Research Article

Evaluation of variation in shade in metal-ceramic restoration from the shade tab

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ABSTRACT

Introduction: During shade matching, the most popular approach is to match the shade of the natural teeth to a shade guide to specify the shade of the final restoration. Digital photography acts as a communication tool between the laboratory and the dentist. However, the accuracy of the shade in the final restoration might vary from the shade tab due to multiple factors. The aim of this study is to assess the variation in shade of ceramic restoration from the shade tab. **Aim:** The aim of this study is to evaluate the difference in the shades between the shade tab and glazed porcelain. **Materials and Methods:** Forty glazed metal ceramic restorations shade matched using Vita classic shade guide were included in the study. Photographs of the restoration before cementation were taken under natural lighting condition with black background by the same operator; an online software (Image Color Summarizer 0.76© 2006–2018) was used to analyze the color clusters; the CIELAB values of the average of each cluster were analyzed. The images were clustered such that the ceramic restoration falls in a single cluster. The ceramic restorations were compared with the photographs of their respective shade tabs taken under same conditions. **Results:** Independent *t*-test was performed for L*, a*, and b* values separately. There was a statistically significant difference ($P = 0.00$) between the restoration and the shade tab in "a* value." There was no statistically significant difference in the L* value ($P = 0.059$) and b value ($P = 0.677$). **Conclusion:** Shade matching assisted by digital photographs is considered to be more accurate when compared to visual methods. However, the changes in the final restoration from the shade tab might happen. The result of this study indicates that there is change in the glazed ceramic restoration from the shade tab used for shade matching.

KEY WORDS: Ceramic restoration, Color matching, Dental shade matching, Digital camera, Metal ceramic, Shade tab

INTRODUCTION

Numerous parameters such as the color and shape of individual teeth as well as the shape of the dental arch are related to the esthetics of the teeth.[1] The dentition is not monochromatic within the oral cavity, but by contrast, it is polychromatic with a gradation of colors and shades. To achieve ideal esthetics color replication process for dental porcelain, this comprises a shade selection phase followed by shade duplication.[2,3]

Many methods are currently used to assess the color of the teeth ranging from visual subjective comparisons using porcelain or acrylic resin shade guides to objective instrumental measurements using spectrophotometers, colorimeters, and image analysis techniques.[4]

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In clinical practice to achieve ideal esthetics, the most important procedure is shade selection followed by fabrication of the prosthesis with the selected shade.[5] Visual method of shade selection using shade tabs is the most common method. In recent days, digital photography is used for color imaging and a communication tool between the laboratory and the dentist.[6]

However, the accuracy of the shade in the final restoration might vary from the shade tab due to multiple factors.[7] There is difference in the ceramic used to the readymade shade guides. Although most of the ceramic brand shades match the Vita shade guide, upon firing produce slightly different shade from the shade tab.[8]

Multiple factors are responsible for the change in the shade after firing such as thickness of the restoration, type of framework/coping used, thickness of the framework/coping, firing temperature, frequency, and technical skill.[9]

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There are new advancements in technology and materials that aid in improved color matching of restorations. CIELAB system is commonly used for measuring color and to identify differences between the values of the color of two objects.[10-12] The purpose of this study is to evaluate the difference in the shades between the shade tab and glazed porcelain.

MATERIALS AND METHODS

Forty glazed metal ceramic restorations shade matched using Vita classic shade guide were included in the study. Photographs of the restoration before cementation [Figure 1] as well as the shade guide were taken under natural lighting condition with black background by the same operator using Canon rebel t6i with 28–135 mm macrolens with image stabilizer. The settings were kept constant for all the pictures (ISO-6400, aperture 22, shutter speed 1/200). The ceramic restorations were compared with their respective shade guide [Figure 2].

Figure 1: Glazed ceramic restoration

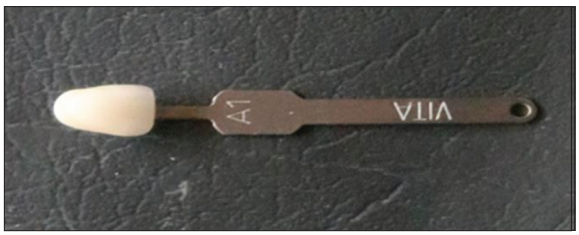

Figure 2: Shade tab

An online software (Image Color Summarizer 0.76 © 2006–2018 http://mkweb.bcgsc.ca/) was used to analyze the color clusters; the CIELAB values of the average of each clusters were analyzed [Figure 3]. The images were clustered such that the ceramic restoration is a single cluster and the black background becomes the second cluster. With the shade tab, the image was divided into three clusters; the tab, the metal holder, and the background [Figure 4].

RESULTS

Independent *t*-test was performed for L*, a*, and b* values separately. There was a statistically significant difference ($P = 0.00$) [Table 1] between the restoration and the shade tab in "a* value." There was no statistically significant difference in the L* value ($P = 0.059$) and b* value ($P = 0.677$) [Tables 2 and 3]. The result of this study indicates that there is change in the glazed ceramic restoration from the shade tab used for shade matching. The a* values were more toward

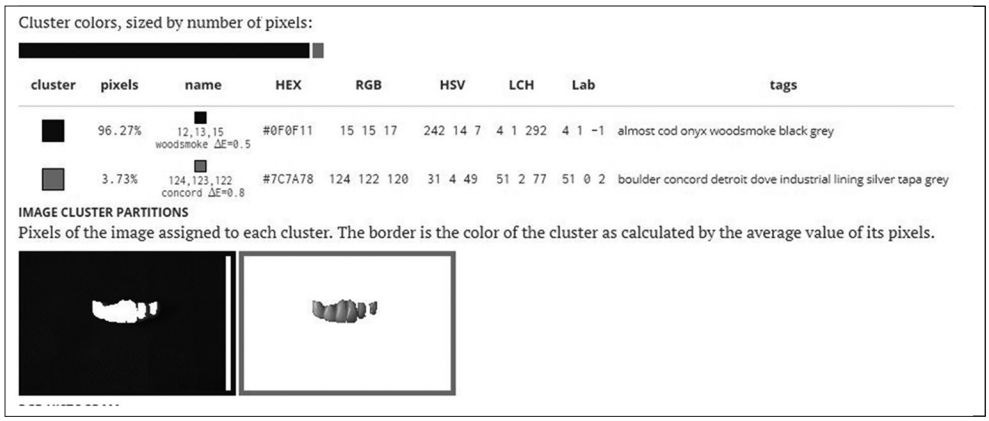

Figure 3: Color clusters in the restoration

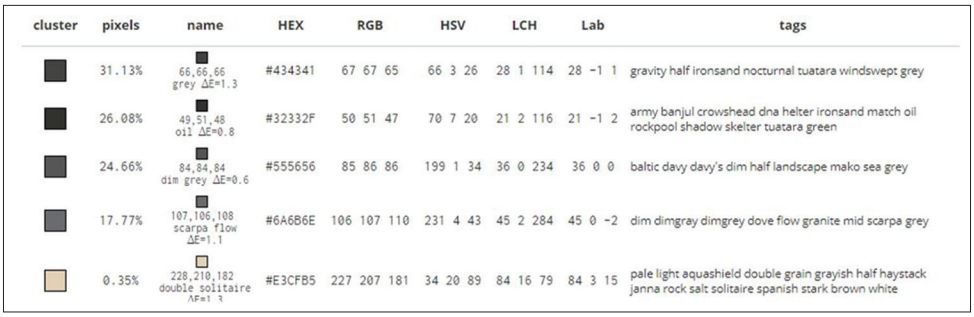

Figure 4: Color clusters in shade tab used for shade matching

the green value which results in darker restoration. Although insignificant, there were changes in the L* and b* values. The L* values of the restorations were more toward the darker side and the b values more toward the yellow values.

DISCUSSION

Esthetics is one of the factors that motivate the patient to seek dental care. The objective of esthetic dentistry is to create a smile with pleasing proportions, harmony with gingival, lips, and face of the patient.[13,14] There are many factors that influence the perception of color. Knowledge of color is required to communicate accurately the shade of the restoration.

To achieve esthetic results in restorations, proper color matching is essential. It makes the restoration appears natural and attractive.[15] Color is the quality of an object or substance with respect to light reflected by the object, usually determined visually by measurement of hue, value, light or dark and brightness of the reflected light, saturation, or chroma.[16,17] Factors that influence perception of color are the light source, the object being viewed and the observer.[9]

The problem arises while communicating the colors to others. Various color scales have been developed for this reason.[5] Munsell color space describes color in terms of hue, value, and chroma.[18] In 1976, the Commission Internationale de l'Eclairage defined a color space based on three separate color receptors (red, green, and blue) in the eye.[11]

The CIELAB color space represents a uniform color space with equal distances corresponding to equal perceived color differences. In three-dimensional space, the three axes are L*, a*, and b*. The L* value is a measure of the lightness of an object. Perfect black has an L* value of zero and a perfect reflecting diffuser an L* value of 100. The a* value is a measure of redness (positive a*) or greenness (negative a*). The b* value is a measure of yellowness (positive b*) or blueness (negative b*). The advantage of the CIELAB system is that the color differences can be expressed in units that can be related to visual perception.[11,19,20]

Table 1: Independent *t*-test for a* value

Groups	Mean±SD	Significance
Group 1 (shade tab)	−2.00±2.05	0.00
Group 2 (restoration)	0.875±0.334	

SD: Standard deviation

Table 2: Independent *t*-test for L* value

Groups	Mean±SD	Significance
Group 1 (shade tab)	14.9±2.86	0.59
Group 2 (restoration)	25.07±2.04	

SD: Standard deviation

Table 3: Independent *t*-test for b* value

Groups	Mean±SD	Significance
Group 1 (shade tab)	4.22±3.73	0.677
Group 2 (restoration)	4.15±3.68	

SD: Standard deviation

Many methods are available to assess the tooth color like porcelain or acrylic resin shade guides, spectrophotometers, colorimeters, and image analysis techniques. Visually matching the shade of the tooth to a shade tab is the common method used.[21] The human eye is very efficient in detecting even small difference in color between two objects.[22]

The study result is similar to the earlier studies by van Der Burgt *et al*. and Prabu *et al.* that the ceramic restoration does not match the shade tabs to which they were compared.[9] Even though most of the ceramic brands match their shade to the Vita classic shade guide, there was difference of the finished prosthesis.[23,24] One method to avoid this is fabrication of custom shade guides. However, there are technical difficulties associated with the fabrication of custom shade guide.[25,26] Multiple factors are responsible for the change in the shade after firing other than the difference in ceramic brand such as thickness of the restoration, type of framework/coping used, thickness of the framework/coping, firing temperature, frequency, and technical skill.[27]

CONCLUSION

Shade matching by visual method using shade tab assisted by digital photographs for communication with the lab is commonly used by dental practitioners. However, the changes in the final restoration from the shade tab might happen. The result of this study indicates that

1. There is change in the glazed ceramic restoration from the shade tab used for shade matching
2. In the restorations, a values were more toward greenness and L value darker and b value toward yellowness when compared to the CIELAB values of the shade tab
3. Other factors such as thickness of the ceramic, thickness of the metal, as well as firing and glazing process might influence the final shade of the restoration. Further studies are needed in this aspect.

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