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Research Article

Is the Color Stability of Resin-Based Composites Affected by the Shade of Prefabricated Composite Resin Veneer?

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Abstract

Purpose: to determine the influence of prefabricated composite resin veneer (PCRV) shade on the color stability (ΔE00) of resin-based composites. Material and method: the composites Brilliant New Generation (BNG - Coltene), Brilliant Everglow (BEW - Coltene) and Filtek Supreme XTE (FXT - 3M ESPE) were selected. Specimens were fabricated and the photoactivation was performed through different PCRV shades (enamel transparent or bleach) as mechanical barrier of light. Photoactivation was carried out using a LED with 1,200 mW/cm^2 for 40s. Optical analysis was performed by a spectrophotometer. ΔE00 was calculated using CIEDE2000 formula, after 30 days of water storage at 37 °C. Data were submitted to two-way ANOVA and Tukey test (α=0.05). Results: all the factors (composite type and PCRV shade) were significant for ΔE00 results ($p<0.05$). The interposition of the PCRV transparent generated lower ΔE00 in comparison to results obtained using PCRV bleach. FXT showed the highest ΔE00 value independent of the PCRV shade.

Conclusion: BNG and BEW generated higher color stability than FXT. Thus, the resins BNG or BEW are indicated as luting agent to the Compomer system.

Keywords: Composite Resin; Clinical Protocols; Color; Dental Veneer

Abbreviations

PCRV: Prefabricated Composite Resin Veneer; BNG: Brilliant New Generation; BEW: Brilliant Everglow; FXT: Filtek Supreme XTE

Introduction

Charles Leland Pincus proposed the dental veneers concept in 1937. Prefabricated resin veneer became an alternative in 1980, with the release of Mastique Laminate Veneer [1]. At that time, the system was manufactured with acrylic resin and cemented with a light-cured composite. The limited technology, weakness of the acrylic veneers and low bond strength to dental substrate resulted in the failure of the Mastique over the time. Nowadays, dental ceramics are the first choice for veneer treatment but resin-based composites are also a cheaper alternative [2].

The advances in dental adhesion associated with the development of new restorative materials allowed that prefabricated composite resin veneers (PCRVs) concept was reestablished in 2009, with the launch of Direct Veneer (Edelweiss) and Componeer (Coltene) [1,3]. This PCRVs are now manufactured with specific resin-based composite which ensure superior mechanical strength and optical properties in comparison to Mastique system [3,4].

The resin-based composite used to fabricate the PCRVs is also used as luting agent for the veneers. PCRVs do not require a specific dental wear as indicated for dental ceramics and the adaptation of these veneers is promoted by the composite resin [5]. This protocol simplifies the technique but the composite may present different thickness which can result in problems as limited polymerization of the luting composite, low mechanical strength, high hydrolytic degradation and consequent color instability [6-8].

Componeer system is produced with the composite Brilliant New Generation. The available kit contains instruments to handle the veneers, an adhesive system (One coat Bond), a color shade guide and contour mask to select the size of the veneer. Moreover, different sizes of PCRVs and the shades transparent and bleach are included in the kit [4]. The manufacturer indicates the restrict use of Brilliant NG to the luting of the PCRVs. This protocol ensure compatibility between the PCRV and the composite used as luting material. However, there are no reports about the influence of PCRV shade in the color stability of the resin used as luting agent. Therefore, the present study aimed to determine the ΔE00 of composite resins photoactivated through PCRVs with different shades. The research hypothesis is that all resins will present similar ΔE00 independent of PCRVs shade.

Materials and Methods

The manufacturer information about each resin is describe in Table 1. Componeer veneer (Coltene) was used as a mechanical barrier for the light transmission. Photoactivation was carried out using a LED Valo Cordless (Ultradent, South Jordan, UT, USA) with 1,200 mW/cm^2 for 40s.

Table 1: Groups and manufacturer information of resin-based composites.

Composite resins	Shade/Batch#	Organic matrix	Filler content	Manufacturer
Brilliant New Generation (BNG)	A2/B2 1304738	BisGMA, BisEMA, TEGDMA	Nanohybrid filler (0,02-2,5µm) 65 vol% (80 wt%).	Coltene Whaledent, Altstätten, Switzerland
Brilliant Everglow (BEW)	A2/B2 G27377	Methacrylates	Submicron Hybrid filler (0,02-1,5µm) 56 vol% (74 wt%)	
Filtek Supreme XTE (FXT)	A2 N642638	BisGMA, UDMA, TEGDMA, PEGDMA e BisEMA	Nanohybrid filler (0,6-20 µm) 63,3 vol% (78,5 wt%)	3M ESPE, St Paul, MN, USA

BISGMA - bisphenol-A-glycidyl methacrylate; BisEMA - ethoxylated bisphenol-A dimethacrylate; TEGDMA - triethylene glycol dimethacrylate; UDMA - urethane dimethacrylate; PEGDMA - Polyethylene glycol dimethacrylate.

Color stability

Optical analysis was determined using a spectrophotometer (CM-3700d, Konica Minolta, Tokyo, Japan) with D65 illuminant and SCI. The reflectance mode was adopted using a standard black background (CIE L* = 24.62, CIE a* = -0.05, and CIE b* = -0.35). CIE L*, a*, and b*-values were automatically calculated by the software. CIE L* is the lightness, with 100 for white and 0 for black. The CIE a* and CIE b*-axis are the red-green and yellow-blue chromatic coordinates respectively. A positive CIE a* or CIE b* value represents a red or yellow shade, and negative CIE a* or CIE b*, represents green or blue respectively. Discs (n=6) were produced with a prefabricated metal matrix (Ø = 8.0 mm x thickness = 1.0 mm). The composite was inserted in a single increment in the matrix with subsequent overlap of a mylar strip. A glass slide was placed on the metal matrix and a constant load of 500 g was applied to overflow the excess of resin. The photoactivation was performed through a PCRVs (Componeer, shades transparent or bleach; Coltene). The optical measurements were performed after 24h in dry conditions (baseline) and after 30 days of storage in distilled water at 37 ˚C. ΔE00 was calculated following the formula [9,10]:

$$\Delta E00 = \left[\left(\frac{\Delta L}{K_L \cdot S_L}\right)^2 + \left(\frac{\Delta C}{K_c \cdot S_c}\right)^2 + \left(\frac{\Delta H}{K_H \cdot S_H}\right)^2 + R_T \cdot \left(\frac{\Delta C}{K_c \cdot S_c}\right) x \left(\frac{\Delta H}{K_H \cdot S_H}\right)\right]^{0.5}$$

Statistical analysis

Data of ΔE00 were submitted to normality and homoscedasticity tests. The results were analyzed by two-way ANOVA. All pairwise multiple comparison was submitted to Tukey's post hoc method (α = 0.05).

Result

The results of ΔE00 are described in table 2. All factors and their interaction were statistically significant ($p < 0.05$). The interposition of PCRV bleach resulted in higher ΔE00 values for all resin-based composite, except for BEW. The highest ΔE00 was ob-

served for FXT independent of the PCRV shade, and the lowest one for the composite BNG.

Table 2: Means and standard deviation of color stability (ΔE00) after aging

PCRV shade	Composite resins		
	BNG	BEW	FXT
Transparent	0.4 (0.01)D	0.6 (0.01)C	1.1 (0.01)B
Bleach	0.6 (0.01)C	0.7 (0.01)C	1.5 (0.02)A

* distinct letter indicates significant difference ($p < 0.05$).

Discussion

PCRVs simplify the veneer restorative protocol. As the golden proportion is already established for the veneers, the smile asymmetry is more easily obtained. The laboratory treatment applied in the PCRV ensures high mechanical and optical properties in comparison to photoactivated composites [1]. However, the luting agent of the PCRV still remains a light sensitivity composite and the color instability of this component can affect the final appearance of the veneers resulting in aesthetic failures.

Dental resin is composed by an organic matrix, inorganic content and a light activator system [7]. Generally, each resin presents a specific composition. In the present study, this difference can be observed in Table 1. Previous studies reported high influence of the inorganic particles size [11], photoinitiator system [6] and monomer type [12] on the optical properties of composite resins. In the present investigation, BNG and BEW (both Coltene) showed lower ΔE00 values than FXT (3M ESPE). It is theorized that the light transmission has been improved by the chameleon effect of BNG and BEW. This optical characteristic might be associated with the similar refractive index of the monomers and the inorganic content of the composite. As a result, the resin should present high degree of conversion which result in lower residual components and high color stability. Nevertheless, this theory should be clarified with other methodologies.

The Commission Internationale de l'éclairage (CIE) recommends ΔE00 values lower than 0.8 for perceptibility and 1.8 for acceptability threshold for color change in dental application [9,13]. In the present study, all resins showed ΔE00 lower than 0.8, except FXT that presented ΔE00 results higher than 1.1. This high results could be associated with high hydrolytic degradation of the composite FXT, but this theory should be confirmed with the sorption and solubility test. Another important issue observed in the present study is that the shade of the PCRVs might influence the polymerization and consequently the optical behavior of the composites. It is important to highlight that the time of photoactivation should be increased for the PCRV bleach in comparison to the protocol used for the shade transparent.

Conclusion

Within the limitation of the present study that evaluated the optical stability of the resin-based composite separately of the PCRV, BNG and BEW composites presented high color stability in comparison to FXT. Thus, the resins BNG or BEW are indicated as luting agent to the Componeer system.

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Conflict of Interest

The authors do not have any financial interest in the companies whose materials are included in this article.

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