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The influence of resin cements on the final color of ceramic veneers

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ABSTRACT

Purpose: To evaluate the effect of three brands of resin cement on the final color of ceramic veneers.

Methods: 50 disk-shaped ceramic specimens (IPS e.Max, 0.6 mm × 8.0 mm diameter) and disk-shaped composite resin background specimens (4.0 mm × 8.0 mm diameter) were prepared and divided into 10 groups ($n = 5$). These paired specimens were bonded using ten shades of resin cement (Variolink Veneer, shades LV-3, LV-2, MV, HV + 2, HV + 3; Panavia F, shades light and brown; and RelyX^{TM} Veneer, shades WO, TR, A3). A spectrophotometer (VITA Easyshade) was used to measure the color parameters (CIE $L^*a^*b^*$ values) of the paired disks before and after cementation. The color differences (ΔE values) after cementation were calculated and statistically analyzed by the One-way ANOVA (at the significant level $p < 0.05$).

Results: The color parameters of the ceramic disks were measured in terms of the increase in L^* value, and the decrease in C^*_{ab} value after bonding with the resin cement. The ΔE values of ceramic disks after cementation ranged from 1.38 to 7.16. The ΔE values were more than 3.3 when the ceramic disks were cemented with resin cements in shade HV + 3 (4.90) and shade WO (7.16). One-way ANOVA of ΔE values revealed significant differences in the resin cement shades.

Conclusions: Resin cements can affect the final color of ceramic veneer restorations, and the extent of this effect varies according to the resin cement shades.

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1. Introduction

Dental veneers are one of the most popular treatments for restoration of unesthetic anterior teeth [1]. The veneer technique is used to close diastemas, restore morphological and structural defects, and improve the appearance of mildly discolored teeth [2,3]. Compared with composite resin materials, ceramic veneers have many advantages, such as excellent biocompatibility, natural appearance, and a reliable clinical success rate [4,5].

The challenge with ceramic veneers is to achieve maximum esthetics by balancing shade matching while providing a thin ceramic restoration [6]. Some studies found that the thickness of ceramic materials and light transmittance were highly correlated [7–9]. The more translucent the material, and greater the influence of the underlying substrate on the final color of the ceramic veneer [10–14]. The final color of ceramic veneer restorations is determined by the combination of tooth structure color, ceramic layer thickness, and cement color.

Ideally, a thin translucent ceramic bonded to a less chromatic and non-discolored tooth provides an esthetically pleasing ceramic veneer restoration [15]. However, when the tooth is discolored, the use of an opacious and chromatic ceramic and resin cement is necessary, as well as additional tooth reduction to mask the discolored substructure [15]. Clinicians are frequently faced with a challenge when selecting the color of the cement for ceramic veneers. Resin cements with various shades offer dental practitioners the chance to select an appropriate shade of resin cement and to adjust the final color of the restoration [16].

Several studies have attempted to determine the effect of resin cement shades on veneer restorations. Some studies found that variation in the thickness of the ceramic material and different shades of cement can lead to perceptible color differences in veneer restorations [17–19]. However, Vichi et al. [11] and Azer et al. [20], suggested that the resin cement had no significant effect on the final color of IPS Empress all-ceramic material, and that differences in the cement thickness (0.1 mm or 0.2 mm) only slightly affected the final appearance. Karaagaclioglu and Yilmaz's study was consistent with these results, finding that the final color difference between ceramics bonded by cement in shades A1 and A3 was not clinical perceptible [21].

The objective of this study was to evaluate the influence of the shade of resin cement on the final color of ceramic veneers. The null hypothesis was that the shade of resin cement does not affect the final color of ceramic veneers.

2. Material and methods

IPS e.Max ceramic materials and three brands of resin cement were evaluated in this study. The chemical information of ceramic material and resin cements are listed in Table 1.

2.1. Ceramic specimen preparation

For this experiment, 50 ceramic disks (8.0 mm × 0.6 mm) were fabricated using a lost-wax technique (IPS e.Max Press, LT A3 shade, Ivoclar, Liechtenstein) according to the manufacturer's instructions. One surface of ceramic disk was polished with 600-, 800-, 1000- and 1200-grit wet silicon carbide paper (Siawat WA, Switzerland) and the bond surface was polished with 600-grit wet silicon-carbide paper, to achieve a final thickness of 0.6 ± 0.03 mm, monitored by a five-point measurement using a digital micrometer (Shanghai Jiuliang Hardware Tools Co., Ltd., China). The ceramic disks were ultrasonically cleaned in distilled water for 10 min and excess of water was removed by an absorbent paper. The disks were then self-glazed at the recommended temperature.

2.2. Composite resin background disks preparation

Fifty composite resin background disks (Dentin shade, DC CORE PLUS, Kuraray Medical Inc., Japan) were fabricated using a Teflon mold (8.0 mm × 4.0 mm) to simulate the normal background dentin shade. The composite resin background disks were cured using a light-polymerizing unit (Mini LED, Satelec, France) for 40 s on each side of the disk, with a light intensity of 1100 mW/cm^2. Wet silicon carbide paper (800-grit) was used to produce a uniform bonding surface, and the thickness of disks was adjusted to 4.0 ± 0.02 mm. The thickness of composite resin background disks was monitored by a five-point measurement using a digital micrometer.

2.3. Color measurement

A spectrophotometer (VITA Easyshade) was used to measure the color parameters (CIE $L^*a^*b^*$ values) and record the C^*_{ab} values of the ceramic disks against the composite resin background disks. Butylphthalate was placed between the ceramic disks and the composite resin background disks to provide an optical contact [22]. These paired disks were measured with the glazed surface against a neutral-gray card (X-Rite, Shanghai Color Management Co., Ltd., China). In order to avoid errors in the color measurement caused by a mismatched position, marks were placed at the edge of the trisection of the disks. The CIE $L^*a^*b^*$ values of each pair of disks were registered at three points approximately 1 mm from the marked edge of the ceramic disk, and the C^*_{ab} values were also measured. The paired disks were cleaned with a 75% alcohol swab to remove the butylphthalate, then rinsed with distilled water and air-dried.

2.4. Bonding between the ceramic disks and composite resin background disks

Fifty paired specimens were randomly divided into ten groups. Ten shades from three brands of resin cement were selected in this study. The shades selected were LV-3, LV-2, MV, HV + 2, HV + 3 (Variolink Veneer, Ivoclar Vivadent, Liechtenstein); light and brown (Panavia F, Kuraray Medical Inc., Japan); and WO, TR, A3 (RelyX™ Veneer, 3M ESPE, USA).

The bonding process of each resin cement system was undertaken in accordance with the manufacturer's instructions. The bonding surface of ceramic disks was treated by the ceramic primer after etching with 8% hydrofluoric acid. And the surface of composite resin background disks was also applied the corresponding bonding agent at three cement