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ORIGINAL ARTICLE

Colorimetric study about the stratification's effect on colour perception of resin composites

G. R. M. La Rosa[1] · S. Pasquale[2] · E. Pedullà[1] · F. Palermo[3] · E. Rapisarda[1] · A. M. Gueli[2]

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Abstract
To evaluate the influence of a different order of dentin and enamel layers on stratification appearance of different resin composites. 144 Dentin (D) and Enamel (E) composite samples (Clearfil Majesty ES-2 Premium, Brilliant EverGlow, Estelite Asteria), 1 mm thick, were divided into 12 configurations for each composite, with Enamel–Dentin–Dentin–Enamel (EDDE) assumed as target. The colour specification was conducted using a spectrophotometer, elaborating the results with the CIE $L^*a^*b^*$ colour coordinates and calculating the colour difference in terms of ΔE^*_{ab} quantity. A value of this last major of 3.3 was considered not clinically acceptable. Moreover, data were analyzed using two-way analysis of variance and Tukey post hoc test ($P < 0.05$). For Clearfil Majesty ES-2 Premium and Brilliant EverGlow, six configurations showed $\Delta E^*_{ab} > 3.3$ compared to gold standard EDDE. ΔE^*_{ab} was influenced especially by b^* and L^* coordinates ($P < 0.05$). EDED showed no visual difference ($0 < \Delta E^*_{ab} < 1.1$) for both composites. For Estelite Asteria, two configurations reported $\Delta E^*_{ab} > 3.3$ compared to EDDE. In particular, the L^* coordinate influenced ΔE^*_{ab} results ($P < 0.05$). EDDD was the best configuration ($0 < \Delta E^*_{ab} < 1.1$). Within the limits of a vitro study, Brilliant EG showed more dependence from order and thickness of stratification (resulting more similar to Clearfil Majesty ES-2 Premium); therefore, it could be indicated for more complex aesthetic restorations. Estelite Asteria seems to be able to balance small differences in thickness of dentin and enamel layers, and consequently, it is more indicated to different clinical situations.

Keywords CIE $L^*a^*b^*$ · Brilliant EverGlow · Estelite Asteria · Resin composites · Stratification

Introduction

The importance of external appearance and cosmetic parameters dictated by modern society has led to an increase in aesthetic demands. In addition, the development of composite restoration materials has broadened their indication in the field of aesthetic restorative procedures [1]. The optical properties of a natural tooth are quite remarkable due to its internal buildup of organic and inorganic materials at a molecular level. The two outermost layers of a tooth crown are enamel and dentin, and they play a major role in conveying the tooth its colour [2]. Enamel is more translucent, but has a lower chroma, while dentin is opaque and more saturated [3]. To achieve the desired characteristics of natural teeth, it should be the goal of the practitioner to make the thickness of the dentin and enamel layers of composite reproduce the anatomic thickness of that tooth prior to restoration [4]. The restorative approach of layering, often called stratification, has been described as the ''anatomic build-up technique'' [3], the ''trendy three-layer concept'' [5], or the ''natural layering concept'' [6].

Clearfil Majesty ES-2 Premium (Kuraray, Okayama, Japan) is a nano-hybrid composite indicated for aesthetic direct restorations. It includes enamel and dentin shades which could be used following the anatomical layering technique [7].

✉ G. R. M. La Rosa
g_larosa92@live.it

1 Department of General Surgery and Surgical-Medical Specialties, University of Catania, Via Plebiscito 628, 95124 Catania, Italy

2 PH3DRA (PHysics for Diagnostics Dosimetry Dating Research and Application) Laboratories, Department of Physics and Astronomy, University of Catania, Catania, Italy

3 Infectious Disease, Department of Clinical and Experimental Medicine, University of Catania, Catania, Italy

However, the standard three-layer stratification requires time. Recently, new resin composites have been introduced with a simplified layer technique.

Brilliant EverGlow (Coltene/Whaledent AG Altstatten, Switzerland) is a new composite, in which, according to the manufacturer, each shade covers two shades at the same time ("Duo Shade" system) of the VITA reference scale (e.g., A1/B1 or A2/B2). Seven universal composite shades and additional enamel and opaque shades for aesthetically more complex restorations constitute the Brilliant EverGlow system. According to the manufacturer, Brilliant EverGlow integrates into existing surroundings with the application of a single shade already providing unerring highly aesthetic restorations. An additional enamel layer can often be used [8].

Estelite Asteria (Tokuyama Dental Corporations, Tokyo, Japan) is another of these new composites. It also proposes a simplified colour choice with only 7 shade body dentins and 5 shade enamels. Estelite Asteria is developed to realize simplified two-step layering composite restorations as well as outstanding aesthetic results. This two-layer stratification technique allows obtaining a highly aesthetic result, because the body masses replicate the hue and the chroma, while the enamel masses allow to reproduce the value [9].

To perform an optical evaluation of the colour of the entire restoration, two methods are possible: one based on a qualitative approach using human eyes but subject to bias due to perception limits and a quantitative method based on the use of instruments, such as a colorimeter or a spectrophotometer. The latter is preferred, as it is more precise due to a more accurate spectral analysis [10, 11]. Data are often elaborated focusing on the CIE (Commission Internationale de l'Eclairage) $L^*a^*b^*$ coordinates for the quantification of the colour difference through ΔE^*_{ab}.

The aim of this study was to evaluate the influence of a different order of dentin and enamel layers on stratification appearance of the two new resin composites, Brilliant EG and Estelite Asteria, through colour specification using CIE system and a statistical analysis and compare these results with an aesthetic resin composite characterized by a conventional stratification system (Clearfil Majesty ES-2 Premium).

Materials and methods

Sample preparation

Table 1 provides information on the materials used in this study. Circular molds, 12 mm in diameter and 1.00 ± 0.05 mm in thickness checked by means of a digital caliper (digital-cal capaμsystem®, TESA, Renens, Switzerland), were used for sample preparation. Composite was placed in the mold on a microscope glass slide, covered with a transparent Mylar strip and light-cured using a 1100 mW/cm^2 polywave light-curing unit, Bluephase (Ivoclar Vivadent, Schaan, Liechtenstein), for 20 s at a standardized distance of 1 mm. After curing, the samples were removed from the mold and stored dry at 37 °C for 24 h [12]. No finishing techniques were used. Great attention was given to obtain flat samples and to prevent bubble inclusions. As variations in thickness could influence the results, only samples that did not differ more than 0.05 mm in thickness were involved in this study [1, 13].

144 samples of 1 mm thickness were prepared ($n = 24$) included Clearfil Majesty ES-2 Premium A2 Enamel and A2 Dentin; Estelite Asteria Natural Enamel (NE) and A2B body; Brilliant EverGlow Translucent (Trans) Enamel and A2B2 dentin. These samples were divided into 12 configurations made out of the superposition of 4 samples. 6 sets of 8 samples (4 dentin and 4 enamel), for each composite, were produced. For each set, the samples were manufactured with composite packages of the same production lot. The discs

Table 1 Materials used in the study

Material	Manufacturer	Type	Composition[a]
Clearfil Majesty ES-2 Premium	Kuraray, Okayama, Japan	Nano-hybrid	Bisphenol A diglycidylmethacrylate, silanated barium glass filler, pre-polymerized organic filler, hydrophobic aromatic dimethacrylate, hydrophobic aliphatic dimethacrylate dl-camphorquinone, accelerators, initiators, pigments
Brilliant EverGlow	Coltene/Whaledent AG Altstatten, Switzerland	Submicron hybrid	Methacrylates, dental glass, amorphous silica, zinc oxide
Estelite Asteria	Tokuyama Dental Corporations, Tokyo, Japan	Nano-hybrid	Bisphenol A di(2-hydroxy propoxy) dimethacrylate (bis-GMA), bisphenol A polyethoxy methacrylate (bis-MPEPP), 1,6-bis(methacryl-ethyloxycarbonylamino) trimethyl hexane (UDMA), triethylene glycol dimethacrylate (TEGDMA), mequinol, dibutyl hydroxyl toluene, UV absorber

[a]Manufacturer's data

have been superposed each other without the interposition of any medium, avoiding any possible influence on optical results.

Enamel–Dentin–Dentin–Enamel (EDDE) was assumed as the target configuration, reproducing the "natural technique" [1]. From the external part (corresponded to the vestibular aspect of teeth) to the more inside (corresponded to the palatal aspect of teeth), all the other configurations were as follows (Fig. 1) [1]:

EDDD, in which the palatal layer of enamel was replaced by a layer of dentin;
EEED mimicked the situation of the interproximal part and the incisal edge when the palatal part is replaced by a layer of dentin;
all the other combinations completed the possible ones (DDDD, DDDE, DDEE, EEEE, DEEE, EEDD, DEDE, EDED, DEED).

Colour measurements

The measurements were performed by a Konica Minolta spectrophotometer, model CM-2600d with measurement geometry d/8°, selecting an area of 6 mm in diameter (SAV, Small Aperture Value). The used protocol for s measurements consists in the selection of homogeneous areas using the home-made sampling plate ad hoc designed and assembled for this research [14]. This device, thanks to a spring-loaded mechanism, ensured at the same time optical contact between the spectrophotometer and the sample as well as the reproducibility of the measurements above all in terms of applied pressure.

Colour was measured in terms of CIELAB coordinates relative to the 10° standard CIE 1964 observer and the D65 illuminant. The scale adjustment was carried out using for the maximum lightness, "White calibration Plate" (CM-A145), and, for the minimum lightness, a CM-A32 device. The elaboration regarded SPEX/100 (SPecular component EXcluded and UV included) data. The acquisition step was made with the SpectraMagic software NX (Konica Minolta Software, Inc, Ramsey, NJ, USA), while Origin software (OriginLab Software, Inc, Northampton, MA, USA) was used for data processing.

The CIELAB colour space describes mathematically all perceivable colours in the three dimensions, L^* for lightness and a^* and b^* for, respectively, the colour opponents green–red and blue–yellow. In particular, L^* defines lightness and varies from 0 (black) to 100 (white). a^* denotes the red/green values, where $+a$ means red and $-a$ means green. The b^* scale measures yellow/blue, where $+b$ means yellow and $-b$ means blue [15].

Using this colour space, the colour difference between two configurations was calculated by the ΔE^*_{ab} quantity according to the following formula:

$$\Delta E^*_{ab} = \sqrt{\left(L^*_1 - L^*_2\right)^2 + \left(a^*_1 - a^*_2\right)^2 + \left(b^*_1 - b^*_2\right)^2},$$

where (L_1^* a_1^* b_1^*) are related to the examined configuration, while (L_2^* a_2^* b_2^*) correspond to EDDE target configuration.

Concerning physiological perceptibility of differences in ΔE^*_{ab}, values ranging from 0.0 to 1.1 were considered as not perceptible, between 1.1 and 3.3 as visually perceptible, but clinically acceptable, while all ΔE^*_{ab} higher than 3.3 were considered as clearly visible and clinically disturbing [1, 16].

For all data, the average values, resulting from five measurements in different positions of samples and the related uncertainties, were calculated. The total uncertainty was obtained according to the propagation uncertainty theory, as the square root of the squaring sum of standard deviation and instrumental error. This last contribution was estimated on the basis of $L^*a^*b^*$ coordinates measured on white calibration plate.

Statistical analysis

The data were statistically analyzed in the software Prism 7.0 (GraphPad Software, Inc, La Jolla, CA, USA). The normality of the distribution of the variables was determined by the Shapiro–Wilk test. Because the data presented a normal distribution, two-way ANOVA with Tukey's post hoc test was used to evaluate differences in ΔL^*, Δa^* Δb^*, and ΔE^*_{ab} within each composite as well as between composite

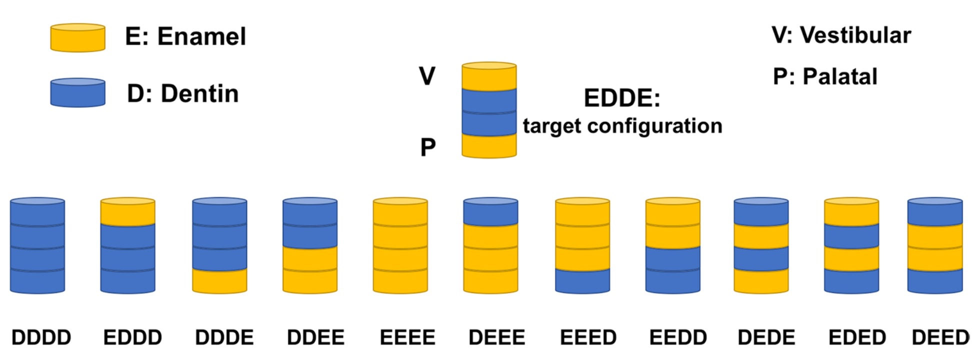

Fig. 1 Representative illustration of different layering configurations. EDDE shows the standard configuration. The upper specimen corresponded to the vestibular aspect of teeth, while the lower to the palatal one. *E* enamel, *D dentin*, *V* vestibular, *P* palatal

groups of the same configuration. The level of significance was set at 0.05.

Results

Tables 2, 3, and 4 present mean values and uncertainties of ΔL^*, Δa^*, Δb^*, and ΔE^*_{ab} values of Clearfil Majesty ES-2 Premium, Brilliant EverGlow, and Estelite Asteria for different stratifications considering EDDE configuration as target, respectively. Statistical analysis revealed a significant difference for ΔL^*, Δa^*, Δb^*, and ΔE^*_{ab} of different stratifications for a same composite as well as of the same stratification for the different composites ($P < 0.05$).

In particular, Clearfil Majesty ES-2 Premium showed the highest value of ΔE^*_{ab} (10.83) ($P < 0.05$). Six configurations (DDDD, DDDE, DDEE, DEEE, DEDE, DEED) showed $\Delta E^*_{ab} > 3.3$ compared to gold standard EDDE for Clearfil Majesty ES-2 Premium and Brilliant EG, especially for b^* and L^* coordinates ($P < 0.01$ and $P < 0.05$, respectively). In addition, two configurations (EDDD and EDED) showed no visual difference ($0 < \Delta E^*_{ab} < 1.1$) with respect to EDDE for Clearfil Majesty ES-2 Premium, while only EDED configuration was similar to the target for Brilliant EG.

Two configurations for Estelite Asteria (DDDD, EEEE) reported $\Delta E^*_{ab} > 3.3$ compared to gold standard EDDE especially for L^* parameter ($P < 0.05$). EDDD was the best configuration for Estelite Asteria ($0 < \Delta E^*_{ab} < 1.1$).

Table 2 Weighted average and uncertainty of ΔL^*, Δa^*, Δb^*, and ΔE^*_{ab} values of different stratifications with respect to EDDE, for Clearfil Majesty ES-2 Premium

Clearfil Majesty ES-2 Premium	ΔL^*	$\pm\delta$	Δa^*	$\pm\delta$	Δb^*	$\pm\delta$	ΔE^*_{ab}	$\pm\delta$
EDDE–DDDD	5.45[a1]	0.70	1.63[a2]	0.04	9.22[a3]	0.18	10.83[a]	0.40
EDDE–EDDD	0.33[b1]	0.27	0.13[b1]	0.13	0.32[b1]	0.11	0.48[b]	0.01
EDDE–DDDE	4.78[c1]	0.52	1.70[a2]	0.02	9.38[a3]	0.14	10.67[a]	0.27
EDDE–DDEE	3.11[d1]	0.24	1.55[a2]	0.03	9.48[a3]	0.09	10.10[a]	0.12
EDDE–EEEE	1.51[e1]	0.23	0.88[c1]	0.01	1.93[c2]	0.10	2.60[c]	0.20
EDDE–DEEE	4.13[c1]	0.67	0.65[d2]	0.02	8.67[d3]	0.10	9.63[d]	0.24
EDDE–EEED	0.10[b1]	0.50	0.97[c2]	0.03	1.32[e2]	0.23	1.64[e]	0.22
EDDE–EEDD	0.50[b1]	0.80	0.49[d1]	0.02	1.19[e1]	0.16	1.38[e]	0.30
EDDE–DEDE	3.88[c1]	0.25	0.28[b2]	0.01	7.26[f3]	0.10	8.23[f]	0.24
EDDE–EDED	0.61[b1]	0.25	0.06[e2]	0.01	0.27[b1]	0.11	0.67[b]	0.11
EDDE–DEED	2.67[d1]	0.26	1.10[c2]	0.03	8.90[d3]	0.10	9.36[d]	0.12

The same letters show differences not statistically significant ($P > 0.05$) in comparison with different stratifications of the same coordinate; the same number shows differences not statistically significant ($P > 0.05$) in comparison with the same configuration of different coordinates

Table 3 Weighted average and uncertainty of ΔL^*, Δa^*, Δb^*, and ΔE^*_{ab} values of different stratifications with respect to EDDE, for Brilliant EG

Brilliant EG	ΔL^*	$\pm\delta$	Δa^*	$\pm\delta$	Δb^*	$\pm\delta$	ΔE^*_{ab}	$\pm\delta$
EDDE–DDDD	2.37[a1]	0.08	1.61[a1]	0.05	5.93[a2]	0.06	6.60[a]	0.07
EDDE–EDDD	1.22[b1]	0.06	0.11[b1]	0.06	0.81[b1]	0.07	1.50[b]	0.07
EDDE–DDDE	1.24[b1]	0.05	1.64[a1]	0.05	6.35[a2]	0.06	6.74[a]	0.05
EDDE–DDEE	1.74[b1]	0.05	1.41[a1]	0.05	6.29[a2]	0.07	6.73[a]	0.05
EDDE–EEEE	0.03[c2]	0.05	0.79[a1]	0.06	0.98[b1]	0.05	1.56[b]	0.05
EDDE–DEEE	1.21[b1]	0.08	0.90[a1]	0.06	5.42[a2]	0.09	5.54[a]	0.08
EDDE–EEED	1.10[b1]	0.07	0.74[a1]	0.05	1.20[b1]	0.08	2.10[b]	0.07
EDDE–EEDD	0.34[b1]	0.08	0.30[a1]	0.07	1.15[b1]	0.08	1.54[b]	0.08
EDDE–DEDE	1.27[b1]	0.05	1.16[a1]	0.05	5.90[a2]	0.04	6.16[a]	0.05
EDDE–EDED	0.82[b2]	0.05	0.04[b1]	0.04	0.07[c1]	0.05	0.76[c]	0.05
EDDE–DEED	1.43[b1]	0.05	0.91[a1]	0.05	5.41[a2]	0.04	5.56[a]	0.05

The same letters show differences not statistically significant ($P > 0.05$) in comparison with different stratifications of the same coordinate; the same number shows differences not statistically significant ($P > 0.05$) in comparison with the same configuration of different coordinates. δ uncertainty deriving from the propagation theory

Table 4 Weighted average and related uncertainty of ΔL*, Δa*, Δb*, and ΔE^*_{ab} values of different stratifications with respect to EDDE, for Estelite Asteria

Estelite Asteria	ΔL^*	± δ	Δa^*	δ	Δb^*	± δ	ΔE^*_{ab}	± δ
EDDE–DDDD	3.49^{a2}	0.09	0.51^{a1}	0.08	0.90^{a1}	0.08	3.50^{a}	0.08
EDDE–EDDD	0.36^{b1}	0.08	0.13^{b1}	0.08	0.01^{b2}	0.08	0.40^{b}	0.08
EDDE–DDDE	2.89^{a2}	0.07	0.63^{a1}	0.08	0.96^{a1}	0.07	2.81^{a}	0.07
EDDE–DDEE	2.99^{a3}	0.11	0.64^{a1}	0.10	0.07^{b2}	0.11	3.12^{a}	0.11
EDDE–EEEE	2.68^{a2}	0.07	0.49^{a1}	0.08	2.69^{c2}	0.07	3.90^{a}	0.07
EDDE–DEEE	1.45^{c1}	0.08	0.67^{a1}	0.08	0.12^{b2}	0.08	1.61^{c}	0.08
EDDE–EEED	1.78^{c2}	0.07	0.21^{b1}	0.07	2.19^{a2}	0.07	2.54^{a}	0.07
EDDE–EEDD	2.45^{a1}	0.07	0.69^{a1}	0.07	0.96^{a1}	0.08	2.80^{a}	0.07
EDDE–DEDE	1.42^{c1}	0.05	0.65^{a1}	0.06	0.03^{b2}	0.05	1.64^{c}	0.05
EDDE–EDED	1.12^{c2}	0.05	0.22^{b1}	0.04	0.77^{a2}	0.04	1.43^{c}	0.04
EDDE–DEED	1.59^{c1}	0.07	0.68^{a1}	0.08	0.39^{a1}	±0.07	1.81^{c}	0.07

The same letters show differences not statistically significant ($P > 0.05$) in comparison with different stratifications of the same coordinate; the same number shows differences not statistically significant ($P > 0.05$) in comparison with the same configuration of different coordinates. δ uncertainty deriving from the propagation theory

Discussion

In aesthetic dentistry, a natural layering technique is required to get high results comparable to the natural dentition [17]. Recently, new nano-hybrid resin composites were introduced with a simplified layering technique and a facilitated shade selection [8, 9].

Brilliant EG and Estelite Asteria have been chosen for this study, because they are two new resin composites that offer a simplified stratification procedure and a modified colour scale compared to the classic ones. A previous study reported their colorimetric analyses in comparison with the VITA scale [14].

In addition, Clearfil Majesty ES-2 Premium was also evaluated to compare these new resin composites with a material characterized by a conventional stratification system ("natural layering concept") [6, 7]. Moreover, Clearfil Majesty ES-2 Premium is one of the most used aesthetic composites [18, 19]; consequently, it could be useful for clinicians know its colorimetric behavior with respect to new composites as Brilliant EG and Estelite Asteria.

The colour measurements were carried out using a spectrophotometer and the related data allow to evidence even slight colour differences, not perceptible to the human eye [11].

In the present study, d/8° (diffuse/8°) geometry was applied [20]. The term "diffuse" is used to indicate that the illumination is not directional, but is rather diffuse by the use of an integrating sphere [21]. Thanks to integrating sphere also the colour specification is related to all directions. The 8° angle is the viewing angle relative to the normal direction for the sample being measured. The used spectrophotometer is designated to allow either Specular Included (SPIN) or Specular Excluded (SPEX) detection mode. In this case, elaboration regarded SPEX to highlight the chromatic differences [15, 20].

In addition, the use of a custom device allowed the reproducibility of the measurements, guaranteeing the optical contact of the device and the sample at the same applied pressure. Colour may be determined using CIE *L*a*b** or CIEDE2000 formulas recommended by the CIE [15]. Though CIEDE2000 is a more recent formula, both are frequently used and still compared in recent dental studies [22, 23]. Moreover, CIELAB 1976 system has been used for the evaluation of colour differences, because it is a simple system, widely used in literature and more understandable for clinician [1, 24].

According to the previous literature, the sample slot of device was realized simulating a black background to reproduce the oral cavity [1, 25, 26].

The samples were unpolished to avoid the possible influence of finishing and polishing procedures on final stratification colour perception as well as to reflect the clinical situation of the internal layers [1, 27]. In addition, mylar sheet allowed to standardize the sample external aspect of sample, obtaining the smoothest composite surfaces, as previously reported [13, 28, 29].

Regarding the shade selection, the shade A2 was chosen, because it is one of the most used in clinical practice [1].

In the present study, the chromatic differences between the different stratifications and the "classical" or "natural" one [30] were evaluated.

Superimposed samples have been tested for a total of 4 mm thick, representing the latter the average thickness of the coronal third of a central anterior tooth [1]. It is known that there is an equal enamel and dentin thickness in this specific area of the tooth, which is approximately 1 mm palatal enamel, 2 mm body dentin, and 1 mm buccal enamel [31]. This condition could be reproduced according to two different approaches: to stratify the different layers one on the top of the previous one or to build up separate samples and to superpose them. This latter methodology has been preferred to avoid the small variability of $L^*a^*b^*$ values found in a methodological test of a previous study [1] when the masses were stratified into a single sample. In this way, the same specimens have been used and their place changed within the sandwich design to simulate the different stratifications.

For Clearfil Majesty ES-2 Premium and Brilliant EG, 6 configurations reported a clinically unacceptable difference compared to the target. In particular, it is interesting to note that in all stratifications in which the enamel surface layer was replaced by dentin one, visible and clinically disturbing differences were obtained ($\Delta E^*_{ab} > 3.3$). Specifically, L^* and b^* coordinates were the parameters more likely to significant variations (these values were significantly higher in the dentin mass configurations surface). It is interesting note that Brilliant EG appearance is very similar to Clearfil Majesty ES-2 Premium one. These results are probably due to the colorimetric characteristics of Brilliant EG dentin mass (more saturated) which make this new composite more similar to the traditional resin with distinct dentin and enamel masses. In addition, these outcomes would explain the highest values observed for L^* and b^* coordinates with respect to the most translucent enamel mass [24]. Therefore, it could be useful for clinicians using these masses for more complex aesthetic restorations in which it is necessary using composites with enamel and dentin masses more defined. These results are in agreement with the previous studies (utilizing dentin and enamel masses) that reported, as the superficial layers were the most important ones in the final colour perception [1, 32].

Regarding Estelite Asteria, it showed two configurations above the limit of 3.3, especially those characterized by a single mass (i.e., EEEE or DDDD). In fact, single mass stratifications showed significant and clinically relevant differences for L^* and b^* coordinates. All other configurations were clinically acceptable. Therefore, Estelite Asteria had shown a reduced dependence on both the stratification order and the thicknesses. In addition, colorimetric characteristics of Estelite Asteria are very dissimilar from Clearfil Majesty ES-2 Premium ones. These results are probably due to the composite nature: indeed, the body mass has chromatic characteristics (especially in value terms) comparable to those of enamel, and consequently, stratifications provided similar chromatic results regardless of the thicknesses of the masses employed. Therefore, the use of such masses could be indicated for simpler restorations in which the use of a mono mass may be sufficient.

The best configurations, more similar to the target, were EDED and EDDD for Brilliant EG and Clearfil Majesty ES-2 Premium/Estelite Asteria, respectively. Moreover, EDDD was the second-best configuration ($1.1 < \Delta E^*_{ab} < 3.3$) for Brilliant EG and EDED for Clearfil Majesty ES-2 Premium/Estelite Asteria ($0 < \Delta E^*_{ab} < 1.1$ and $1.1 < \Delta E^*_{ab} < 3.3$, respectively). These results are in agreement with a previous study reported a higher influence of external layers on the final colour perception [1]. In particular, EDDD could represent an alternative to the classical stratification technique, simplifying the clinical procedure without affecting the final colorimetric result with respect to the natural stratification [1].

The different optical behaviors observed for the different composites are probably due to the different translucency level of the investigated materials. Indeed, it has been previously reported that the dentin masses have lower translucency values than the body masses (that corresponds to a less grey appearance) [24]. The level of translucency also conditions the “chameleon effect” that increases inversely to the size restoration and directly proportional to the translucency [33]. However, further studies are needed to evaluate the optical behavior of the two composites with respect to the dental tissues. Moreover, the results obtained are limited to the specific thickness of the samples used in this study [1] and valid in relation to the examined hues.

Conclusions

New composites (Brilliant EG and Estelite Asteria) with a simplified stratification technique were evaluated and compared with a composite presented a traditional colour system (Clearfil Majesty ES-2 Premium). Within the limits of a vitro study, Brilliant EG presented dentin and enamel masses more characterized and consequently more similar to the traditional colour system of Clearfil Majesty ES-2 Premium. For this reason, Brilliant EG showed more dependence from order and thickness of stratification; therefore, it could be indicated for more complex aesthetic restorations.

On the other hand, Estelite Asteria had dentin and enamel masses very similar between them, and therefore, different from Clearfil Majesty ES-2 Premium ones. Consequently, Estelite Asteria seems to be able to balance small differences in thickness of dentin and enamel layers and consequently more indicated to different clinical situations. Further research is needed to evaluate the colorimetric characteristic of the others shades and the correspondence of these in vitro results with clinical outcomes of Brilliant EG and Estelite Asteria.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study, formal consent is not required.

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