Assess the Knowledge of Composite Shade Selection and Color Matching among Dental Students in Riyadh, Saudi Arabia

Bushra Faiz Alhawsawi[1*], Wejdan Mohammed Alshamrani[2], Modhi Fahad Aldughayem[2], Ghadah Yousef Alshehri[2], Eman Ali AlKhudairy[2], Sultanh Hathal Alqahtani[2]

[1]Assistant Professor, Restorative Department, College of Dentistry, Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia

[2]Dental Intern, College of Dentistry, Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia

*Corresponding Author:
Bushra Faiz Alhawsawi
Assistant Professor, Restorative Department, College of Dentistry,
Riyadh Elm University, Riyadh, Kingdom of Saudi Arabia
Email: bushra.alalsaib@riyadh.edu.sa

ABSTRACT

Introduction: The scientific principles of color and shade matching are basic knowledge a dentist must have.

Aim: To determine the knowledge of composite shade selection and color matching among dental students, improvement of the quality in dental schools, and insurance to have qualified future dentists.

Material and Methods: A cross-sectional study was conducted in Riyadh city, Saudi Arabia in September 2020, by collecting data through Google e-survey forms on a convenience sample of dental students. All data were analyzed by using statistical package for social sciences (SPSS).

Results and Discussion: A total of 501 (26.9% males and 73.1% females) responded to the survey. Regarding the knowledge, 57.1% think they need to learn more about the composite shade selection procedure.The majority (85.8%) agreed that they do the shade selection procured before the tooth preparation.Regarding the tooth condition during shade selection, 63.5% agreed that the best condition to choose the shade is when the tooth is wet. More than half of the participants (53.7%) always remove the stains and debris before shade selection. Regarding the position of the patient, 68.9% agreed that the patient should be in upright position during shade selection. Concerning the patient level to the dentist eyes, 83% said that the position of the patient should be directly at the eye level of the dentist. When asked about the natural daylight, 84.8% use it during shade selection. Regarding shade used, A2 is commonly used by 64.3%. Difficulties during shade matching were present with 78.8%. Furthermore, 85.8% think that they need more education and practice about shade selection.

Conclusion: Dental students require more training and knowledge about the shade selection, improvement of the communication between the student and the patients to understand the patients' demands regarding the aesthetic and to increase the effectiveness of the restoration.

Keywords: Color, composite, esthetics, shade matching.

Introduction

Dentistry has changed through the years. Earlier, the dentist was avoided until the patient cannot stand the pain and extracting the tooth is the only choice. However, the success of restoration mainly depends on restoring the function. Therefore, operative dentistry has advanced over a period. Aesthetics nowadays, especially color matching of the restoration, the translucency and opacity, have become essential concerns to the patients as well as to the operator.[1],[2] Additionally, restorations are expected to mimic the shade of the natural dentition. Patients are currently more concerned about the shade match and demanding aesthetic replacement that matches their existing dentition.[1] Hence, patients must be satisfied about their teeth' color as it can affect many factors. One of these factors is the patient's psychology, which is the most concern, in addition to patients' different point of views. Moreover, the aesthetics of the restoration mostly depends on proper shade selection and color matching which are multifactorial and complex processes that should take into considerations many aspects.[3],[4] For instance, the source of the light, the patient's position, the surrounding tissues, the time of selecting the shade and the status of the tooth can change the perceived color.[4],[5] Moreover, there are two main methods for shade matching.[5],[6] The first one is visual method which is the most common since it is simpler, more natural, and cost effective.[4],[5] One of the main concerns in this method is its highly subjective nature; different individuals can have different shade perceptions for the same object. The second one is instrumental color method which is more accurate.[4] Spectrophotometers and colorimeters have been used as an attempt to overcome problems with visual matching in dentistry. Instrumental measurements can quantify color and enable communication to be more uniformed and precise. In addition, instrumental readings are objective and more rapidly obtained.[3] The science, the physiology, and the scale for measurement of the shade are aspects which the dentist is mostly ignorant of. Without understanding the basics, routine shade selection becomes a mere guess work, whether done on the chair-side or in the laboratory. Because of this guess work, shade mismatches are often encountered.[7] Conclusively, the scientific principles of color and shade matching are basic knowledge a dentist must have which is measured quantitatively. Limited information is available regarding the knowledge of composite shade selection and color matching among dental students in Riyadh, Saudi Arabia. Therefore, this study aims to determine the knowledge of composite shade selection and color matching among dental students, improvement of the quality in dental schools, and insurance to have qualified future dentists. The research question was to identify the association between knowledge and demographics,

Material and Methods

A cross-sectional study was conducted in Riyadh city, Saudi Arabia in September 2020, by collecting data online through Google e-survey forms on a convenience sample of dental students in Riyadh. Approval was obtained from the research center of Riyadh Elm University. The questionnaire was designed in English and composed of 20 items divided into two major categories, starting with demographics, such as gender, university enrolled and academic year, then questions related to the topic in hand. The sample included undergraduate students from different universities in Riyadh. The questionnaire was distributed together with an explanatory letter requesting participation and ensuring confidentiality and anonymity. Questionnaire was evaluated for validity and reliability by conducting a pilot study among 20 dental students to determine the reliability by using Cronbach's alpha coefficient. Validity of the questionnaire was tested by sending it to experienced researchers and changes were made according to their feedback and comments. Following that the questionnaire was distributed to the sample.

Sample size was estimated to be 500 to represent the population of Saudi Arabia using software for sample size calculation. Descriptive statistics of frequency distribution and percentage were calculated for all the demographic variables and questionnaire items. Relationship between the demographic variables and questionnaire items were assessed by applying Chi Square test. A value of $p<0.05$ was considered significant for all statistical purposes. All data were analyzed by using statistical package for social sciences (IBM-SPSS version 25, Armonk, NY: USA).

Results

A total of 501 dental students responded to this online survey. Female participants were 366, whereas males were 135. The percentage of Riyadh Elm University students was 68.1% in which 41.1% were in 6th academic year. Regarding the knowledge, 57.1% think they need to learn more about the composite shade selection procedure while 41.3% believe they have enough knowledge(Table 1).

For the technique preference, 36.3% prefer to use more than one technique during shade selection. On the other hand, 33.3% use vita shade guide and 26.7% use visual method (from the eye vision).

Furthermore, 3% participants use instrumental methods (spectrophotometry, calorimetry or computerized analysis of digital images) (Figure 1). The majority (85.8%) agreed that they do the shade selection procured before the tooth preparation, whilst 14.2% said that they take the shade after the perpetration (Figure 2).Regarding the tooth condition during shade selection, 63.5% agreed that the best condition to choose the shade is when the tooth is wet and only 36.5% take it when the tooth is dry. More than half of the participants (53.7%) always remove the stains and debris before shade selection and 36.1% said that they sometimes do so, whereas 10.2% said that they never clean the tooth before shade selection. Taking the patient's look into consideration, 48.9% ask the female patient to remove any bright cosmetics or lipstick prior to shade selection and 28.1% sometimes ask the female patient, while 23% never ask. In addition, 46.5% never consider the patient's clothing during shade selection, whilst 31.1% sometimes consider that and only 22.4% pay attention to the clothing (Figure 3). Regarding the position of the patient, 68.9% agreed that the patient should be in upright position during shade selection, whereas 20.4% put their patient in reclined position and only a few participants (10.8%) put their patient in supine position (Figure 4). Concerning the patient level to the dentist eyes, 83% said that the position of the patient should be directly at the eye level of the dentist, while 10.6% said above the eye level and only 6.4% put the patient below the eye level (Figure 5). When asked about the natural daylight, 84.8% use it during shade selection and 10.6% select the dental light, whilst 2.8% use the fluorescent light and 1.8% said that it doesn't matter. Regarding the time required to choose the shade, 45.3% needed 10 sec and 29.7% needed more than 10 sec, whereas 25% needed only 5 sec. During shade selection, 41.5% said that they don't use any background to rest their eyes. On the other hand, 38.1% use the blue background and 20.4% use gray background. Moreover, 20.2% always take another dentist's opinion during shade selection, while the majority (64.3%) sometimes ask for another opinion and 15.6% never take another opinion. In addition, 48.3% take the patient's opinion during shade selection and 38.3% sometime consider the patient's opinion, whilst only 13.4% never ask the patient. Regarding shade used, A2 is commonly used by 64.3% and 18.6% said that they combine the shades (layer by layer), whereas 8.4% said they use shade A1 followed by 5.6% use shade B1 and 3.2% use B2. Difficulties during shade matching were present with 78.8% and 12.6% said that they never face any difficulties. Furthermore, 85.8% think that they need more education and practice about shade selection, while 14.2% think that they don't need further education (Figure 6). A comparison of questionnaire responses among gender and academic year is shown in Tables 2a and 2b. A value of p<0.05 was considered significant for all statistical purposes.

Table 1: Descriptive statistics

Variable		n	%
Gender	Female	366	73.1
	Male	135	26.9
University	REU	341	68.1
	KSU	35	7.0
	KSU-HS	72	14.4
	PNBU	18	3.6
	Farabi	17	3.4
	Others	18	3.6
Academic year	4th	78	15.6

	5th	99	19.8
	6th	206	41.1
	Internship	118	23.6
K2w_Shade_Sel	I have enough knowledge	207	41.3
	I need to learn more about it	286	57.1
	I have no knowledge	8	1.6

Table 2a: Comparison of questionnaire responses among gender and academic year

		Gender					Academic Year								
		Female		Male		p	4th		5th		6th		Internship		p
		n	%	n	%		n	%	n	%	n	%	n	%	
Method preference during shade selection	Visual (Only from the eye vision)	84	23.0	53	39.3	0.004*	21	26.9	33	33.3	60	29.1	23	19.5	0.017*
	Vita shade guide	129	35.2	38	28.1		18	23.1	28	28.3	83	40.3	38	32.2	
	Instrumental	12	3.3	3	2.2		4	5.1	3	3.0	5	2.4	3	2.5	
	More than one technique	141	38.5	41	30.4		35	44.9	35	35.4	58	28.2	54	45.8	
Best time of shade selection?	Before the preparation	328	89.6	102	75.6	0.000*	59	75.6	93	93.9	174	84.5	104	88.1	0 .005 *
	After the preparation	38	10.4	33	24.4		19	24.4	6	6.1	32	15.5	14	11.9	
What is the best condition to choose the tooth shade?	When the tooth is wet	245	66.9	73	54.1	0.008*	40	51.3	70	70.7	127	61.7	81	68.6	0 .031 *
	When the tooth is dry	121	33.1	62	45.9		38	48.7	29	29.3	79	38.3	37	31.4	
Position	Eye level directly	301	82.2	115	85.2	0.159	67	85.9	83	83.8	169	82.0	97	82.2	0.742
	Above the eye level	44	12.0	9	6.7		9	11.5	11	11.1	22	10.7	11	9.3	
	Below the eye level	21	5.7	11	8.1		2	2.6	5	5.1	15	7.3	10	8.5	
Light	Natural daylight	319	87.2	106	78.5	0.003*	51	65.4	81	81.8	190	92.2	103	87.3	-
	Dental light	29	7.9	24	17.8		19	24.4	16	16.2	12	5.8	6	5.1	
	Fluorescent light	13	3.6	1	0.7		4	5.1	1	1.0	4	1.9	5	4.2	
	Doesn't matter	5	1.4	4	3.0		4	5.1	1	1.0	0	0.0	4	3.4	
Time taken	5 sec	93	25.4	32	23.7	0.001*	10	12.8	32	32.3	44	21.4	39	33.1	.000*
	10 sec	181	49.5	46	34.1		26	33.3	46	46.5	108	52.4	47	39.8	
	More than 10 sec	92	25.1	57	42.2		42	53.8	21	21.2	54	26.2	32	27.1	
Background color	Gray background	71	19.4	31	23.0	0.000*	20	25.6	17	17.2	50	24.3	15	12.7	.038*

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	Blue background	160	43.7	31	23.0		20	25.6	44	44.4	77	37.4	50	42.4	
	I don't use any background	135	36.9	73	54.1		38	48.7	38	38.4	79	38.3	53	44.9	
More education	Yes	308	84.2	122	90.4	0.077	78	100.0	80	80.8	170	82.5	102	86.4	.001*
	No	58	15.8	13	9.6		0	0.0	19	19.2	36	17.5	16	13.6	

Table 2b: Comparison of questionnaire responses among gender and academic year

Items 8, 9, 10, 16, 17, and 19		Gender					Academic Year								
		Female		Male			4th		5th		6th		Internship		
		n	%	n	%	p	n	%	n	%	n	%	n	%	p
Do you remove the stains and debris before shade selection?	A	212	57.9	57	42.2	0.002*	45	57.7	57	57.6	102	49.5	65	55.1	0.630
	S	125	34.2	56	41.5		23	29.5	34	34.3	81	39.3	43	36.4	
	N	29	7.9	22	16.3		10	12.8	8	8.1	23	11.2	10	8.5	
Do you ask the female patient to remove any bright cosmetics or lipstick?	A	202	55.2	43	31.9	0.000*	31	39.7	58	58.6	99	48.1	57	48.3	0.219
	S	100	27.3	41	30.4		28	35.9	25	25.3	54	26.2	34	28.8	
	N	64	17.5	51	37.8		19	24.4	16	16.2	53	25.7	27	22.9	
Do you consider the patient's clothing during shade selection?	A	92	25.1	20	14.8	0.000*	16	20.5	26	26.3	42	20.4	28	23.7	0.038*
	S	123	33.6	33	24.4		15	19.2	38	38.4	63	30.6	40	33.9	
	N	151	41.3	82	60.7		47	60.3	35	35.4	101	49.0	50	42.4	
Do you usually take another dentist's opinion during shade selection?	A	63	17.2	38	28.1	0.001*	24	30.8	17	17.2	34	16.5	26	22.0	0.049*
	S	253	69.1	69	51.1		43	55.1	60	60.6	140	68.0	79	66.9	
	N	50	13.7	28	20.7		11	14.1	22	22.2	32	15.5	13	11.0	
Do you take the patient opinion during shade selection?	A	169	46.2	73	54.1	0.001*	40	51.3	39	39.4	99	48.1	64	54.2	0.033*
	S	157	42.9	35	25.9		27	34.6	38	38.4	80	38.8	47	39.8	
	N	40	10.9	27	20.0		11	14.1	22	22.2	27	13.1	7	5.9	
Do you face any difficulties during shade matching?	A	24	6.6	19	14.1	0.019*	9	11.5	9	9.1	15	7.3	10	8.5	0.515
	S	298	81.4	97	71.9		62	79.5	81	81.8	158	76.7	94	79.7	
	N	44	12.0	19	14.1		7	9.0	9	9.1	33	16.0	14	11.9	
A-Always, S-Sometimes, N-Never															

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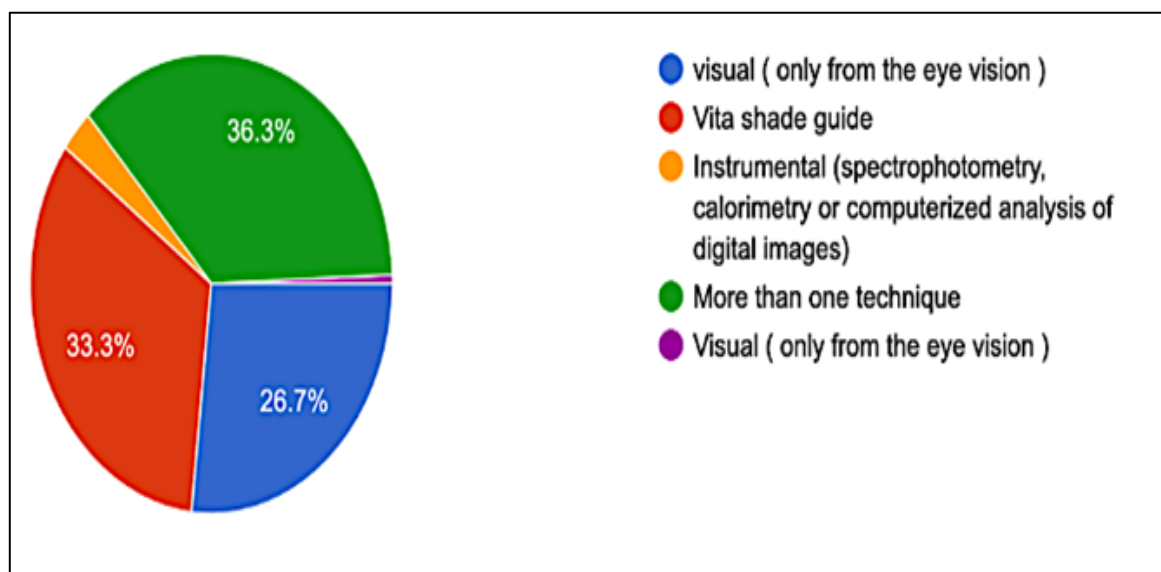Saudi Arabia

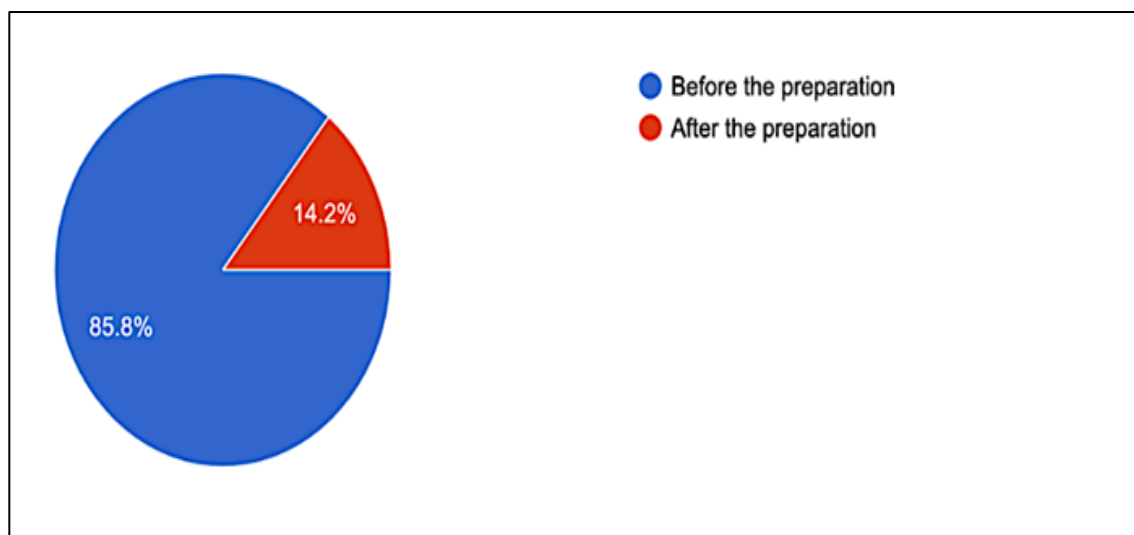Figure 1: Methods preferred during shade selection
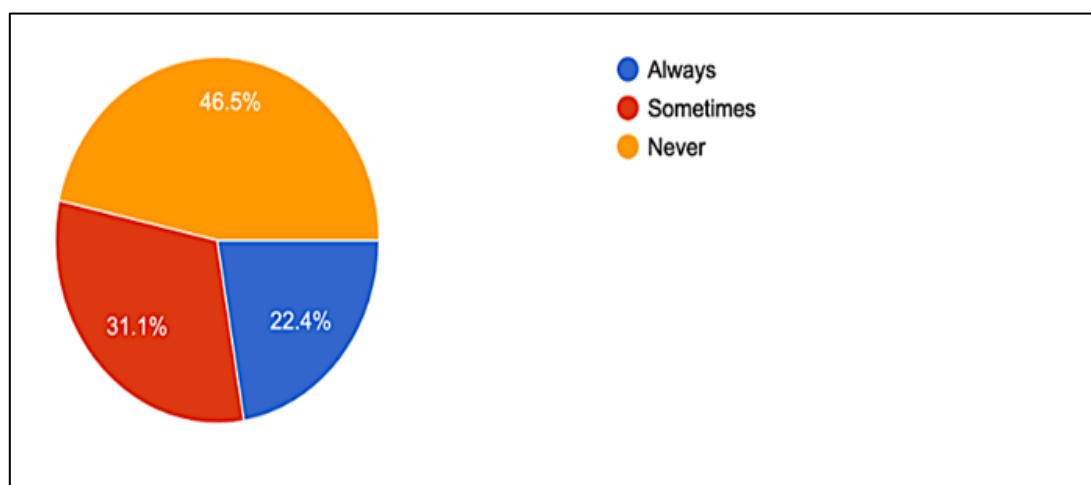

Figure 2: Time of shade selection

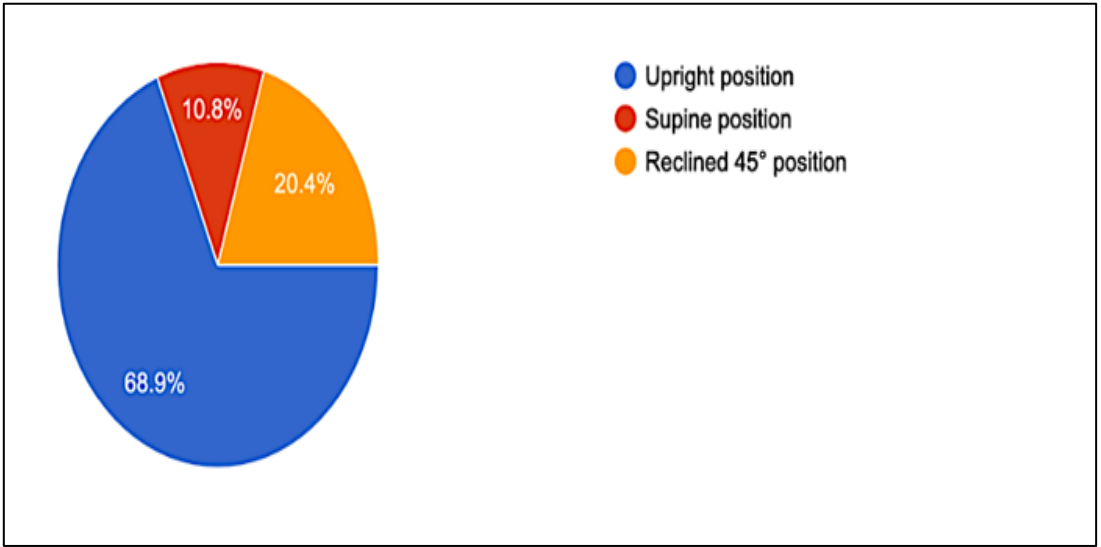Figure 3: patient's clothing consideration during shade selection
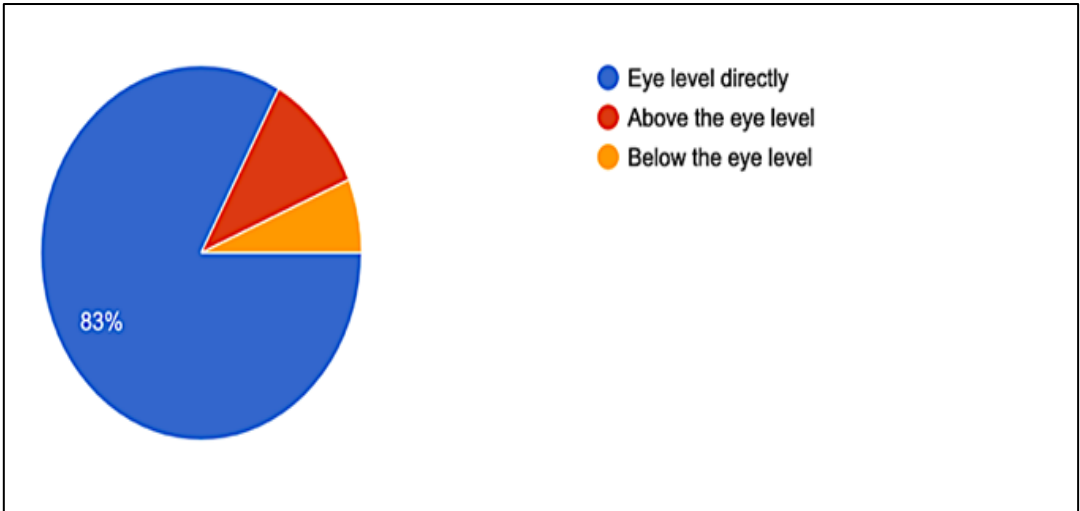
Figure 4: Level of the patient during shade selection

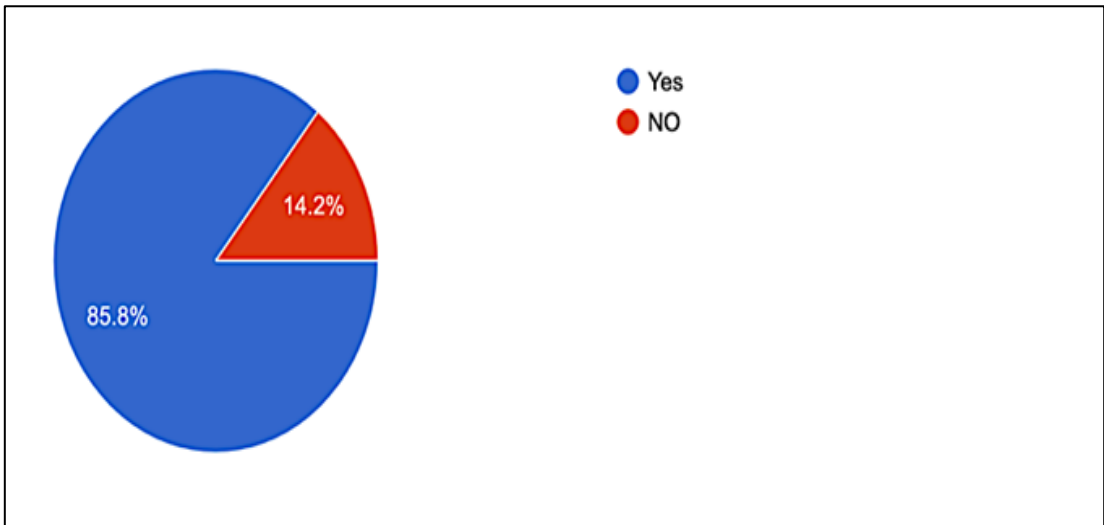Figure 5: Position of the patient according to the dentist

Figure 6: The need for more education and practice about shade selection

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Discussion

The present study included 501 dental students who completed the questionnaire to discover the level of the knowledge and practice of dental students regarding scientific principles and artistic qualities involved in tooth shade selection procedure.

This study has found that 85.8% of the participants think that they need more education and practice about shade selection. The practitioners must have a thorough knowledge regarding the principles and properties of the color shade to reach a satisfying natural looking restoration.

In contrast to earlier findings that 89.4% of the population uses vita shade guide during shade selection,[1] our study showed only 33.3% use vita shade guide and 36.3% prefer to use more than one technique during shade selection. Whilst 26.7% use visual method, and 3% use instrumental methods. The vita shade guide is commonly used since it is simpler, faster, and cost effective; however, using different methods would be more accurate to eliminate any doubt.

The majority (85.8%) agreed that they do the shade selection procedure before the tooth preparation and 63.5% agreed that the best condition to choose the shade is when the tooth is wet. The shade should be selected when the teeth are hydrated in a natural state before starting the isolation and the preparation to eliminate the light reflection on the teeth when they are dehydrated.[8]

More than half of the participants (53.7%) always remove the stains and debris before shade selection. Teeth should be clean using a dental prophylactic prior to the shade selection procedure.[3],[9]

Nearly half of the participants (48.9%) ask the female patient to remove any bright cosmetics or lipstick prior to shade selection. However, 46.5% never consider the patient's clothing during the shade selection. It is recommended to remove any lipstick, clothing and colored structures around the teeth that may be able to reflect against and affect the color.[3],[7]

Moreover, 68.9% agreed that the patient should be in upright position during shade selection. Similarly, it is highly advisable to make the patient in upright position against light.[3],[9]

According to the dentist position, 83% said that the position of the patient should be at the eye level directly which was previously recommended during shade selection to inhibit the amount of strain/re-adjustment.[10]

Natural daylight was selected by 84.8% as the type of light used during shade selection. The reliability of the shade matching is supported by the light source used. The light in the dental clinic can from a natural daylight, dental light, fluorescent light, or incandescent light. Any light condition can give a different outcome. Sitting the patient under different light conditions is preferred to avoid the specter of metamerism (change in colors of an object under different light sources) that will affect the shade prescription. For the best result, let the patient sit under all light conditions.[4]

The majority (45.3%) needed 10 sec to take the shade selection, which is not advisable due to the decreasing in color vision ability as well as instability of the color when examining an object, such as tooth, for more than 10 sec because of eye fatigue. Hence, the ideal time is 5 sec, and the first glance usually is the most accurate.[1],[7],[8]

During shade selection, 41.5% don't use any background to rest their eyes. However, it is beneficial to move your eyes away every 10 sec and look at a blue or gray background to resensitizecolor vision.[8]

Furthermore, 64.3% often ask for another opinion. It is advisable to take another dentist's opinion when in doubt, especially a younger colleague during shade matching, since the cornea and lens yellow color turn into brown with age.[10] Concerning the patient's opinion, 48.3% take it during shade selection. Taking the patient's opinion increases the satisfaction with the outcome.[3],[9] A2 shade was the most used shade in practice by 64.3%. A1, however, was reported in a previous study to have the uppermost usage 66.2%.[6]

Lastly, 78.8% face difficulties during shade matching and 57.1% considered themselves with insufficient knowledge about shade selection procedure, which indicates the need for more practice and knowledge to eliminate the difficulties. Limitations of this study is that the sample included dental students only from Riyadh. Hence, findings

of this study may not be generalized to the dental student population of Saudi Arabia. There is a possibility of under- or over-reporting in self-reporting studies.

Conclusion

The present study attempted to shed lights on the knowledge of shade selection and color matching among dental students in Riyadh. The study has found that dental students require more training and knowledge about the shade selection, improvement of the communication between the student and the patients to understand the patients' demands regarding the aesthetic and to increase the effectiveness of the restoration. Furthermore, educating the student about the importance of the natural looking teeth is required as well to boost the patients' confidence. In conclusion, courses and workshops on shade matching procedure may help students to defeat their insufficiency and enhance their knowledge.

Conflicts of interest
There are no conflicts of interest.

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