

Accuracy and Reliability of Visual Shade Color Discrimination By Men and Women in Comparison to Digital Shade Selection: A Comparative Study

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ABSTRACT

Generally, people considered women are more capable than men regarding tooth shade selection and color matching. But the selection of shade in natural teeth depends on the following factor: the illuminating light, the tooth, and the observer. As we know that eyes can often see color accurately but the accuracy is affected by the brain's interpretation of the visual spectrum. In the present study, we tried to analyze the shade selection accuracy by men and women in comparison to digital shade.

Purpose: Compare the reliability and accuracy of shade selection done by the male observer and female observer with a digital shade matching device.

Materials and methods: Tooth color was measured in 39 volunteer's maxillary right and left central incisor teeth with vita classic shade guide by two different observers (male and female) against a digital shade matching device (Vita Easyshade compact). L, C, and H values and ΔE value determined by visual method using vita classic shade guide against digital shade matching system (Vita Easyshade compact). ANOVA and Bonferroni multiple comparison statistical analysis were used to compare the data.

Results: There was very little significant difference between shade selected by male and female observers against vita easy shade compact with respect to L, C, and H value ($p < 0.05$). ΔE show a significant device difference where Vita Easyshade compact has the highest mean of 3.113 followed by vita classic have least mean value of 2.475.

Conclusion: Determining the shade of a tooth demands clinical skills and experience. The females achieved better results in terms of shade selection as they are more conscious about esthetics.

Keywords: Dental shade guides, Easyshade compact, Esthetic dentistry, Shade Matching, Vita classic shade guide.

International Journal of Prosthodontics and Restorative Dentistry (2021): 10.5005/jp-journals-10019-1318

INTRODUCTION

Woody Allen once wrote a humorous essay entitled "What if the impressionists were dentists, then the whole play deals with a parody on the life of the impressionist".¹ Dentists are doctors of the mouth but from the last three decades, their final work is judged by the level of their artistic talents. Now, most dentists have such innate skills, and increasing the level of predictability and evidence into the subjective field of esthetic is the solution for dental clinicians today.

Esthetic consciousness in the present generation regarding color and appearance is quite significant and they are highly knowledgeable about the consequences of the same. When it comes to anterior restoration of teeth, patients are highly demanding and more possessive regarding the appearance of the restoration. Unaware in regards to the formalities of the procedure, they concentrate on the looks of the restoration and its replication to the adjacent teeth. Both shape and color of the restoration should twin with the adjacent tooth and color of the restoration being at the highest priority in judging successful and esthetically superior restoration.²

Frequently used method for shade selection in the dental office is visual shade matching and clinicians can master the skill of shade matching through clinical experiences, knowledge, and training of shade matching protocol.³ Although many shade-matching instruments have been developed to increase the clinical success of color matching.⁴ One among various recent advances for the ease of shade selection is Vita Easyshade compact. This device is handheld

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How to cite this article: Singh RK, Nidawani P, Galagali G, *et al.* Accuracy and Reliability of Visual Shade Color Discrimination By Men and Women in Comparison to Digital Shade Selection: A Comparative Study. *Int J Prosthodont Restor Dent* 2021;XX(X):1–6.

Source of support: Nil

Conflict of interest: None

and gives electronic optical measurements. The supremacy and accuracy of the device in analyzing and reading shade are affirmed by the manufacturers. This technology rules out the human errors observed during visual matching as it is repeatable and accurate. The patient's opinion should be considered as a priority while shade matching.⁵

This study aims to analyze the accuracy and reliability of visual tooth shade selection by men and women in comparison with digital shade systems.

MATERIALS AND METHODS

The study will be conducted on the patient to evaluate the reliability and accuracy of the visual method by two different observers (male and female) using a commercially available vita classic shade guide against a digital shade matching device. Shade matching will be done using Vitapan classic shade guide on patient maxillary anterior by two different observers (male and female). Again, on the same subject shade matching is done by using a digital shade matching device (Vita Easshade compact). The ideal site to evaluate the shade match is the middle third of the patient's tooth which is referred to as tooth's shade.

In the present study for data collection, we used Vitapan Classic Shade guide for shade selection, Rite lite for proper illumination, and Vita Easshade compact for digital shade evaluation.

Before selecting the shade, thorough oral prophylaxis is done for the patient, sterilization of the shade guide, and collaboration of instrument carried out before using Vita Easshade compact and the protective shield is inserted on the tips. Then, for each subject, the shade selection is done with Vitapan classic shade guide by the male and female observer and finally select the shade with Vita Easshade compact. After collecting the data,

comparison and analysis of the data of vita classic with Vita Easshade compact done.

Before initiating the shade matching, the participants were informed regarding the clinical procedure they are being subjected to, and written informed consent was obtained. Research has been conducted in full accordance with ethical principles, including permission from the institutional ethical committee.

Tooth color was measured in caries and fillings free maxillary anterior teeth. The total selected sample was 39. First measured tooth color with vita classic shade guide by the male and female observer (Figs 1 and 2). Finally, tooth shade was measured with a digital method using Vita Easshade compact (Fig. 3).

Collected data were exported into the CIE L*a*b* system for the color measuring process. To measure color with ES. ES was positioned and aligned correctly on the tooth (middle third of the buccal aspect of the tooth). All measurements were made by following the manufacturer's instructions. Before any measurement devices were calibrated (Figs 4 and 5).

The obtained data were tested for normal distribution by descriptive statistics test. Quantitative variables were compared using one-way ANOVA test. Multiple comparisons between groups

Q2



Fig. 1: Shade selected by the male observer



Fig. 2: Shade selected by the female observer



Fig. 3: Shade selection with Vita ES



Fig. 4: Shade selection with Vita ES



Fig. 5: Shade obtained with Vita ES

Table 1: Descriptive analysis for male observer

Male observer	Frequency	Percent
A1	13	33.33
A2	22	56.41
A3	1	2.56
B1	3	7.69
Total	39	100

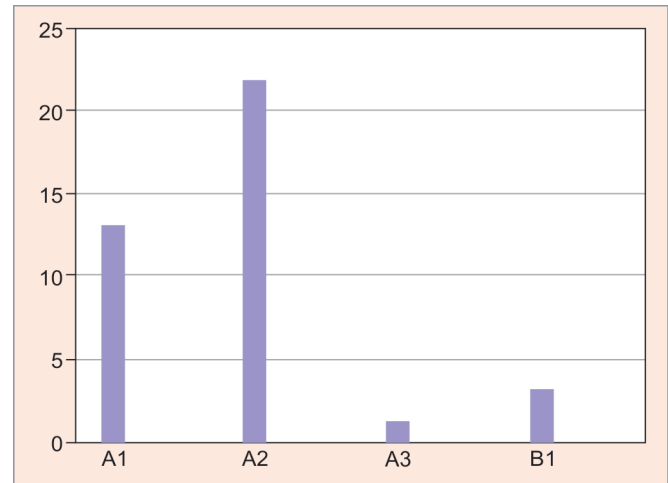


Fig. 6: Descriptive analysis for male observer

Table 2: Descriptive analysis for female observer

Female observer	Frequency	Percent
A1	17	43.59
A2	14	35.90
A3	2	5.13
B1	5	12.82
B2	1	2.56
Total	39	100

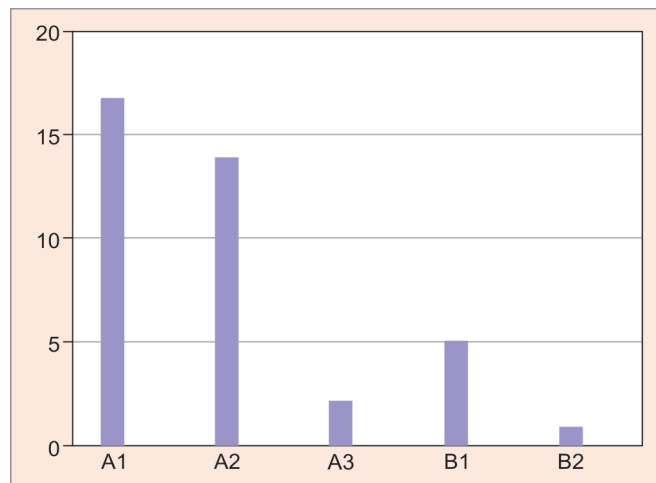


Fig. 7: Descriptive analysis for female observer

were done by *post hoc* test (Bonferroni) test. Statistical analysis was done using the SPSS.

RESULTS

The shade matching procedure for natural teeth was done by using a vita classic shade guide and Vita Easyshade compact with the male and female observer.

Shade selected with vita classic shade guide shows very little significant difference by male (Table 1 and Fig. 6) and female (Table 2 and Fig. 7) observer ($p < 0.05$). After selecting shade with the visual method, we compare the data with shade obtained from vita easy shade compact (Table 3 and Fig. 8) and it shows the significant difference ($p < 0.05$).

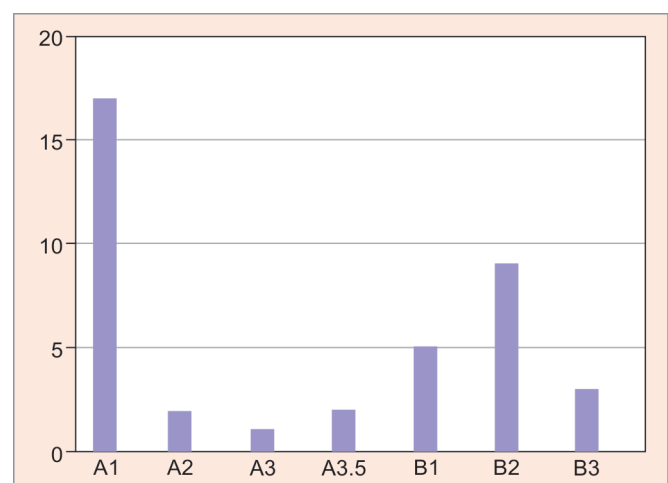


Fig. 8: Descriptive analysis for vita easy shade compact

Table 3: Descriptive analysis for vita easy shade compact

Vita easy shade compact	Frequency	Percent
A1	17	43.59
A2	2	5.13
A3	1	2.56
A3.5	2	5.13
B1	5	12.82
B2	9	23.08
B3	3	7.69
Total	39	100

The shade selected by the male observer was compared with Vita Easyshade compact (Table 4) and there was a significant difference between the male observer and vita easy shade compact ($p < 0.005$). But when the shade selected by the female observer was compared with Vita Easyshade compact (Table 5), it shows very little significant difference ($p < 0.00$).

Finally, we compared the shade selected by the male observer with the female observer (Table 6) which shows a significant difference between selected shades ($p < 0.05$).

DISCUSSION

The shade matching capabilities among women are assumed to be more evident when compared with men. Color deficiency among men is commonly seen but this fact has not affected the results of our study as all the observers enrolled were color normal. In a study done by Applebury and Hargrave, they found that in humans, two cone cell pigment genes are present on the X chromosome. If women are heterozygous, they could be tetra-chromatic, which adds an advantage in shade matching.^{6,7} As there was no statistically significant difference in the quality of tooth color matching between color normal males and females, in the present study the null research hypotheses were accepted. Some studies reported that gender played an important role in shade matching, and females achieved significantly better results than males.⁸ Whereas numerous studies showed that there is no difference in shade matching ability between genders.⁹⁻¹¹

A prospective multicenter study using five different observer groups evaluated tooth-colored restorative material in a simulated clinical setting to report the perceptibility and acceptability thresholds (PT and AT). Dental students showed PT and AT values statistically similar to the overall threshold values, which justified the selection of observers for the current study.¹²

Pecho et al. considered the rotation of CIELAB Color discrimination ellipsoids can play a major role in analyzing the correct shade in dentistry. The visual shade matching was done by using the vita classic shade guide and CIEDE2000 (2:1:1) Color difference formula, which contemplates the rotation of these ellipsoids.¹³ When the same data were compared by gender, the shade selected by females was closer to CIELAB color ellipsoids. In the current study, also female shows more accuracy than the male observer.

A study was done by Barna et al. and they said that if dentists are having a color defect, then it will hamper the ability of shade selection.¹⁴ whereas Moser et al. tested 670 dentists at the ADA meeting in 1981 for the red-green color deficiency by using the Dvorine Pseudo-Isochromatic plate test and they found that 66 (9.9%) men have some degree of color deficiency and 19 (2.8%) were found to be severely color deficient. But women showed a very moderate degree of color deficiency. These studies tend to indicate that many people with color-vision defects are generally unaware of their condition.¹⁵

Normally, the human eye can differentiate between two wavelengths that are as close as 2–4 nm. The chromatic response function is important for color differentiation as a person with normal vision can distinguish approximately 150–200 variations of Hue in the spectrum. As age increases there is a change in ability for color discrimination which may affect the ability to differentiate between blue/yellow or violet/blue-green color but the red/green color tends to remain stable.¹⁶ Rajan et al. said that the success of esthetic restoration depends on the knowledge of color science.

Table 4: Comparison between vita easyshade compact and male observer

		Vita easy shade compact						Chi-square value	p value
		A1	A2	A3	A3.5	B1	B2	B3	Total
Male observer	A1	7	0	0	0	4	2	0	13
	A2	8	2	1	0	1	7	3	22
	A3	0	0	0	1	0	0	0	1
	B1	2	0	0	1	0	0	0	3
Total		17	2	1	2	5	9	3	39

Table 5: Comparison between vita easyshade compact and female observer

		Vita easy shade compact						Chi-square			
		A1	A2	A3	A3.5	B1	B2	B3	Total	value	p value
Female observer	A1	15	0	0	0	2	0	0	17	82.551	0.000
	A2	2	2	1	0	0	6	3	14		
	A3	0	0	0	2	0	0	0	2		
	B1	0	0	0	0	3	2	0	5		
	B2	0	0	0	0	0	1	0	1		
Total		17	2	1	2	5	9	3	39		

Table 6: Comparison between male observer and female observer

		Female observer					Chi-square value	p value
		A1	A2	A3	B1	B2		
Male observer	A1	9	0	0	4	0	13	0.000
	A2	6	14	0	1	1	22	
	A3	0	0	1	0	0	1	
	B1	2	0	1	0	0	3	
Total		17	14	2	5	1	39	

Although limitations in materials and technique may take a perfect color match impossible, a harmonious restoration can almost always be achieved.¹⁷

For color perception within the color range of natural teeth, the brightness of the selected light source is important. Inter-Society Color Council advised using 75–100 fc of light level in a dental laboratory for proper illumination and close inspection whereas Preston et al. recommended using 200–300 fc for the dental setting. He also recommended an ideal ratio of task illumination to room illumination of 3:1.¹⁸

Barna et al. found that shade selection is not significantly affected within the range of 75–300 fc and there was an interplay between the source of light and shade guide when judgments were made, in context to values of teeth. Foot candles are important in shade selection, but so are the inherent wavelengths of the light source used.¹⁴

Sproull demonstrated that dental shade guides were not accurate, as they did not extend through the volume of color space. Most guides lack an orderly or systematic arrangement and few guides show clustering, duplications of colors in certain parts with voids in other applicable color space regions. This study found that 8 categories, grouped by 16 shades, improved agreement among examiners and hence, lends credence to Sproull's observations.¹⁹

In the present study, the observer used Rite-Lite to maintain standard light protocol with a correlated color temperature of 5,500°K. Overall results show that there are significant ($p < 0.005$) differences between shade selected by female and male observers compare to digital shade matching devices.

CONCLUSION

The present study showed that female observers have better accuracy on visual shade selection under standard light illumination than a male observer in comparison with Vita Easyshade compact as shade selected by a female observer using vita classic shade guide is closely matched with Vita Easyshade compact. But when the given shade guide and patient's teeth are to be matched, no cause exists, for the clinicians to be selected based on their gender. Better color vision screening should be performed for the clinician.

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