Shade matching quality among dental students using visual and instrumental methods

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ABSTRACT

Objectives: Study aims were to compare shade matching quality between visual and machine-aided shade selection among dental students and to evaluate the effect of experience and gender.

Methods: A total of 204 undergraduates and interns participated. They were briefed about colour matching using a visual method with a Vita-3D Master system and a spectrophotometer. Participants with colour vision deficiency were excluded. Six maxillary anterior teeth of a maxillary blue stone cast were replaced with six maxillary artificial teeth. Participants selected the best shade match using each method. A daylight illuminator with the GTI mini-matcher colour viewing system was used during the test. The results were statistically analysed with SPSS version 19 with 95% confidence intervals. Frequencies and Chi-square tests were used to analyse the data, at $\alpha = 0.05$ and with $P < 0.05$ indicating significance.

Results: Among the participants, 36.3% visually selected the correct shade, and 80.4% did so using the Easy Shade Compact machine. Experience ($P = 0.177$) and gender ($P = 0.560$) did not affect visual shade selection; in addition, with the Easy Shade Compact device, males and females equally mastered its use ($P = 1.0$), and experience did not influence outcomes ($P = 0.552$).

Conclusions: The shade matching device was significantly better than the conventional visual method. With both techniques, neither experience nor gender influenced shade matching quality.

Clinical significance: Visual tooth colour matching is unreliable and inconsistent because of various subjective and objective factors, and the use of a colour measuring device might improve the quality of shade matching among dental students.

1. Introduction

The success of aesthetic restorations depends primarily on the proper shade selection, and matching the correct tooth shade for anterior teeth is one of the most critical procedures. Many factors that contribute to the quality of shade matching have been mentioned in the literature and include receivers, tooth texture and contour, light source, the surroundings, and background.[1–7] Previous studies have noted differences among dentists concerning shade matching for the same teeth over days and among practitioners.[8,9] Researchers have claimed that many variables such as colour deficiency, gender, experience, and eye fatigue can lead to inconsistencies and affect ability to select the proper shade.[3,10–14]

To eliminate the variability of conventional visual shade selection, electronic shade matching devices have been marketed. The devices are generally one of three types:

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spectrophotometer, digital colour analyser, or colorimeter.[1–15] These devices basically consist of a detector and signal conditioner and software that processes the signal to make the data usable in the clinic or laboratory.[15] The selection of such an instrument depends on its reliability, accuracy, working life, and cost. A number of these electronic devices have been tested by evaluating their accuracy and precision or comparing results to visual observation.[3–5,9,13,15–18] Yet, the subject remains controversial among researchers. Although one group concluded that the visual method (human examiners) was significantly better than that of the three digital devices tested,[19] other groups have found that shade matching devices or digital cameras are more reliable and accurate.[8,17,18]

The purposes of this study were to compare the shade matching quality of visual matching and a shade selection device among dental students, and to evaluate the effect of the experience and gender on shade matching quality. The null hypothesis was that there would be no difference between methods and that gender and experience would have no effect on selecting the correct tooth shade.

2. Materials and methods

2.1. Subjects

A total of 204 volunteer students, all undergraduates and interns, participated in this study (102 men). The age range was 20–30 years with different levels of dental education (Table 1). The study was performed at the Faculty of Dentistry, King Abdulaziz University (KAU), in Jeddah, Saudi Arabia. It was approved by the Research Ethics Committee of the Faculty of Dentistry (REC-FD #019-11). All participants provided written consent before the study commenced. Two examiners did all procedures, helping each other.

Participants were divided into two groups based on experience and education level. The first group consisted of third, fourth and fifth-year students who had little or no knowledge or experience regarding tooth shade matching. The second group had the knowledge and clinical experience with matching the tooth shade using the Vita- 3D Master Shade Guide System (Vita Zahnfabrik, Bad Sackingen, Germany). All participants underwent a Colour Vision Deficiency (CVD) test using Ishihara charts, which is a test for Colour-Blindness (Ishihara's. Tokyo, Kanehara). CVD test was performed to each participant separately. Ishihara chart was held 75 cm from the participant and tilted so that the plane of the paper was perpendicular to the line of the vision. The participant read the Ishihara chart and the examiner compared it with the checklist provided with the booklet of the chart. A daylight

Fig. 1 – Maxillary cast with six maxillary artificial teeth.

illuminator with a GTI mini-matcher colour viewing system (GTI Graphic Technology, NY, USA) was used during the test. Participants with CVD were excluded.

2.2. Shade matching

A maxillary blue stone cast (Whip Mix, Germany) was fabricated. The six maxillary stone anterior teeth were replaced with six maxillary artificial teeth (Vita Lumin Vacuum, Vita Zahnfabrik, Germany) (Fig. 1). The participants were given a presentation about how to do tooth shade matching using two techniques. The first one was a visual technique with the Vita-3D Master system (Vita Zahnfabrik, Germany), and the other one was the Easy Shade Compact device (Vita Zahnfabrik, Germany). The participants were asked to match one shade that of the maxillary right central incisor to avoid eye fatigue. Each participant selected the best shade match following the manufacturer's instructions by selecting the value, chroma, and hue. The shade matching with the Vita-3D Master shade guide was done under the daylight illuminator (GTI Graphic Technology, NY, USA). The study was double blinded so that neither the examiners nor the participants knew the shade of the artificial teeth; only the principal investigator knew the correct shade. The Easy Shade Compact device was used according to the manufacturer's instructions. It was calibrated after each participant's usage. Since there is no contamination, the shield was not placed on the probe. The probe was touching the middle third of the tooth, and the shade tab mode was used for quality control.

2.3. Statistical analysis

The results were analysed with SPSS version 19 and 95% confidence intervals. Frequencies and Chi-square tests were used to analyse the data, with $\alpha = 0.05$ and significance set at $P < 0.05$.

3. Results

The overall ability for all students was low (36.3%) with the visual method (Table 2). There was not a statistical difference for experience in terms of ability to select the correct shade ($P = 0.177$). Table 3 also shows the lack of a significant gender difference in ability to visually select the correct matching shade ($P = 0.560$).

Table 1 – Student class listing by frequency.						
	Education level					
	3rd Year	4th Year	5th Year	6th Year	Intern	Total
Frequency	43	35	45	41	40	204
Valid Percent	21.1	17.2	22.1	20.1	19.6	