RESEARCH PAPER

Knowledge, Attitude and Practice Regarding Tooth Shade Selection among Dental Students and Practitioners: A Descriptive Questionnaire Based Study

Dr. Rasmita Kumari Samantaray[1], Dr. Sunayana Priyadarshini[2], Dr. Akankshya Gupta[3], Dr. Aurosikha Sahoo[4], Dr. Pallawi Sinha[5], Dr. Swagat Panda[*]

[1]Associate Professor, Hitech Dental College and Hospital ,Affiliation: Odisha University of Health Sciences, Email id: drrasmita91@gmail.com ,Department of Prosthodontics and Crown & Bridge, Pin Code : 751012, Orcid-0009-0003-9635-5040.
[2]Associate Professor, Hitech Dental College and Hospital, Affiliation: Odisha University of Health Sciences, Email id: sunayana.priyadarshini7@gmail.com ,Department of Prosthodontics and Crown & Bridge, Pin Code : 751025,Orcid id:0009-0007-5419-0363.
[3]Post Graduate Trainee, Hitech Dental College and Hospital, Affiliation : Odisha University of Health Sciences, Email id:akankshyagupta@gmail.com, Department of Conservative Dentistry & Endodontics, Pin Code : 751025
[4]Post Graduate Trainee, Hitech Dental College and Hospital, Affiliation : Odisha University of Health Sciences, Email id - aurosikha5521@gmail.com Department of Conservative Dentistry and Endodontics, Pin code – 751025.
[5]Associate Professor, Hitech Dental College and Hospital, Odisha University of Health Sciences ,Email id: palls1712@gmail.com,Department of Prosthodontics and Crown & Bridge, Pin Code : 751025 ORCID ID: 0000-0001-7316-715X.
[5]Professor, Hitech Dental College and Hospital , Affiliation: Odisha University of Health Sciences, Email id: reachswagat@gmail.com , Department of Conservative Dentistry & Endodontics ,Pin code-751025, ORCID ID : 0009-0006-4812-3570.

Abstract

Accurate tooth shade selection is essential for achieving esthetic success in restorative dentistry. This descriptive questionnaire-based study evaluated the knowledge, attitude, and practice regarding tooth shade selection among dental students and practitioners. A structured questionnaire consisting of 27 questions was given to the participants divided into four groups based on clinical experience. The questionnaire assessed awareness of shade selection principles, attitude toward esthetic procedures and routine clinical practices. Responses were statistically analyzed and compared among groups. Differences were observed in knowledge levels and clinical practices, with experienced clinicians demonstrating better awareness and application of appropriate shade selection protocols.

Keywords: Tooth shade selection; Knowledge; Attitude; Practice; Esthetic dentistry
How to cite this article: Samantaray RK, Priyadarshini S, Gupta A, Sahoo A, Sinha P, Panda S. Knowledge, Attitude and Practice Regarding Tooth Shade Selection among Dental Students and Practitioners: A Descriptive Questionnaire Based Study. Int J Drug Deliv Technol. 2026;16(56s): 997-1006. DOI: 10.25258/ijddt.16.56s.106
Source of support: Nil.
Conflict of interest: None.

Introduction

In modern dentistry, tooth-colored restorations are becoming increasingly popular. For patients, favorable aesthetics, including accurate choice of tooth color, are of primary importance in determining satisfaction with the outcome of treatment. In routine clinical practice, tooth colors are usually determined visually, by means of shade guides; the extensive spread of digital color- measurement devices is limited by partial measurement inaccuracies and relative high costs of the devices.[1] Great emphasis is being placed on esthetic restorations by patients and dentists alike. For these tooth-colored restorations, an accurate and acceptable shade selection on the chair-side and its accurate formulation in the laboratory still remains a demanding task even for the experienced clinicians and laboratory technicians.[2]

The study of color is a fundamental part of aesthetic dentistry. Color is undoubtedly one of the parameters with the greatest weight when patients judge the quality of the restoration, above all in the anterior region. Achieving perfect mimicry of the surrounding natural teeth thus becomes a crucial objective for

*Author for Correspondence: reachswagat@gmail.com

dental practitioners and for patients. In this respect, it is therefore important to know and understand all aspects related to tooth color and the restoration materials used, both ceramics and compound resins.[3]

environment, age and visual perception[4].

Visual shade selection using conventional shade guides remains the most commonly used method in clinical practice due to its simplicity and affordability. However, improper knowledge and incorrect clinical practices can lead to inaccurate shade selection[4].

Knowledge regarding ideal lighting conditions, proper positioning and use of shade guides, cleaning of teeth before shade selection and obtaining second opinions are important aspects of clinical success. Therefore this study was conducted to evaluate the knowledge, attitude and practice methods used by dental students and dental practitioners during tooth shade selection[5].

Aim

To evaluate the knowledge, attitude and practice methods used by dental students and dental practitioners during tooth shade selection.

Tooth color is influenced by hue, value and chroma. Accurate shade selection is essential for successful esthetic restorations. Various factors affect shade selection such as lighting conditions, operator experience, surrounding

Materials and Methods

A descriptive questionnaire based study was conducted among dental students and dental practitioners. Ethical committee approval was taken and the participants were verbally explained the entire research procedure.

A questionnaire comprising 27 questions in annexure-1 was prepared relating to knowledge, attitude and practicing methods that are used by dental students and dental practitioners.

The participants were divided into four groups:

Group A: Students with no clinical experience

Group B: Students with some clinical experience

Group C: Clinicians with minimum 5 years of experience

Group D: Clinicians with minimum 10 years of experience

Results

The responses obtained from participants were analyzed under knowledge, attitude and practice domains.

DESCRIPTIVE STATISTICS

GROUP		N	Minimum	Maximum	Mean	Std. Error	Std. Deviation
1	Knowledge_1	80	1.43	3.29	2.2357	.04011	.35875
	practice_1	94	1.13	2.13	1.6795	.02582	.25038
	attitude_1	93	1.00	2.00	1.3748	.02060	.19861
2	Knowledge_1	54	1.43	2.86	2.1852	.04398	.32319
	practice_1	58	1.13	2.13	1.6358	.03549	.27032
	attitude_1	57	.86	2.00	1.3684	.02722	.20551
3	Knowledge_1	89	1.29	2.71	2.1236	.03294	.31075
	practice_1	94	1.25	2.38	1.7739	.02199	.21320
	attitude_1	96	1.00	2.00	1.5298	.02931	.28715
4	Knowledge_1	28	1.43	2.57	2.1378	.05221	.27625
	practice_1	30	1.38	2.25	1.7417	.04017	.22004
	attitude_1	29	1.29	2.14	1.5468	.03823	.20585

Table-1:- Comparison of Knowledge, Attitude and Practice among the various groups

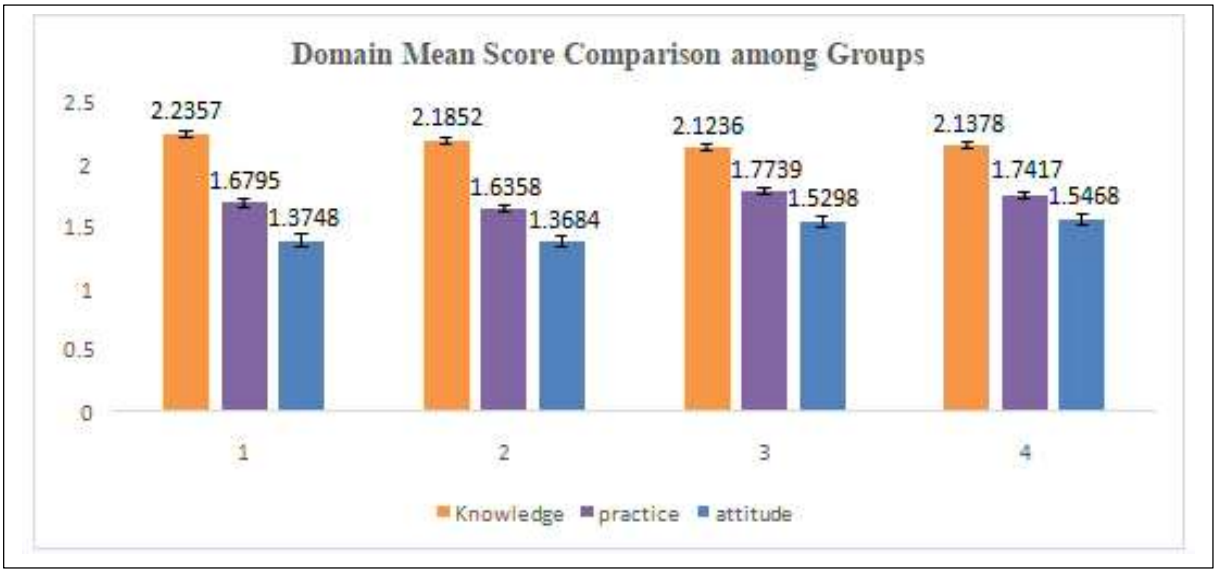

Figure-1:- Domain Mean Score Comparisons among the groups

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Knowledge_1	Between Groups	.574	3	.191	1.801	.148
	Within Groups	26.261	247	.106		
	Total	26.836	250			
Practice_1	Between Groups	.821	3	.274	4.764	.003*
	Within Groups	15.627	272	.057		
	Total	16.448	275			
Attitude_1	Between Groups	1.783	3	.594	10.725	.000*
	Within Groups	15.014	271	.055		
	Total	16.797	274			

*statistically significant

Table -2: ANOVA Statistics to compare the group mean difference among the groups

Knowledge Domain Responses		Group 1		Group 2		Group 3		Group 4		Chi Square	P Value
		N	%	N	%	N	%	N	%		
1	Knowledge	26	24.3	6	9.7	21	21.0	7	22.6	269.520	<0.0001*
	Talent	1	.9	0	0	2	2.0	1	3.2		
	Individual observer	63	58.9	49	79.0	63	63.0	18	58.1		
	Skill	17	15.9	7	11.3	14	14.0	5	16.1		
	Hue	36	34.6	24	38.7	33	33.3	9	30.0		

2	Value	17	16.3	16	25.8	53	53.5	18	60.0	46.980	<0.0001*
	Chroma	19	18.3	12	19.4	6	6.1	3	10.0		
	Translucency	32	30.8	10	16.1	7	7.1				
3	Light source	66	61.7	40	64.5	60	60.0	23	74.2	252.187	<0.0001*
	Tooth including texture and layers	29	27.1	11	17.7	24	24.0	4	12.9		
	Environment	3	2.8	5	8.1	5	5.0				
	Receiver‘s eye	9	8.4	6	9.7	11	11.0	4	12.9		
4	1000	12	13.0	12	22.2	8	**8.8**	**4**	**13.8**	43.805	<0.0001*
	2000	33	35.9	17	31.5	17	**18.7**	**4**	**13.8**		
	3000	26	28.3	15	27.8	52	**57.1**	**15**	**51.7**		
	5500	21	22.8	10	18.5	14	**15.4**	**6**	**20.7**		
5	Within 5 Seconds	5	4.8	5	8.1	28	**28.0**	**1**	**3.2**	159.638	<0.0001*
	10-15 seconds	56	53.3	37	59.7	44	**44.0**	**25**	**80.6**		
	15-20 seconds	31	29.5	16	25.8	25	**25.0**	**5**	**16.1**		
	1 minute	13	12.4	4	6.5	3	**3.0**	**0**	**0**		
13	Single unit	14	13.7	12	19.7	19	**19.2**	**3**	**9.7**	283.833	<0.0001*
	Two halves	18	17.7	7	11.5	22	**22.2**	**4**	**13.1**		
	Cervical, middle, Incisal	70	68.6	42	68.9	58	**58.6**	**24**	**77.4**		
	No	2	2.1	3	5.1	1	**1.0**	**2**	**6.6**		

14	Yes	62	63.9	33	55.9	68	**70.1**	**20**	**66.7**	310.682	<0.0001 *
	Somewhat	33	34.0	23	39.0	28	**28.9**	**8**	**26.7**		

Table-3:- Knowledge related responses as compared Group wise

Attitude Domain Responses		Group 1		Group 2		Group 3		Group 4		Chi Square	P Value
		N	%	N	%	N	%	N	%		
6	Yes	77	72.6	48	80.0	88	88.0	26	86.7	111.905	<0.0001 *
	No	29	27.4	12	20.0	12	12.0	4	13.3		
7	Yes	87	84.5	59	95.2	92	92.0	1	3.2	437.561	<0.0001 *
	No	16	15.5	3	4.8	8	8.0	30	96.8		
9	Yes	14	13.2	6	9.8	7	7.0	2	6.5	193.289	<0.0001 *
	No	92	86.8	55	90.2	93	93.0	29	93.5		
18	Always	7	6.7	5	8.1	11	11.1	1	3.2	249.896	<0.0001 *
	Sometimes	56	53.3	39	62.9	60	60.6	19	61.3		
	Never	42	40.0	18	29.0	28	28.3	11	35.5		
20	Natural day Light	71	67.6	48	78.7	58	58.6	17	54.8	142.142	<0.0001 *
	Dental clinic lightning conditions	21	20.0	6	9.8	29	29.3	9	29.0		
	Corrected light device	13	12.4	7	11.5	12	12.1	5	16.1		
22	Always	33	32.0	22	37.3	24	24.0	15	48.4	118.364	<0.0001 *
	Sometimes	27	26.2	21	35.6	38	38.0	10	32.3		
	Never	43	41.7	16	27.1	38	38.0	6	19.4		
23	Always	67	64.4	43	71.7	51	51.0	29	93.5	134.407	<0.0001 *
	Sometimes	29	27.9	15	25.0	24	24.0	2	6.5		
	Never	8	7.7	2	3.3	25	25.0	0	0		
19	From the patient	26	25.0	28	45.2	20	20.0	3	9.7	59.879	<0.0001 *
	From dental Auxiliary	26	25.0	10	16.1	15	15.0	8	25.8		
	Both	52	50.0	24	38.7	65	65.0	20	64.5		

Table-4:- Attitude related responses as compared Group wise

A Statistically significant difference was observed among the groups in various knowledge, attitude and practice parameters.

Table-4 Practice related responses as compared Group wise

Practice Domain Responses		Group 1		Group 2		Group 3		Group 4		Chi Square	P Value
		N	%	N	%	N	%	N	%		
8	Young male	6	4.6	4	6.5	7	7.0	1	3.2	370.233	<0.0001*
	Young female	69	64.5	44	71.0	57	57.0	14	45.2		
	Adult male	6	5.6	1	1.6	12	12.0	6	19.4		
	Adult female	27	25.2	13	21.0	24	24.0	10	32.3		
10	Visual	32	30.5	35	56.5	56	56.0	18	58.1	241.034	<0.0001*
	Instrumental	3	2.9	25	40.3	4	4.0	1	3.2		
	Both	70	66.7	2	3.2	40	40.0	12	38.7		
11	Dental light	9	8.6	2	3.2	10	10.0	1	3.2	427.235	<0.0001*
	Fluorescent light	13	12.4	3	4.8	6	6.0	1	3.2		
	Corrected light	5	4.8	6	9.7	7	7.0	6	19.4		
	Natural day light	78	74.3	51	82.3	77	77.0	23	74.2		
12	Rubber dam isolation	53	51.5	25	40.3	10	10.2	6	20.0	107.041	<0.0001*
	Cotton roll	29	28.2	23	37.1	60	61.2	11	36.7		
	Evacuator system	21	20.4	14	22.6	28	28.6	13	43.3		
15	Dental chair light	26	25.5	10	16.4	9	9.3	2	6.5	58.474	<0.0001*
	Clinical lightning conditions	45	44.1	25	41.0	62	63.9	21	67.7		

	Corrected light device	31	30.4	26	42.6	26	26.8	8	25.8		
16	Always	50	48.1	44	72.1	72	74.2	21	70.0	154.363	<0.0001*
	Sometimes	48	46.2	16	26.2	20	20.6	7	23.3		
	Never	6	5.8	1	1.6	5	5.2	2	6.7		
17	Always	27	25.7	8	12.9	7	7.1	1	3.3	107.318	<0.0001*
	Sometimes	70	66.7	44	71.0	48	48.5	19	63.3		
	Never	8	7.6	10	16.1	44	44.4	10	33.3		
22	Always	73	69.5	43	70.5	50	50.0	20	64.5	118.364	<0.0001*
	Sometimes	23	21.9	13	21.3	23	23.0	10	32.3		
	Never	9	8.6	5	8.2	27	27.0	1	3.2		
24	Always	29	29.0	16	27.1	22	22.4	1	3.3	12.634	0.002*
	Sometimes	51	51.0	30	50.8	23	23.5	11	36.7		
	Never	20	20.0	13	22.0	53	54.1	18	60.0		

Discussion

Traditionally dentist selects the appropriate shade for restoration by matching the natural teeth with shade tabs from manufacturer supplied shade guide. There is inconsistency in shade matching abilities when traditional methods are used because shade selection is affected by host of variables such as age,experience,the shape and texture of tooth being matched, time taken and type of light source that is used during the process.[6,7]

The experienced participants (group- D) who have a minimum ten years' experience in the field of dentistry answered that correct amount of temperature of light source which is needed during shade matching procedures was 3000-5500 kelvin which is in consistent with studies conducted by Basavanna and Chitra Gohil in their study in 2013 and contrary result was found by Gasparik et al in 2014 indicating that clinical experience has no effects on shade matching ability[8].

The present study also collected data from the dental under graduates, the interns and the post graduates who were grouped into (group A &B) and it was found from the study that interns and post graduates had a better shade matching ability than the under graduates and the possible reason behind it may be their exposure to clinical situation.[9]

Source of light is most important factor while doing shade selection.Natural day light (Northern day light) has CRI equals to 100 and temperature of light between 3000-5500 kelvin.This range is preferable and is a optimum characteristic which should be maintained during shade matching procedure. The corrected light device provides the same characteristic as that is achieved under natural light.Clinicians who does practice during evening time utilizes clinical lightning condition during shade matching practices which has a possibility to attain mis-match.The result of present study demonstrated that shade matching scores are better when done under a commercially available light correcting

sources which is consistent with the studies conducted by Curd et al and Ala Mohammed Ajaj et al in2006.The present study compared the effect of natural day light,clinical light sources and commercially available corrected light device which has CRI equals to 100 and the temperature being 6500k.[10,11]

The present study was also conducted under the natural day light as a source of light and result obtained from the study showed variability in selecting the proper shade under done under natural day which is in contrary to the study findings conducted by Curd et al in 2006.In study conducted by Mohammadreza et al it was found that there is no significant difference between shade matching ability of natural and clinical lightning condition which is in contrary with the present study[12].

Previous studies suggested that there was deficiency of knowledge among general dentist about consequence of intensity and lightning condition during shade matching which is contrary finding to this present study and 80% dentists performed shade selection under in appropriate light intensity which is consistent with the present study.

No dentist used commercially corrected light sources which should be used during shade matching procedure which is consistent with the findings seen by Saboori et al.Based on the result of the present study it is recommended to use a proper light source to improve skills in order to achieve restorations/prosthesis of appropriate color and aesthetic.

When time to be taken while matching shade of a tooth was asked maximum number of participants answered that 10-20 seconds is minimum time that should be taken during matching a shade of a tooth and more than this stipulated time there is a chance of human eye getting fatigue leading to mismatch of shade.[13]

Most commonly devices that is used by the clinicians was the visual shade matching devices i.e the vitapan classic shade guide.The common reason of not using the electronic shade devices is its cost.The electronic shade device is costly and procedure is cumbersome.When asked about understanding the significance of letters and numbers in a vitapan classic shade guide,the non-clinicians or the group A and group B answered that they somewhat understand the significance whereas the clinicians or the Group C and D answered that they understand completely the numbers and letters given in the shade tab.[14]

Shade selection should be carried out before as well as after operative procedure by matching the shade to its adjacent tooth because sometimes after operative procedure the color of tooth varies due to degeneration of pulpal/periodontal tissue or various chemicals that is used during root canal therapy or due to exposure of dentin layer following tooth preparation.[15]

It is advisable to keep the patient at eye level of the clinician during shade matching practice. Keeping patient at various levels may also affect the shade selection practice. Viewing the patient at an eye level utilizes the most sensitive part of retina is used.

Sometimes it is necessary to take a second opinion from patient as well as dental auxiliary during shade matching. It is the patient who is going to wear the prosthesis. And sometimes due to work load/fatigue and constant glaring to patients tooth the clinician sometimes may choose a different shade which may lead to mismatch. More-ever the perception of patient is of utmost importance. Have a close family member or a friend to help during the process.[16]

It is also necessary to clean the tooth prior to shade matching procedure. Most patients in our country are tobacco chewers and the stain sheaths the original shade of the tooth as well as gives a different shade.[17]

It is imperative to isolate the oral environment from saliva and debris but not over drying the tooth as any contamination and over drying may lead to whitish appearance of the tooth which in turn may affect the shade selection.[15]

When photography was the method of choice to communicate to ceramic laboratory for determining the shade, the clinicians used contrast card during this process.[18]

One way ANOVA test was used to study the group wise comparison of shade matching

ability. Statistically significant difference was seen between groups for corrected light device. This could be interpreted that the ability to match the correct shade is enhanced when corrected light device is used as compared to natural day light and clinical lightning condition.

Conclusion

The color of an object can change depending on the type of illuminant. There are three main illuminant such as Incandescent, Fluorescent and Natural light. Incandescent emits more of red/yellow light and its color temperature is about 2856 K. Fluorescent emits more of blue light and its color temperature is 4000 K, were as natural light is extremely variable. Mid-day light is said to be best for shade selection because at this time light is most balanced. Corrected light devices which emits light with more uniform distribution of color. Its color temperature is 3000- 5500 K and color rendering index equals to 100 provides a better environment during shade matching as compared to the clinical lightning condition and natural day light.[19,20]

Limitations of the Study

Within the limitations of this study, differences were observed in knowledge, attitude and practice among dental students and dental practitioners regarding tooth shade selection.Improved education and training regarding proper shade selection protocols may help improve clinical outcomes.

References

1. Corcodel N, Krisam J, Klotz AL, Deisenhofer UK, Stober T, Hassel AJ, Rammelsberg P, Zenthöfer A:Evaluation of small-group education on the shade determination ability of preclinical dental students—A controlled clinical trial. European Journal of Dental Education. 2018 Aug;22(3):e582-7.
2. Salman A, Habib SR, Azad AA:Scientific and artistic principles of tooth shade selection: A review. Pakistan Oral & Dental Journal. 2011 Jun 1;31(1).
3. Gómez-Polo C, Gómez-Polo M, Celemin-Viñuela A, De Parga JA:Differences between the human eye and the spectrophotometer in the shade matching of tooth color. Journal of dentistry. 2014 Jun 1;42(6):742-5.
4. Mehta R, Kumar A, Goel M, Kumar V, Arora T, Pande S. Shade Selection: Blending of Conventional and Digital Methods-An Updated Review. Journal of Oral Health & Community Dentistry. 2014 May 1;8(2).
5. Kim-Pusateri S, Brewer JD, Davis EL, Wee AG:Reliability and accuracy of four dental shade-matching devices. The Journal of prosthetic dentistry. 2009 Mar 1;101(3):193-9.
6. Curd FM, Jasinevicius TR, Graves A, Cox V, Sadan A:Comparison of the shade matching ability of dental students using two light sources. The journal of prosthetic dentistry. 2006 Dec 1;96(6):391-6.
7. Jain M, Jain V, Yadav NR, Jain S, Singh S, Raghav P, Kohli J, Sharma A:Dental students' tooth shade selection ability in relation to years of dental education. Journal of Family Medicine and Primary Care. 2019 Dec;8(12):4010.
8. Basavanna RS, Gohil C, Shivanna V:Shade selection. International Journal of Oral Health Sciences. 2013 Jan 1;3(1):26.
9. Roodgarian R, Jafari T, Khafri S, Abolghasemzadeh F:Influence of different light sources on visual shade matching performance. Caspian Journal of Dental Research. 2016 Sep 15;5(2):30-6.
10. Curd FM, Jasinevicius TR, Graves A, Cox V, Sadan A:Comparison of the shade matching ability of dental students using two light sources. The journal of prosthetic dentistry. 2006 Dec 1;96(6):391-6.
11. Baharin SA, Dong TY, Jing TW:Anterior tooth shade selection procedure: influence of light sources and patient‘s position. Sains Malaysiana. 2013 Jan 1;42(1):7-11.
12. Roodgarian R, Jafari T, Khafri S, Abolghasemzadeh F:Influence of different light sources on visual shade matching performance. Caspian Journal of Dental Research. 2016 Sep 15;5(2):30-6.
13. Ajaj AM:Basics of Shade Selection and

Importance of Laboratory Communication Restorative Dentistry. J Dent Health Oral Disord Ther. 2015;2(6):00072.
14. Roodgarian R, Jafari T, Khafri S, Abolghasemzadeh F:Influence of different light sources on visual shade matching performance. Caspian Journal of Dental Research. 2016 Sep 15;5(2):30-6.
15. Ahmad I:Protocols for predictable aesthetic dental restorations. John Wiley & Sons; 2008 Apr 15.
16. Imbery TA, Tran D, Baechle MA, Hankle JL, Janus C:Dental Shade Matching and Value Discernment Abilities of First-Year Dental Students. Journal of Prosthodontics. 2018 Dec;27(9):821-7.
17. Geissberger M:Esthetic dentistry in clinical practice. John Wiley & Sons; 2013 Jul 8.
18. Brewer JD, Wee A, Seghi R:Advances in color matching. Dental Clinics of North America. 2004 Apr;48(2):v-341.
19 Basavanna RS, Gohil C, Shivanna V:Shade selection. International Journal of Oral Health Sciences. 2013 Jan 1;3(1):26.
20. Sikri VK. Color: Implications in dentistry. Journal of conservative dentistry: JCD. 2010 Oct;13(4):249.