly concentrated HP on restorative materials.

2. Materials and methods

Seven tooth-coloured restorative materials, including 4 composite resins (a nanohybrid, a microhybrid, a flowable, and a packable composite resin), a compomer, a CGIC, and an industrially sintered ceramic material used for CAD/CAM restorations, were evaluated in the present study. The details of the restorative materials used in this study are listed in Table 2.

2.1. Study design

The specimens of each type of materials tested were divided into four groups ($n = 10$): control group at 25 °C (group 25C), bleaching group at 25 °C (group 25B), control group at 37 °C (group 37C), and bleaching group at 37 °C (group 37B). In accordance with the previous studies,[13,16] the temperature of 25 °C was selected as a representative room temperature, and 37 °C was selected as a representative body temperature. Over a period of 2 weeks, specimens of groups 25B and 37B were subjected to an in-office bleaching regimen at respective environmental temperature. The groups 25C and 37C specimens remained stored in artificial

Table 1 – Summary of laboratory studies investigating bleaching effects on restorative materials.

References	Bleaching agents used	Environmental temperature during bleaching	Type of microhardness test	Summary of findings
Lima et al.[5]	35% HP	37 °C	Surface microhardness	Microhardness of composite resin remained unchanged after HP treatment but decreased after CP treatment.
Hannig et al.[6]	38% HP, 5.9% HP and 6.5% HP, 10% CP	37 °C	Subsurface microhardness	Microhardness of composite resin and compomer decreased even at deep layers.
Silva Costa et al.[7]	7% HP and 35% HP, 10% CP and 35% CP	37 °C	Surface microhardness	Microhardness of composite resin remained unchanged after HP and CP treatment.
Gurgan and Yalcin[8]	6.5% HP and 10% CP	NA	Surface microhardness	Microhardness decreased after HP and CP treatment except for a packable composite.
Mujdeci and Gokay[9]	14% HP and 10% CP	NA	Surface microhardness	Microhardness of composite resin and glass-ionomer cement remained unchanged after HP and CP treatment.
Polydorou et al.[10]	38% HP	Room temperature	Surface microhardness	Microhardness of composite resin and ceramic remained unchanged after HP treatment. An increase in microhardness was found for ormocer.
Yap and Wattanapayungkul[11]	35% HP and 35% CP	NA	Surface microhardness	Microhardness of composite resin and resin-modified glass-ionomer cement remained unchanged after HP and CP treatment.
Bailey and Swift[12]	6% HP and 10% CP	37 °C	Surface microhardness	Microhardness of composite resin decreased after HP and CP treatment.
Yu et al.[13]	10% CP	37 °C and 25 °C	Surface and subsurface microhardness	Environmental temperature influenced the effects of CP on surface and subsurface microhardness of restorative materials.

HP, hydrogen peroxide; CP, carbamide peroxide; NA, data not available.