Comparison of Color Match to Noritake and Vitapan Classical Shade Guides of Three Porcelain Systems

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ABSTRACT

Objective: This study intended to evaluate the color match of porcelain samples of Ceramco, Noritake, and Vita by two shade guides of their systems from the viewpoints of the teachers in Department of Prosthodontics.

Methods: In this study, five professors of Prosthodontics determined the color of four samples made out of three different types of porcelain, using Vitapan Classical and Noritake shade guides. Data were analyzed using descriptive statistics, t-test, and ANOVA (P< 0.05).

Results: Samples made out of Noritake porcelain had a better color match with both determination systems; however based on ANOVA test results, these findings were not statistically significant. The average of color match in Vitapan Classical system and Noritake system was 40% and 43%, respectively. Although clinically, Noritake system compared to Vitapan classical system had better color match, t-test showed this difference was not statistically significant.

Conclusion: Porcelain type and shade selection system had no effect on tooth color selection.

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**Introduction**

Shade matching is one of the key aspects in achieving beautiful dental restoration. Understanding the scientific principle of color is more critical to make the restoration natural and attractive (1,2). Selecting the color of restoration to be matched with shade of the patient’s teeth is also of importance (3, 4). otherwise, it can cause complications such as dental cost for replacement of treatment, patient’s non-satisfaction, as well as reputational consequences for the dentist (3, 5).

It was reported that color vision is a major component of restorative and esthetic dentistry, however in the researches, color vision of the dentists, as a group, has not been tested at any time during their jobs (6). Carsten et Al. in their study concluded that dentists should learn how to control the internal and external factors that affect the human vision through the selection of correct color (7). The results of this research showed that the object reflects only the light which falls on them and the eyes can sense hue, intensity, and saturation of light. Therefore, accurate and high-intensity lighting is required for correct shade matching (4, 7).

In another study, Vitapan Classical shade guide was used to assess the effect of different arrangements of a shade guide on the repeatability and accuracy of visual shade choice by restorative dentists. They found that these two characters were similar when different arrangements (hue/chroma-ordered and value-ordered) of this shade guide were used (8). In addition, restorative dentists ought to identify the related characteristics of porcelain with accurate matching color in selected restoration. The present study aimed to evaluate the color accordance of porcelain samples of Ceramco, Noritake, and Vita by shade guides of their systems from the viewpoints of the teachers in Department of Prosthodontics.

**Materials and Methods**

The present study was designed as a descriptive cross-sectional study. Three porcelain systems were used and four samples were investigated in each system:

1. Ceramco (ceramco-Dentsply, Burlington, NJ, USA)
2. Noritake (Kuraray Noritake Dental Inc, Tokyo, Japan)
3. VITA VM13 (Vita, Zahnfabrik, Germany)

Four colors from the shade guide (A2, B2, C2, D2) were selected for testing. Four samples of each porcelain system were fired in chromium metal (President dental, Munchen, Germany) according to the manufacturer’s instructions for the size of premolar teeth (12×10). After identification coding of fired porcelain samples (n=12), color selection and lack of color blindness (based on Ishihara test(9)) were performed by five male observers who were assistant professors of Department of Prosthodontics.

Selection procedure was done in gray-colored 3×4 rooms and between the same hours of the day (10 to 12 a.m.). They were asked to be placed behind the window, 50 cm far from the samples and to be color matched using Vita system. During the color selection, observers looked blue sheet for 5 sec to avoid errors during the visual selection of color (10).

The color selection test was repeated for Noritake system in the same conditions. The results was recorded in separate questionnaires. Percentage of each selected color, in each porcelain system, was calculated by the following formula:

\[
\text{Percentage of color matching} = \left( \frac{\text{numebor of correct colors}}{5} \right) \times 100
\]

**Statistical analysis**

The results were analysed by descriptive method. T-test and ANOVA test were also conducted (P < 0.05).

**Result**

Percentage of color matching in three porcelain systems by two shade guides is shown in Table 1. In a clinical viewpoint, samples made by Noritake porcelain were more matched with practical color determination method.

ANOVA test showed that no significant differences were obtained for the accuracy of shade selection results achieved with two different shade guides, Vitapan Classical and Noritake (Table 2). According to the results, accurate color match was related to Noritake porcelain by Vitapan Classical shade guide which was determined 100%, 40%, 80%, and 60% in A2, B2, C2, and D2, respectively. The maximum mismatch was recorded for ceramco porcelain which was zero in B2 and D2 in both Noritake and Vitapan Classical shade guides. Moreover, Vita porcelain could not be determined in D2 samples by Vitapan Classical shade guide.

**Discussion**

Tooth shade selection has acted as the main factor in the restorative dentistry in which various factors such as light source, observed object, and observer affect color perception(10). Different shade guides have been introduced from which the first shade guide, Vitapan Classical, consists of four arrangements (A to D). Another popular shade guide which is not so systematically arranged is Ivoclar Vivadent Chromascop which has been categorized based on the hue (1 to 5) and increasing chroma (10 to 40). Having developed dental color sciences, Vita 3D Master was introduced consisting of 11 types of ceramic porcelains and samples ranged from the lightest (value=1) to the
Table 1: Percentage of color matching in three porcelain systems by two shade guides

<table>
<thead>
<tr>
<th>Sample</th>
<th>Color detection by observers</th>
<th>Color detection by observers</th>
<th>Color detection by observers</th>
<th>Color detection by observers</th>
<th>Color detection by observers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>A2</td>
<td>B1</td>
<td>C2</td>
<td>D2</td>
<td>A2</td>
</tr>
<tr>
<td></td>
<td>40%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>N#</td>
<td>20%</td>
<td>20%</td>
<td>40%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>40%</td>
<td>0</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>C2</td>
<td>C2</td>
<td>C4</td>
<td>C3</td>
<td>B1</td>
<td>D2</td>
</tr>
<tr>
<td></td>
<td>80%</td>
<td>20%</td>
<td>80%</td>
<td>20%</td>
<td>60%</td>
</tr>
<tr>
<td>D2</td>
<td>D2</td>
<td>A1</td>
<td>A3</td>
<td>C1</td>
<td>D3</td>
</tr>
<tr>
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<td>40%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>0</td>
</tr>
<tr>
<td>N</td>
<td>40%</td>
<td>0</td>
<td>60%</td>
<td>-</td>
<td>20%</td>
</tr>
</tbody>
</table>

*Vitapan classical shade guide, #: Noritake guide

Table 2: Mean (SD) of color match in porcelain samples

<table>
<thead>
<tr>
<th>Color selection/ Porcelain</th>
<th>Noritake shade guide</th>
<th>Vitapan Classical</th>
<th>P value (t-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vita</td>
<td>35(34.15)</td>
<td>30(25.81)</td>
<td>0.82*</td>
</tr>
<tr>
<td>Noritake</td>
<td>70(25.81)</td>
<td>50(34.64)</td>
<td>0.39*</td>
</tr>
<tr>
<td>Ceramco</td>
<td>25(37.85)</td>
<td>40(32.65)</td>
<td>0.57*</td>
</tr>
<tr>
<td>Total</td>
<td>43(36.01)</td>
<td>40(29.54)</td>
<td>0.80*</td>
</tr>
</tbody>
</table>

* Statistically non-significant

darkest (value =5). This shade guide used three dimensions of color-including value, chroma, and hue to systematically determine the shade with the consistent criteria[11]. In order to decrease the color mismatch because of visual determination, two categories were developed based on the electronic instruments: colorimeters (using a filter with simulation of the human eye) and spectrophotometers (measurement of reflection/ transmission of an object in 350-800 nm as visible frequency range)(12, 13). Although the shade guides do not fully express the natural color of teeth, they are still the main evaluation mechanisms and color transferors in dentistry.

In this study, four colors of each porcelain system were evaluated. Porcelain samples made out of Noritake, Ceramco, and Vita had the better match with Vitapan classical guide, respectively. Moreover, it was found that Noritake, Vita, and Ceramco had a high match with Noritake guide. Although clinically, Noritake porcelain showed the highest match with two shade guides, this observation was not statistically significant. Moreover, significant difference was not found in color determination results by observers in comparison of two shade guides.

Bayindir et al. compared the coverage errors of three different shades and found that Vitapan 3D Master shade guide had the lowest error compared to other guides (14). In another study, Vita 3D-Master shade guide with the conventional guide was investigated. The results showed that restorations which were determined with the 3D-Master could be placed without any further shade corrections. However, almost 17% of restorations identified with the classical system required following shade modifications. Finally, they reported that the match of the selection shades with the 3D-Master was observed significantly better by the clinicians (15). Paul et al. tested the shade match of single porcelain restorations with the conventional visual shade and a new spectrophotometric system and found that Vita Classical did not cover all natural teeth colors (16).

Ö人格 et al. found that the ceramic crowns which were made with the Vita Tooth guide 3D-Master shade guide showed a closer color match with the natural teeth in comparison to Vitapan Classical guide. Additionally, the ΔE values and the observer’s scores were determined within the range of clinical satisfactory for both investigated shade guides (17).
Chen et al. compared the coverage errors of five shade guides (VITA Classical, VITA 3D-Master, Chromascop, Shofu Vintage Halo NC, and E Noritake) in anterior vital normal teeth. They resulted that Shofu Vintage Halo NC could better show color match of natural teeth in different regions (cervical, body, and incisal) (18). Matching of the shade among the 15 beverage and porcelain modifications by four shade tabs was also studied (Vita Akzent, Vita Interno, Shofu Vintage and Unibond and Noritake Super Porcelain EX-3) and found that excluding the hue, the color arrangement of four kinds of shade tabs was the same as that investigated for 15 kinds of beverage. On the other hand, the beverage color could be closely matched via any type of porcelain modification by means of mixing the porcelain powder of proper hue, value, and chroma (19).

**Conclusion**
To conclude, porcelain system and shade guide systems could not affect the successful color selection. Two applied shade guides (Vitapan Classical and Noritake) could determine a matched color lower than 50%.

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