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Research Article

Evaluating the Final Color of Restorations with Three CAD/CAM Core Materials (Co–Cr, Zirconia, and PEEK), Veneered by Two Methods (Indirect CAD/CAM Composite and Heat-Pressed Ceramics)

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Background. This study aimed to evaluate the final color of restorations with three different core materials (Co–Cr, Zirconia, and PEEK) veneered with heat-pressed ceramic or CAD/CAM composite. *Methods*. Forty cores in the form of square with dimensions of 10×10 mm and thickness of 0.5 mm were milled from Zirconia and Co–Cr blocks and were veneered with either A2 shade CAD/CAM composite resin or heat-press ceramic ($n = 10$). Ten samples from polyetheretherketone blocks were only veneered with composite resins. A2 shade veneer material with 2 mm served as control for color evaluation of samples. Color parameters were measured by spectrophotometer. The data were analyzed using one-way ANOVA and Tukey's post hoc test. *Results*. The mean color differences between Co–Cr, Zirconia and PEEK samples veneered with composite and the control sample were 2.91 (±0.45), 3.24 (±0.33), and 2.75 (±0.35) and for Co–Cr and Zirconia in ceramic groups were 6.46 (±0.32) and 1.97 (±0.19), respectively. One-way ANOVA and Tukey's post hoc test showed a significant difference between the core groups veneered with ceramic ($P \leq 0.001$). The type of core material in the composite veneered samples, however, did not make a significant difference ($P = 0.186$). All groups except for Co–Cr-ceramic showed clinically acceptable results ($\Delta E < 3.7$). *Conclusion*. Type of core material presented significant effect on the final color of restorations when ceramic was used as a veneer material. Conversely, the final color of composite veneer restorations is not affected by the core type. CAD/CAM composites can provide adequate color coverage for different core materials without exceeding a minimum clinically acceptable thickness.

1. Introduction

Esthetics plays a key role in the success of restorations and is one of the most critical parameters for patients when defining high-quality restorations. A restoration's final appearance depends on many factors, including the type of materials used, their thickness, color stability, and translucency [1]. All-ceramic restorations are becoming an incredibly popular alternative to metal-ceramic restorations, especially in the anterior regions since they increase translucency and improve light transmission. However, all-ceramic restorations are prone to cracking and chipping due to the lack of support by metal copings and have low electrical and thermal conductivity [2]. The chemical stability, superior mechanical properties, esthetics, and biocompatibility of zirconia make it a suitable material to replace metal cores. Although zirconia frameworks are more visually appealing than metal frameworks, they have the disadvantage of being opaque and white. In fact, zirconia cores and ceramic veneers are semitranslucent from a visual perspective [3].

Polyetheretherketone (PEEK) is a thermoplastic polymer that is another suitable alternative to metal cores due to its

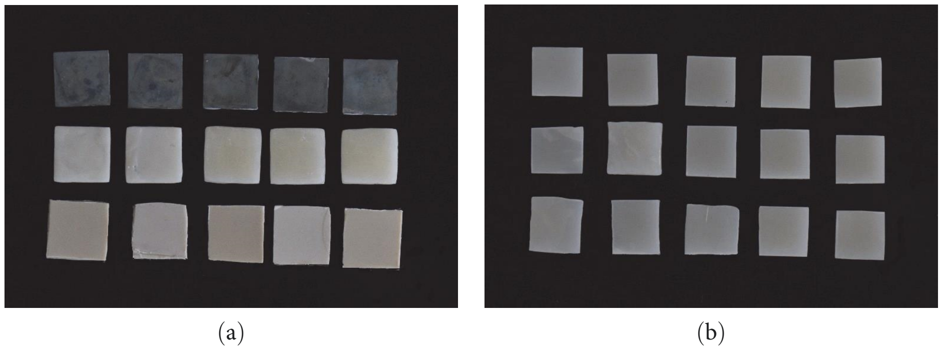


Figure 1: (a) Co–Cr, Zirconia, and PEEK core samples and (b) heat-pressed ceramic samples.

high strength-to-weight ratio and creep resistance. PEEK has been used in dentistry for the last 10 years as a healing cap and temporary abutment. The CAD/CAM type can be used as a substitute for metal in full mouth reconstructions. There are several advantages to using this material, including improved biocompatibility, appearance similar to teeth, adjustability with dental burs, and optimal physical properties. PEEK's tensile properties are closely related to those of bone, enamel, and dentin. Further, in sterilization processes, this material maintains its mechanical properties at high temperatures (335°C) and has been shown to absorb less water, not hydrolyzed by water, and does not show any toxicity. When used as a full coverage monolithic restoration, PEEK, like zirconia, has esthetic problems. Due to this material's low translucency and gray appearance, a resin veneer is needed to cover the core [4, 5].

As mentioned earlier, porcelain veneer chipping is the main reason for the failure of all-ceramic restorations. Composite veneers were found to be clinically appropriate as a ceramic substitute for zirconia frameworks [6]. According to numbers of studies, metal composite restorations have become popular since they offer a favorable esthetic and are easy to repair [7]. The bending strength, fracture resistance, and tensile strength of composites are similar to those of ceramics. They are more closely aligned with the margin of the restoration and resist compressive forces better than ceramics, so less occlusal force is transferred to the margin of the restoration [8]. However, composites wear out more quickly than ceramics and teeth, accumulate plaque more easily, and have less color stability than ceramics. This type of restoration also has a relatively low-shear bond strength, which can be its main weakness [9, 10].

Recent developments in composites have resulted in high-impact polymer composites (HIPC), which are cross-linked and amorphous and have better physical properties than polymethyl methacrylate (PMMA). Due to the absence of light cure plastics and dental glasses, these composites maintain their color and accumulate less plaque, making them comparable to ceramic veneers and press ceramics. The durability of these materials has been demonstrated by in vivo studies for more than 9 years, and unlike ceramics, they do not suffer from aging. Additionally, they are economical and can be used in fixed or removable prostheses in monolithic or veneered forms [11].

Several studies have found that factors such as the color of the core, the materials used in core construction, and the thickness of the core and veneer have a significant impact on the final color and translucency of metal-ceramic and all-ceramic restorations [12–20]. However, based on different method and materials used in dental literatures, some studies showed that the color difference of veneer materials in front of some type of cores may not be detected by human eyes or clinically significant [16, 17]. In contrast, some studies reported clinically unacceptable color change when specific core materials or minimum veneer thickness were used [14, 15]. To the best of our knowledge, no study has compared veneered restorations made of composites and pressed ceramics with different core materials (Co–Cr, zirconia, or PEEK). Regarding previous studies, the research hypothesis of this study was: the type of cores and veneers significantly influence the restoration's final color in both ceramic and composite groups.

2. Materials and Methods

As per a previous study by Lee et al., [21] the mean standard deviation of 1.07 for the ΔE variable was considered. With a Type 1 error of 0.01 and a statistical power of 90% for a 3.3 difference test, the minimum sample size required for each subgroup was calculated to be $n = 5$.

Forty Co–Cr and zirconia cores were prepared using a milling machine (CORiTEC 340Imes-icoreEiterfeld, Germany) to cut the core samples of Co–Cr blocks (CORiTEC Co–Cr Disc, imes-icore GmbH, Eiterfeld, Germany) and zirconia blocks (IPS e.max ZirCAD MO, Ivoclar Vivadent Co., Germany) into squares with dimensions of 10×10 mm and thickness of 0.5 mm. Ten cores of white core PEEK were wet cut using CAD/CAM blocks (BreCAM BioHPP, Bredent, Senden, Germany) designed specifically for open systems (Figure 1(a)).

According to the factory, PEEK restorations require a minimum core thickness of 0.5 mm and a maximum veneer thickness of 2 mm. Zirconia and Co–Cr have proven their strength in this thickness. The chemical compositions and lot numbers of the materials used in the present study are presented in Table 1.

The presintered zirconia blocks were sintered according to the manufacturer's instructions. Then, the samples of all three groups were placed in an ultrasonic cleaner (Quantrex

Table 1: Study materials in detail.

Material	Brand	Manufacturer	Composition	Lot number
Co–Cr alloy	CORiTEC CoCr	Imes-icore GmbH., Eiterfeld, Germany	Co (>62%), Cr (>28%), W (>8.45%), Si (>1.65%), Mn, Fe, C (>0.5%)	184856
Zirconia ceramic	IPS e.max ZirCAD	Ivoclar Vivadent Co, Germany	ZrO_2, Y_2O_3, HfO_2, and Al_2O_3	3314000217
PEEK	BreCAM BioHPP	Bredent, Senden, Germany	Ceramic filled (20%) PEEK	540 0203 1
Composite	BreCAM-HIPC	Bredent GmbH & Co.KG, Witzighausen, Germany	Matrix: ultracompact PMMA Filler: ceramic microfiller	406700
Primer	MKZ Primer	Bredent GmbH & Co.KG, Witzighausen, Germany	Ethanol	415160
Primer	Visio.link	Bredent GmbH & Co.KG, Senden, Germany	MMA, PETIA, and photoinitiators	152117
Composite	Cre.lign opaker	Bredent GmbH & Co.KG, Witzighausen, Germany	Bis-GMA composite with microfillers	160202
Composite	combo.lign opaquer	Bredent GmbH & Co.KG Senden, Germany	Bis-GMA composite with microfillers	210403
Composite	Dual-curing combo.lign luting composite	Bredent GmbH & Co.KG, Witzighausen	Bis-GMA composite with microfillers	171313
Ceramic	IPS e.max® ZirPress	Ivoclar Vivadent, Schaan, Liechtenstein	SiO_2, Al_2O_3, Na_2O, K_2O, CaO, ZrO_2, P_2O_5, F, +other oxides, and +Pigments	R65422

90 WT, L&R Manufacturing, Inc. Kearny, NJ, US) with distilled water for 6 min to clean the sticky surface particles. According to the factory's instructions, the surface of all samples was sandblasted with 110 μm aluminum oxide at an angle of 45° and a distance of 3 cm for 10 s and cleaned with alcohol and a brush (maximum pressure was 2, 2–3, 3–4 for zirconia, PEEK, and Co–Cr samples, respectively). In zirconia and Co–Cr samples, core surfaces were primed (MKZ Primer, Bredent GmbH & Co.KG, Witzighausen, Germany) and allowed to evaporate for 30 s to bond with the composite. In the Co–Cr group, opaque dual cure paste with light color (combo.lign opaquer; Bredent GmbH & Co. KG, Senden, Germany) was mixed (equal proportions of opaquer paste and catalyst paste). A thin wash (0.1 mm) of the obtained material was applied to the samples and exposed to light for 180 s. Both zirconia and Co–Cr samples were then coated with a uniform layer (0.1 mm) of A2-colored opaque material (Cre.lign opaker; Bredent GmbH & Co. KG, Senden, Germany) and exposed to light for 180 s with dental laboratory light cure (Labolight LV-III, GC, Tokyo, Japan). A 360 s final polymerization was conducted at the end. In the Co–Cr group, surface oxidation process was carried out according to the manufacture instructions to bond to ceramics. The first and second layers of opaque were applied in accordance with factory instructions and sintering was completed in the furnace. In the group of zirconia cores, a liner Ivoclar Vivadent (IPS e.max, ZirLiner) was applied to the surface of the samples before they were sintered.

The PEEK samples that olny veneered by composite, were primed with a thin layer of primer (Visio.link, Bredent GmbH & Co.KG, Witzighausen, Germany) and light cured at 370–400 nm for 90 s. Following the instructions given earlier, 0.1 mm thick primer (Cre.lign opaker; Bredent GmbH & Co.KG, Senden, Germany) was applied.

For veneering by ceramic in the Zirconia and Co–Cr groups, a square wax pattern (Prowax; Ivoclar, Vivadent, Liechtenstein) of 1.2 mm height was placed on the core surface, and a sprue was connected to the wax pattern and cast with phosphate bond investment. Following 1 hr of investment setting, the sample was placed in the furnace (Programat EP, Ivoclar, Liechtenstein), and the ceramic (IPS e.max ZirPress ceramic block) was pressed into the mold using the lost wax technique (Figure 1(b)).

Composite veneer milled using milling machine (CORiTEC 340i; Imes-icore, Eiterfeld, Germany) from CAD/CAM blocks (BreCAM-HIPC, GmbH & Co.KG Weissenhorner, Germany) with dimensions of 10 × 10 mm and thickness of 1.2 mm (Figure 2(a)). Composite veneers, like ceramic veneers, have an initial thickness of 1.2 mm, and eventually reach 1 mm after polishing according to the manufacturer's instructions. Composite veneers were internally primed with a thin layer of primer (Figure 2(b)). Dual-curing combo.lign luting composite with A2 color was placed on the inner surface of the veneers, then were placed on the cores (Co–Cr, Zirconia, and PEEK) and exposed for 180 s (Figures 2(c) and 2(d)). Cement additions were removed using a modeling spatula and polishing burs after hardening.

2.1. Color Assessment of Samples. The samples were first cleaned and dried using an ultrasonic device for 10 min. Color measurements were performed by one person under the same environmental conditions utilizing a spectrophotometer (SP64 Portable Sphere Spectrophotometer, X-Rite, Hong kong, China) with SCE (specular component excluded) geometry using the D65 standard brightness and a white standard background. UV filter was set to cover 100% of radiation. Device aperture is 4 mm, and illumination and visibility paths were based on the CIE diffuse/8° geometry.

Using distilled water to prevent optical contact edge loss the refractive index was set at approximately 1.33. A special white screen was used to calibrate the device between measurements. The average of three measurements was calculated for each sample.

To determine the color of the samples, the CIE Lab system was used. These measurements were also performed on a 2 mm thick composite veneer sample (BreCAM-HIPC, GmbH & Co.KG Weissenhorner, Germany) in A2 as a control sample. Following that, the color difference between each sample and this control sample (ΔE) was calculated. The color difference below 1 cannot be seen with the naked eye. A trained eye can detect the color difference between 1 and 2.5. A difference of 2.5–3.7 is visible but is clinically acceptable. Therefore, the threshold limit for color difference was set at 3.7.

The color difference was calculated using the following formula:

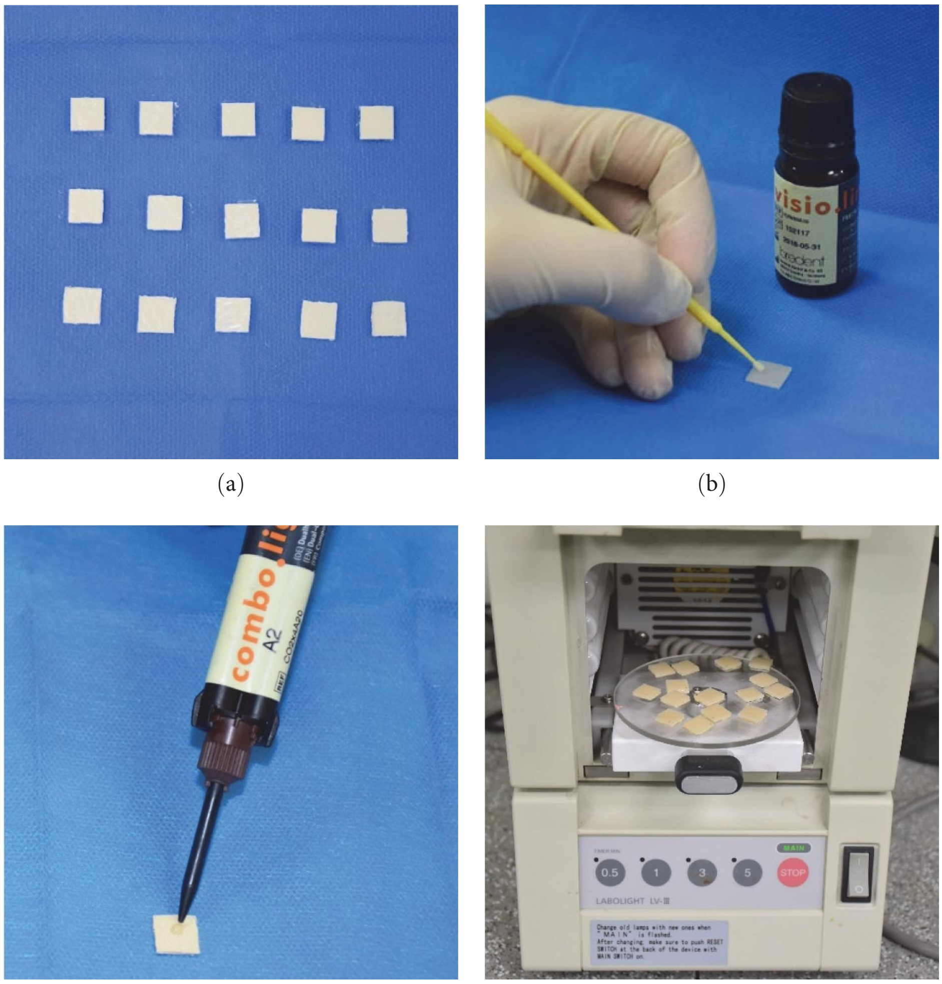
$$\Delta E = [(L \times x - L \times y)2 + (a \times x - a \times y)2 + (b \times x - b \times y)2]^{1/2}. \quad (1)$$

The data analysis was conducted using SPSS (SPSS IBM Copr, Released 2011, IBM Statistics for windows, Version 20.0. Armonk, NY: IBM Corp) statistical software. A one-way analysis of variance was used to analyze the data. The significance levels of 0.05 were used throughout all the statistical tests.

3. Results

Based on the statistical results, the nonparametric test indicated a significant difference between the samples ($P \leq 0.001$). The results of the one-way ANOVA and Tukey's post hoc test showed a significant difference between the core groups when ceramic is used as a veneer material ($P \leq 0.001$). The type of core material in the composite veneered samples, however, did not make a significant difference ($P = 0.186$).

ΔE was 1.97 for zirconia ceramics, 6.46 for Co–Cr ceramics, 3.00 for zirconia composites, 2.91 for Co–Cr composites, and 2.75 for PEEK composites. Zirconia ceramics has the lowest ΔE that only can be detected by trained eyes (below 2.5). The color difference (ΔE) in all three groups of veneered samples with composite is within the clinically acceptable range. Co–Cr-ceramics have an ΔE of 6.46, which is unacceptable from a clinical standpoint. ΔE is significantly lower in Co–Cr-composites than in Co–Cr-ceramics. Ceramic



(a) (b) (c) (d)

Figure 2: (a) BreCAM-HIPC samples. (b) Preparing composite veneer samples by applying visio link primer. (c) Application of dual-curing combo.lign luting composite to veneer surfaces. (d) The samples are placed in the light-curing device for final polymerization.

significantly showed less color difference than composite in the zirconia group. The ΔE of zirconia groups is clinically acceptable in both ceramic and composite veneered samples.

4. Discussion

A dental crown usually consists of two parts: the core and the veneer. Cores provide strength for dental restorations, and veneers restore the appearance and color of the teeth. The composite resins and ceramics are common veneering materials. There are several advantages to ceramics, such as wear resistance, favorable visual properties, less plaque accumulation but a major disadvantage is their fragility. Alternatively, composite resins can serve as a substitute for ceramic veneers. In addition to absorbing occlusal forces, composite materials reduce the weight and cost of expanded prosthetics. When compared to ceramics, this category has a lower thermal expansion coefficient, less dimensional change, and less wear on the opposite teeth. Their disadvantages include plaque accumulation and low-wear resistance. Additionally, the bond between composite veneers and different cores, such as zirconia, metal alloys, and PEEK, has been questioned and investigated in several studies. As a result of these limitations, ceramic remains a viable veneering option for core materials. In the light of the widespread acceptance and clinical efficacy of composites and ceramics as veneering materials, the present study examined the effect of the different core materials (chrome cobalt–zirconia-PEEK) on the final color of composite and heat-pressed ceramic veneers.

To eliminate core thickness effects and make veneer thickness uniform, all samples had the same core thickness. In CAD/CAM systems, 0.5 mm is the minimum thickness for cores and is suitable for all these restorations. According to Fazi et al. [12], veneer thickness had a more significant effect on final color than core thickness and ceramic color. In this research, thicknesses were based on clinically applicable tooth preparation; 1.5 mm reduction of the buccal surface was followed by 0.5 mm of core to create strength, and a 1 mm veneer to create a toothlike appearance.

Clinically acceptable thresholds for color difference are difficult to determine. Numbers between 0 and 1 indicate the color difference that is invisible to the naked eye; numbers between 1 and 2.5 indicate a slight color difference that can only be seen by trained eyes. The numbers between 2.5 and 3.7 indicate an amount of color difference that can be seen by human eyes, and the clinically acceptable threshold is 3.7. Several studies have reported the same number [13].

Based on the statistical analysis in this research, the research hypothesis was confirmed because there is a significant difference between the color changes (ΔE) of different groups ($P \leq 0.001$). Co–Cr-ceramic samples did not present acceptable clinical performances ($\Delta E = 6.46$). Metal backgrounds are opaque, and they can be easily detected under veneering materials due to the considerable distance in the spectrum and the translucency of the veneering materials [22]. When it comes to nonmetallic materials, the passing of light through their bulk is unavoidable, which can have a significant impact on their visual characteristics. On the other hand, the average of color difference for zirconia-ceramic samples was $\Delta E = 1.97$, which was not above the clinical acceptable level.

In composite group, despite a minimum veneer thickness of 1 mm, the color covering ability was adequate and there was no significant difference between those samples veneered with composite ($P = 0.186$). The color differences for PEEK, zirconia, and Co–Cr cores were 2.75, 3.24, and 2.91, respectively, all of which fell within the clinically acceptable range ($E\Delta = 3.7$); however, their color differences were higher than the threshold visible to the human eye ($E\Delta > 2.5$). These results can be associated with using Crea.lign opaquers of the same color which improved the final color of composite samples, removed opaque shadows from beneath cores, and increased bond strength when combined with primer.

To the best of the authors' knowledge, this is the first study to examine the effect of core type on color parameters of veneer composites made with CAD/CAM systems. Compared with other studies, this study uses a different method and type of veneer, making comparison and appropriate conclusions difficult. Zeighami et al. [13] found that shadow of the PEEK cores (white and dentin) had significant effects on the final color of veneered samples with indirect composite veneer. Based on 0.5 mm of core thickness and 1 mm for veneer thickness in that study, ΔE for white core was 4 and ΔE for dentin core was 2.75. In the present study, a white core with a thickness of 0.5 mm was veneered with 1 mm CAD/CAM composite and ΔE was calculated as 2.75, which is clinically different from the study of Zeighami et al. [13]. In addition, the effect of core type in composite veneered colores was not statistically significant in the present study, unlike Zeighami et al.'s [13] study. The different results could be attributed to the use of CAD/CAM composites in this study, which have better color characteristics and color coverage than the manually placed composites in the Zeighami et al.'s [13] study. Also, the spectrophotometer device and the observer's viewing angle were different between the two studies [13].

Except for Co–Cr-ceramic specimens, all study groups showed color differences within clinically acceptable level ($\Delta E < 3.7$). A study by Kourtis et al. [20] found that two factors, the ceramic type and the alloy in metal-ceramic restorations, influenced the final color. In their study, the metal alloy thickness was 1 mm and the ceramic thickness was 1.2 mm. Hues were greater in gold alloys and Co–Cr alloys than in the Ni–Cr and the Pd alloys [20].

Nakamura et al. [14] similarly found that various metallic and nonmetallic backgroundshave a significantly different effect on the final color of four types of composite veneer and one heat-pressed ceramic samples. The color differences between all specimens when backed with silver-palladium backgrounds in comparison with A3 color backgrounds (control groups) could be detectable by human eyes (2/26–4/67). They concluded that when silver–palladium is used as a background, it is difficult to achieve an adequate color match. However, color difference was not significant in all type of specimens when A1 color ceramic and gold alloy backgrounds were used. In the present study, composite samples did not show significantly different ΔE in three core groups [14]. This difference in results may due to that Nakamura et al. [14] used a composite with a high-filler content to improve strength and wear resistance. As a result, this composite has a translucency similar to ceramics, which may be due to the similar reflection coefficients of the matrix and the fillers. The use of materials with higher translucency causes more light to pass through and scatter light from the background. The composite used in the current study (HIPC) has a high percentage of filler along with microceramics in the matrix. Because of the laboratory process, the residual monomer percentage is very low, and the smooth surface shows only minor plaque accumulation and excellent color stability.

According to Chaiyabutr et al. [15], dental abutment color, cement color, and ceramic thickness influence the color characteristics of lithium disilicate ceramic veneers. The samples used in this study were anatomical CAD/CAM veneers. Dark colored abutment teeth showed the greatest color difference, and in ceramics with thicknesses of 1 mm (no matter whether the cement is opaque or transparent) or 1.5 mm (if translucent cement is used), color differences were higher than the clinically acceptable threshold ($\Delta E > 3.7$) [15]. According to the current study, the 1 mm thickness of the ceramic veneer was affected by the background color, and in the Co–Cr group, the results were not acceptable from a clinical point of view. Chaiyabutr et al.'s [15] study indicates the glass matrix and lithium disilicate crystal phase are responsible for the effect of background color on the ceramic veneer color. According to their study, light scattering inside the glass matrix is reduced and therefore the translucency of the veneer increases.

In Koutayas et al.'s [16] study, 0.6 mm densely sintered alumina ceramic was veneered using 2 mm feldspathic porcelain. The effect of the underlying core (high-precious gold alloy, aluminum-oxide ceramic material, titanium metal alloy, yttrium-stabilized zirconium dioxide ceramic material, and glass–ceramic material) color on the final color of the restorations veneered with dense alumina ceramic was statistically significant, however,could not be detected by the human eye ($\Delta E < 2$).This result can be attributed to the use of a dense alumina disc veneered with feldspathic porcelain along with opaque cements, which acted as color insulators for the background. In Koutayas et al.'s [16] study, zirconia cores showed more color difference than samples with more translucency such as lithium disilicates, which was due to the white and opaque appearance of zirconia. In the present study, also the average color difference of zirconia cores was reported to be higher in the group of zirconia-composite than other composite groups [16].

In Suputtamongkol et al.'s [17] zirconia-based cores and lithium disilicate-based veneers were cemented to metal posts and cores or prefabricated posts and composite build-ups. According to the results of this research, the background color can affect the overall color of premolar and molar all-ceramic zirconia crowns with 1.5 mm thickness ($\Delta E = 1.2$–3.1) and the cement layer had very little effect on the final color. In this study, although color changes can be detected by colorimetric instruments, it was still in the clinically acceptable range regardless of whether the backgrounds are metal posts and cores or prefabricated posts and composite buildups as cores [17].

Shimada found that the masking ability of ceramic materials are affected by the difference in reflection coefficients between the particles and the matrix, as well as the color pigments. This factor affects the passage and scattering of light from the surface of the material. A higher refractive index results in a higher refraction of light, causing ceramic materials to appear opaque. Depending on the thickness of ceramics, this coefficient changes and determines its color characteristics and its covering properties [18].

Stawarczyk et al. [19] examined standard samples of PEEK material, zirconia, chromium–cobalt–molybdenum alloy, and titanium oxide along with ceramic veneers of varying thicknesses. The research results indicated that core type, veneer material, and veneer thickness had significant impact on both CIE Lab and VITA Easyshade color measurements. When compared to gold standard core materials such as CoCrMo and ZrO_2, PEEK showed no differing tendencies in the CIE Lab-system parameters. Regardless of the veneering material, the relative frequency of the VITA EasyShade parameters for PEEK core material (A1: 25%, A2: 17%, and B3: 31%) was comparable to that of CoCrMo (A1: 25%, A2: 16%, and B3: 31%). In this study, however, samples of core and veneer were placed on top of each other without cement that could scatter light between them [19].

In the present study, the core and veneer thickness, as well as the color of the veneer and cement, were standardized to eliminate the effects of variables. However, effects of these variables on the final color of restorations need to be investigated in future studies. This study is limited by the fact that translucency values of composites and ceramic veneering materials were not measured. Moreover, materials of this study must be tested in anatomical forms and under conditions more similar to those in clinical practice.

5. Conclusions

Within the limitations of this current study, it was concluded that:

(1) Different study groups had significantly different color changes. Compared to the standard sample, Co–Cr-ceramic showed the greatest amount of color difference between all groups, which was clinically unacceptable. Other groups had color differences that were clinically acceptable (less than 3.7). Since the detectable range of color differences is considered to be 2.5–3.7, the color differences in all samples could be detected with human eyes, except for zirconia ceramic.

(2) Based on the lack of significant difference in the distribution of the color difference variable between composite groups, the final color of composite veneer restorations is not affected by the core type.

(3) The results of this study suggested that CAD/CAM technique for composites with enhanced quality and improved color characteristics provided adequate color coverage for the core and esthetics for the restorations without exceeding a minimum clinically acceptable thickness. Furthermore, the opaque layer applied with the appropriate thickness, improved bonding, and provided appropriate color covering.

Data Availability

The datasets used during the current study are available from the corresponding author on reasonable request.

Disclosure

A preprint has previously been published [23].

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

All authors have made an important scientific contribution to the study and are thoroughly familiar with the primary data.

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