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ORIGINAL ARTICLE

Color and translucency of finished and unfinished esthetic restorative materials after staining and bleaching

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KEYWORDS

Bleaching;
Color;
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Abstract *Purpose:* To evaluate the effect of staining and bleaching on color and translucency of finished and unfinished nano-filled resin composite and giomer. *Materials and methods:* Twenty specimens (ten finished + ten unfinished) were fabricated from each material, then an initial color and translucency measurement was taken. Specimens were stained in coffee for 48 h at 37 °C, rinsed and dried. After which the second color and translucency measurement was taken. After in-office bleaching with 40% H_2O_2 Opalescence boost, a third color and translucency measurement was taken. CIE L^* a^* b^* system was used for measuring color change and translucency. Two-way ANOVA and paired *t*-test were used for statistical analysis at $P \leq 0.05$. *Results:* After staining, all specimens showed clinically acceptable color change ($\Delta E \leq 3.3$) with no significant differences between groups. After bleaching, all specimens showed clinically unacceptable color change ($\Delta E > 3.3$) and significant differences between finished & polished and unfinished groups ($P = 0.024$). Nano-composites recorded significantly higher translucency than giomer ($P = 0.000$) except after bleaching. In addition, the translucency of unfinished groups were significantly higher than finished & polished groups ($P = 0.001$). *Conclusions:* The tested materials responded similarly to staining and bleaching. High concentration bleaching increased color change and reduced translucency. Finishing & polishing restorative materials improves their resistance to color change after bleaching, but it adversely affects translucency.

1. Introduction

The esthetic success of a restoration is directly related to its optical appearance (Hosoya et al., 2011). Color and translucency of esthetic restorations are crucial optical properties (Villarroel et al., 2011). To render a restoration imperceptible, restorative materials should reproduce both color and translucency of natural dentition and maintain long-term stability

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and resistance to discoloration (Villalta et al., 2006). A number of parameters affect translucency of resinous restorations such as thickness (Arimoto et al., 2010), filler particles, opacifiers (Lee, 2008), and resin matrix composition (Azzopardi et al., 2009). Color stability is related to resin matrix, size of filler particles, degree of polymerization and coloring agents (Nasim et al., 2010). Extrinsic discolorations can be caused by dietary and smoking habits, bad oral hygiene and adsorption or absorption of water-soluble stains within the resin matrix (Bagheri et al., 2005). In addition, resin composites undergo superficial and microstructural changes after finishing and polishing procedures (Nasim et al., 2010).

Proper finishing and polishing of restorations enhance their esthetics and longevity (Jefferies, 2007). Finishing and polishing require the sequential use of gradually smaller grained abrasives to produce a glossy surface (Jones et al., 2004). Finishing and polishing composite restorations aims to adjust occlusion, to create a smooth, uniform, easily cleaned restoration, and to allow an adequate light reflection (Jefferies, 2007). Moreover, to eliminate the superficial resin layer which come in contact with oxygen and does not polymerize (Al-Fawaz and Awilya, 2003). This resin layer has a direct effect on the staining ability of resin composite (Scheie, 2003).

Size and shape of fillers affect surface morphology of composites after finishing procedures (Da Costa et al., 2007). Reducing filler size is expected to improve surface smoothness (Turssi et al., 2005). However, there is a controversy regarding the color stability of nano-filled composites (Lee et al., 2004, Cavalcante et al., 2009).

Pre-reacted glass ionomer filled composites (Giomers) are hybrid esthetic restoratives based on pre-reacted glass ionomer "PRG" technology in which pre-reacted glass ionomer cements are used as fillers (Tian et al., 2012). The surface reaction type (S-PRG) is based on forming a glass-ionomer phase only on the surface of a glass core layer by an acid-base reaction between polycarboxylic acid and special surface-fractured multifunctional fluoroboroaluminosilicate glass filler in presence of water (Hosoya et al., 2011). Staining potential of giomers has not been widely investigated, as well as their reaction to bleaching agents (Hosoya et al., 2011).

Stains can be removed partially or totally by brushing with toothpaste, repolishing, and bleaching (Celik et al., 2009). Bleaching has increased during the last decade with the advent of new in office and at home bleaching agents (Yilmaz et al., 2013). Thus, it is common to bleach restored teeth. Esthetic restorations might show changes due to the softening effect of bleaching which subsequently affect their clinical durability (Villalta et al., 2006). Studies by Rosentritt et al. (2005), Rao et al. (2009) have explained the color changes of resin composite after bleaching by the properties and quality of the polymer; type and quantity of the filler or type and concentration of bleaching agents.

Materials with different monomers may show different resistance to staining and bleaching (Prabhakar et al., 2010). Therefore, this in vitro study evaluated the effect of staining and in-office bleaching on color and translucency of finished and unfinished nano-filled resin composite and giomer. The first null hypothesis was that staining and bleaching have no effect on color of finished and unfinished tested materials. The second null hypothesis was that staining and bleaching have no effect on translucency of finished and unfinished tested materials.

2. Materials and methods

2.1. Preparation of the specimens

Two esthetic restorative materials, a nano-filled resin composite (Filtek Z350XT) and a giomer (Beautifil II), were tested in this study (Table 1). Twenty specimens, 10 mm in diameter and 2 mm thick, were fabricated from each material using a split Teflon mold. The mold was positioned on a transparent matrix band (Mylar, DuPont, Wilmington, Del.) over a glass slide and it was completely filled with the tested material as one increment. The mold was then covered with another matrix band and a glass slide. A 500 g weight was placed for 1 min on top to let the excess material extrude, compact the material and prevent void and bubble formation. Afterwards, the weight was removed and the tested restorative material was light cured using LED curing unit with an intensity of 1200 mW/cm^2 (Elipar™ S10 LED Curing Light, 3 M Company, St. Paul MN, USA). Curing was done for 40 s according to manufacturer instructions through the glass slide.

2.2. Finishing and polishing of specimens

Top surfaces of ten specimens from each material were finished using finishing discs (Sof-Lex™ Contouring and Polishing Discs Kit, 3 M Company, St. Paul MN, USA), while the other ten specimens were left unfinished. Coarse finishing discs were used for 15 s in a hand piece (MK-dent Germany, CE 0123, REF No. AM1014), using a low speed motor (STRONG, model no 204, Seoul South Korea) at 10,000 RPM with moderate pressure according to manufacturer instructions. Spiral finishing wheels (Sof-Lex™ Spiral Finishing and Polishing Wheels, 3 M ESPE Company) were then used for 30 s at 15,000 RPM, followed by spiral polishing wheels for 30 s at same speed. Specimens were then washed with distilled water for 30 s and blot dried with paper towels. An initial color and translucency parameter measurement was taken using a spectrophotometer (UV- Shimadzu 3101 PC, Japan) on a white and a black standard background plates as a baseline measurement before staining procedures. Prior to measuring, the spectrophotometer was calibrated on NPL (national physical laboratory) tiles. Measurements were repeated three times for each specimen; the mean and standard deviation of the readings were calculated. The wavelength scan in the measurements was carried out from 380 to 780 nm.

2.3. Staining method

Specimens were stained by preparing a coffee solution after mixing 3.6 g of coffee powder (Nescafe Classic, Nestle, Egypt) in 300 ml of boiling distilled water as per manufacturer's recommendation (Hafez et al., 2010). After 10 min of stirring, the solution was filtered using a filter paper (Hafez et al., 2010). Specimens were incubated in coffee for 48 h at 37 °C, and then they were gently rinsed with distilled water and air dried, after which, a second color and translucency measurement was taken.

2.4. Bleaching procedures

All specimens were subjected to bleaching using 40% H_2O_2 Opalescence boost (Ultradent Products, Inc., South Jordan,

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