Evaluation of the color guide VITA 3D-master and agreement with new dental resins

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ABSTRACT

Color is one of the most important parameters in the field of esthetics and dental restoration. Visual color determination by comparison of the tooth with standard tooth color shade guides is the most frequently applied method in dentistry. Recently, the new shade guide VITA 3D Master has been specifically designed for the selection of tooth rather. The design of this guide is based on the range of color of natural teeth, although there is not any work evaluating the validity of this guide and bearing in mind the color of resins employed in dental restoration. For our study, we have performed color measurements of 13 new resins and the VITA 3D Master guide, under the same experimental conditions. The results show that there is a lack of uniformity in the a*b* plane for every luminance level, and that there is in it a need of a new shade guide with higher values of a* and b*, especially for intermediate luminance values (L* = 65-72), since that is the zone of the chromatic diagram where most of the resins are placed.

1. INTRODUCTION

Color is one of the most important parameters in the field of esthetics and dental restoration. The color and appearance of teeth is a complex phenomenon, with many factor such as light conditions, translucency, opacity, light scattering, gloss and the human eye and brain influencing the overall perception of tooth colour[1]. The chromatic space where natural teeth are placed in the CIELAB system, evaluating the central maxillary incisors in vivo for 600 subjects[2], is: L* = 67.6 ± 7.0, a* = 4.3 ± 2.1 and b* = 12.1 ± 3.3, or according to other authors[3] L* = 69.3 ± 5.92, a* = 5.4 ± 1.33 and b* = 18.7 ± 3.37, analyzing also the central maxillary in vivo for 180 and employing a spectroradiometer.

Many methods are currently used in order to assess teeth color. These methods range from visual subjective comparison using paper, colored porcelain or acrylic resin shade guides up to objective instrumental measurements using spectrophotometers, colorimeters or image analysis techniques. Visual color determination by comparison of the tooth with standard tooth color shade guides is the most frequently applied method in dentistry. It is a subjective process whereby the tooth and the shade guide are observed simultaneously under the same lighting conditions.

In the design of the traditional guides a logical disposition of the samples of the guide and an adequate distribution of them in a color space are very important. Traditionally the guides are based on the Munsell Color Order System; nevertheless, the range of available shades is not adequate and does not cover the complete color space of natural tooth color [2,4]. On the other hand, there is a lack of consistency among and within individual dentists in matching colors, since the results cannot be transformed into the CIELAB color scale[5].

Recently, a new shade guide has been specifically designed for the selection of tooth rather than denture color. This system, VITA 3D-Master, contains shade tabs that, according to the manufacturer, are uniformly arranged in color space of natural teeth. This new guide seems to be better than the previous ones, but there are no studies about its uniformity and suitability

On the other hand, the photoactivated composed resins are today the most employed material of sealing in the world in dental restoration. Nevertheless, the development or design of new color guides employed in dental restoration is not based on the final color of the resin already

photoactivated, but generally on the tooth color. In fact, neither its equivalence with the guide, nor its special location in relation to these ones are currently known.

The aim of this work is the evaluation of the uniformity and reproducibility of the new guide VITA 3D-Master in the employment of photoactivated resins not based on VITA system, as the new ones based on the natural stratification.

2. METHOD

Color measurements of the VITA 3D-Master guide were carried out employing a spectroradiometer SpectraScan PR704 by Photo Research focused at the second third of the surface of the sample, avoiding in this way the translucent parts of the piece of the guide.

Samples of the guide were placed in an illumination/observation Verivide cabin and a D65 source was employed, with illumination/measurement conditions of 45°/0°. Field size was 1° and Standard Observer CIE-1964 was employed. To set the position of the guide pieces in the cabin, a mold of silicone was used so that the pieces inserted in it remained always in the same position.

For this study 13 dental resins usual in clinical practice were employed; 8 of them are based, according to the manufacturers, on the VITA system, while the rest of them are based on the new system called natural stratification[1]. Table 1 shows the characteristics of these composites. The instrumentation and measure conditions of color were similar to those employed for the shade tabs.

Table 1: Characteristics of composites employed in this study.

Material	Shade	Manufactory
A110	B1	3M dental product St,Paul, MN, USA
Artemis Dentine	A3	Vivadent/Ivoclar, Liechtenstein
Artemis Enamel	A3	Vivadent/Ivoclar, Liechtenstein
Artemis	super clear	Vivadent/Ivoclar, Liechtenstein
Helio Molar	A3	Vivadent/Ivoclar, Liechtenstein
InTen-S	A3	Vivadent/Ivoclar, Liechtenstein
Miris Dentine	shade 4	Coltene/Whaledent
Miris Enamel	neutral	Coltene/Whaledent
Synergy Duo	A1/D2	Coltene/Whaledent
Synergy Nano	A2/B2	Coltene/Whaledent
Tetric	A1	Vivadent/Ivoclar, Liechtenstein
Tetric Ceram	C3	Vivadent/Ivoclar, Liechtenstein

3. RESULTS

Figure 1 shows the color differences obtained between each of the luminance planes of the guide. According to the manufacturers, these planes must maintain constant the color difference between them. As it can be seen, the color differences between two consecutive planes are very similar (from 4.10 to 4.54), except for the levels 1 and 2 that differ in 5.86 CIELAB units. This is because of the high luminance value of the sample 1M2, probably due to the sheen of this shade. In this figure 1 it can be seen also the distribution of the different luminance levels, so that when L* value diminishes, the shades are more saturated (for example, 3M2 is more saturated than 4M2).

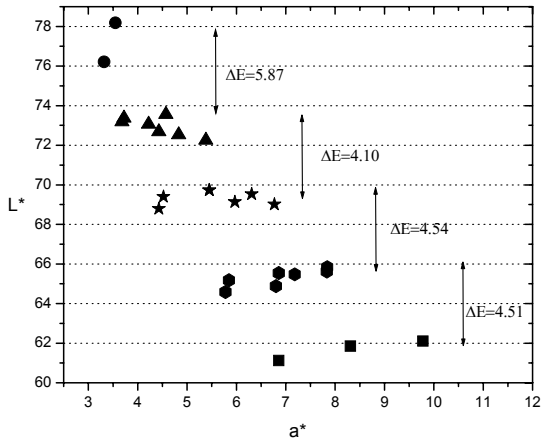

Figure 1: Color difference between planes of the guide.

According to the Vita 3D Master manufacturer, the distribution of the shades corresponding to the same L* level must fit to a regular hexagon. As example, figure 2 shows the

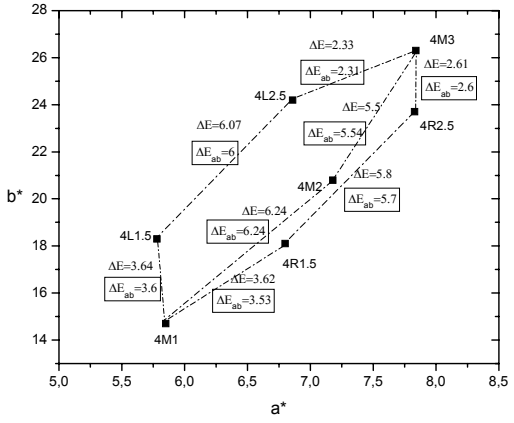

Figure 2: Color difference for simples on a same plane (level 4).

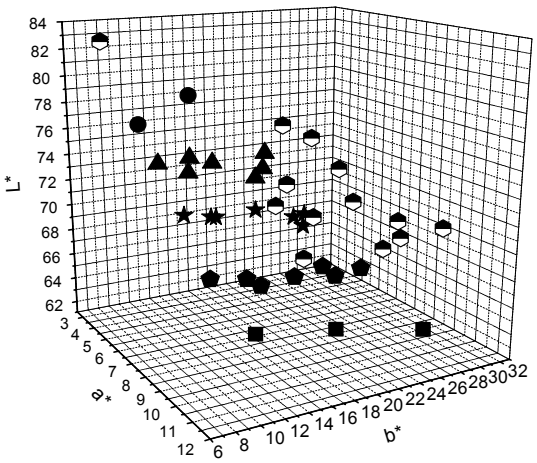

Figure 3: Chromaticity coordinates a*and b*, and luminance for the dental shade guide and the composite resins.

projection of the shades on level 4 in order to evaluate this distribution. The total color difference (ΔE) and the difference on the a*b* plane (ΔE_{ab}) are represented in the figure. These color differences ΔE and ΔE_{ab} are very similar between consecutive samples, which indicates that luminance is constant between consecutive shades. On the other hand, the color difference is due, as it is seen in the figure 2, principally to the difference in b*. According to this result we can say that for the same luminance level the difference between consecutive shades is higher in hue that in saturation.

As for the shades distribution, it fits to a hexagon, although not regular as it is indicated by the manufacturers of the guide. In the figure 2 we can see that the color differences between consecutive shades are in an interval from 2.33 to 6.07 CIELAB units on level 4. Similar results are obtained on other luminance levels.

Figures 3 and 4 show with solid symbols the distribution of the shades and with open/solid symbols the samples of resin. Different symbol forms show the different luminance levels (as in figure 1).

The values of a *, b * and L* of the VITA 3D Master shades cover the range of color of natural teeth (L* = 67.6 ± 7.0, a* = 4.3 ± 2.1 and b* = 12.1 ± 3.3. or L* = 69.3 ± 5.92, a* = 5.4 ± 1.33 and b* = 18.7 ± 3.37), although the values for the b* coordinate in the VITA 3D Master guide are higher to those reported in previous works[2,3], specially if we consider them individually.

As for the resins, as it can be observed in the figure, they present a different location with respect to the shade guides.

On the other hand, resins present a* values higher than 7, over the range of this coordinate for natural teeth. This result can be also found for the b* coordinate, but in this case there is a better agreement.

4. CONCLUSIONS

A colorimetric study of the recent VITA 3D Master guide was performed. Results show, as manufacturers report, that this guide presents different levels of L*, with a constant color difference (about 4.20) between consecutive luminance levels. Nevertheless we do not find a regular distribution on the a*b* plane for the samples placed on the same luminance plane. The interval of a *, b * and L* values of the VITA 3D Master shades covers the range of color of natural teeth, although the interval for the b* coordinate for the guide is wider than for the teeth. When the color of the guide is

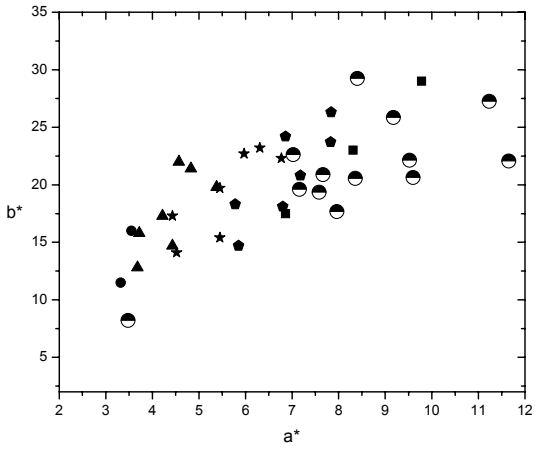

Figure 4: Plane a*b* for dental shade guide and the composite resins.

compared with that one of the analyzed resins, we observe that the resins present higher values of a* and b*, especially those based on the "natural stratification". According to the obtained results we can conclude that there is a lack of uniformity on a* b* planes for each luminance level, and that there is in it a need of a new shade guide with higher values of a* and b* and higher chromas, especially for intermediate luminance values (L* = 65-72), since that is the zone of the chromatic diagram where most of the resins (already photopolymerized) are placed.

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