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Assessment of Shade Matching Proficiency among Dental Students: An Analysis of Accuracy and Factors Influencing Performance

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Research Article

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ABSTRACT

Abstract: This study aims to investigate the knowledge, attitude, and perception of dental students regarding the study aimed to compare the shade-matching abilities of dental students under standard clinical lighting and color-corrected lighting conditions to determine the impact of lighting on accuracy and consistency. Students' cognitive abilities are involved in the multifaceted and intricate process of shade matching. Hence, the present study aimed to assess and compare the shade-matching ability of undergraduate dental students in various years of dental education under clinical and correcting light.

Aim: To evaluate the shade-matching ability of dental students focusing on their perception, accuracy, and consistency in selecting the correct tooth shade.

Objectives: 1) To assess the level of awareness among dental students have regarding shade matching in restorative dentistry.

2) To evaluate the accuracy of dental students in shade selection under standardized light conditions and natural light conditions.

Method: A cross-sectional survey was conducted among 200 dental students, comprising 56 males (22%) and 144 females (78%), including 62 third-year BDS students, 64 fourth-year BDS students, and 74 interns. The survey included 14 questions exploring awareness, and perceptions, on shade matching ability for pre-clinical Curriculum. Responses were analyzed based on gender and year of study using chi-square tests to identify statistically significant differences.

Keywords: Color Matching, Clinical Performance, Dental Aesthetics, Influencing Factors, Restorative Dentistry, Shade Matching, Skill Development, Visual Shade Selection.

Introduction

Methodology

A) Study design and area: A cross-sectional study was carried out at tertiary care teaching hospital Khammam.

B) Study Population: The health care students including those of IV year and Interns who responded to the offline paper print questionnaire survey.

C) Study Instrument: A self-administered questionnaire was designed based on knowledge attitude and awareness of the shade-matching ability and had a total of 14 questions. Each participant has to fill in their demographic data like Name, age, and year of study. Participants had to select one option from the answers provided against questions the questions were based on knowledge attitude and awareness among dental students.

D) Pilot Study: A pilot study was conducted on a group of students to assess the validity and reliability of the study.

E) Sampling Method: The sampling method used is a convenience method.

F) Inclusion Criteria: The students who were interested in the study and who were willing to participate.

G) Exclusion Criteria: students who are not willing to participate are excluded.

H) Organizing the study: The study was designed in a paper-based version of the self-administered questionnaire of 14 questions focusing on knowledge, and awareness. Includes the sections of demographic data: Name, Age, Sex, and Year of study demographic information and asked to answer all questions by selecting one option from the provided answers. I) Statistical analysis: Data from the filled questionnaire was collected in a tabular form in an Excel worksheet and evaluated for analysis. The analysis was performed by SSPS version 29.

Result

A total of 200 students took part in this with females (78%) and males (22%). Age of the participants ranged from 18-25 years. In this study, females were more likely to demonstrate awareness of Digital dentistry than males. Significantly Interns showed greater familiarity with advanced applications than fourth-year students.

	N	Minimum	Maximum	Mean	Std. Deviation
Age	200	18	25	23.76	2.436

Gender		Frequency	Percent
Valid	MALE	56	
	FEMALE	144	78.0
	Total	200	100.0

Year of the Study		Frequency	Percent
Valid	III BDS	62	31.0
	IV BDS	64	32.0
	INTER	74	37.0
	N		
	Total	200	100.0

Distribution and comparison of responses based on gender

Item	Response	Males		Females		Chi-Square value	P-value
		n	%	n	%		
Q1	1	0	0	0	0	5.464	0.0001*
	2	56	100	144	100		
Q2	1	10	17.9	30	20.8	6.646	**0.016***
	2	46	82.1	114	79.2		
Q3	1	14	16.7	15	10.4	7.486	0.09
	2	5	5.4	20	12.1	5	
	3	30	44.1	15	22.6	3	
	4	3	5.1	95	56.8	4	
	5	4	6.8	9	11.2	5	
Q4	1	16	42.1	23	17.9	9.814	**0.06**
	2	15	40.5	25	19.5	2	
	3	5	15.4	70	513	3	
	4	15	4.2	34	25.1	4	
	5	4	6.5	9	11.7	5	
Q5	1	16	25.7	10	14.3	6.655	0.07
	2	21	34.3	54	25.7	2	
	3	10	26.5	64	35.7	3	
	4	8	13.3	17	18.6	4	
	5	1	4.6	9	15.6	5	
Q6	1	15	23.7	25	46.3	5.046	0.167
	2	18	47.6	33	52.4	2	
	3	10	22.5	85	67.5	3	
	4	12	7.7	11	32.3	4	
Q7	1	18	57.1	21	42.9	9.485	**0.06**
	2	15	14.9	37	45.1	2	
	3	10	22.5	76	54.1	3	
	4	12	10.4	10	32.5	4	
Q8	1	25	45.4	95	65.5	6.166	**0.07**
	2	19	34.5	23	15.8	2	
	3	6	10.9	17	11.7	3	
	4	4	7.2	10	6.8	4	
	5	1	2.1	1	3.1	5	
Q9	1	12	29.1	30	469	1.211	0.750
	2	10	30.6	20	394		
	3	10	25.4	73	546		
	4	7	12.5	12	375		
	5	6	11.6	7	126		
Q10	1	20	52.2	22	158	8.275	**0.08**
	2	9	30.4	19	196	2	
	3	7	20	20	23	3	
	4	4	10.4	90	435	4	
	5	5	11.4	5	7.6	5	
Q11	1	36	57.1	15	193	5.928	0.115
	2	8	13.2	99	613	2	

	3	12	22.6	34	125	3	
Q12	1	20	13.5	86	165	6.303	0.98
	2	32	19.3	22	207	2	
	3	4	14.9	33	251	3	
Q13	1	10	17.9	30	208	6.483	0.05*
	2	46	82.1	114	792		
Q14	1	21	37.5	24	6	3.258	0.003*
	2	6	10.7	24	166		
	3	10	17.8	52	361		
	4	19	33.9	44	305		

P≤0.05 is statistically significant

Distribution and comparison of responses based on year of the study

Item	Response	III BDS		IV BDS		INTERN		Chi-Value	P-Value
		n	%	n	%	n	%		
Q1	1	0	0	0	0	0	0	4.575	0.001*
	2	62	100	64	100	74	100		
Q2	1	3	4.8	6	9.3	5	6.7	7.842	0.005”
	2	59	95.1	58	90.6	69	93.2		
Q3	1	6	15.4	6	5.4	6	15.6	11.192	0.513
	2	14	20.6	16	33.5	3	4.4		
	3	18	31.7	14	32.9	9	10.8		
	4	7	15.9	11	29.5	7	15.9		
	5	11	22.5	17	38.5	49	55.5		
Q4	1	6	15.8	6	15.8	4	10.5	17.051	0149
	2	6	16.2	11	29.7	1	2.7		
	3	26	23.4	33	34.5	34	43.5		
	4	2	26.5	8	12.6	25	34.6		
	5	22	31.5	4	6.3	10	13.7		
Q5	1	5	8.0	5	7.8	25	33.7	13.314	0.07
	2	15	24.1	17	26.5	23	44.5		
	3	25	40.3	18	28.1	10	13.5		
	4	10	27.4	20	37.5	6	8.1		
	5	7	8.6	4	9.7	10	11.6		
Q6	1	9	16.7	8	14.8	8	14.8	42.592	**0.07**
	2	15	23.8	16	25.4	1	1.6		
	3	7	8	20	22.7	9	10.2		
	4	14	45.2	4	12.9	7	22.6		
Q7	1	3	6.1	9	18.4	11	22.4	19.802	0.071
	2	16	19.5	18	22.5	7	8.5		
	3	46	54.7	25	32.6	20	21.5		
	4	12	32.2	17	23.6	30	51.9		
Q8	1	10	29.4	21	38.6	12	23.3	15.579	0.06
	2	22	30.6	21	36.4	15	26.9		
	3	20	28.6	10	15.6	12	23.3		

	4	5	9.4	2	6.5	24	32.6		
	5	5	9.4	10	15.6	10	13.6		
Q9	1	8	12.5	6	9.4	13	20.3	22.714	**0.07**
	2	11	16.7	15	22.7	6	9.1		
	3	15	20.3	20	27	4	5.4		
	4	11	16.7	7	21.9	2	6.2		
	5	17	21.5	18	21.6	49	54.4		
Q10	1	5	10.9	5	10.9	10	21.7	19.322	0.081
	2	10	20.8	12	25.5	3	6.2		
	3	30	50.6	13	26.7	17	54.6		
	4	27	19.1	30	39.5	38	18.5		
	5	3	11.5	4	13.5	2	5.5		
Q11	1	11	14.7	15	58.3	30	58.8	25.349	**0.07**
	2	27	45.3	25	41.7	28	41.2		
	3	24	41.5	24	34.5	16	21.5		
Q12	1	33	43.4	24	40.9	55	71.7	9.118	**0.04***
	2	12	28.5	7	13.6	4	17.4		
	3	17	32.1	31	33.5	5	15.3		
Q13	1	32	51.6	30	46.8	24	32.4	14.206	0.05*
	2	30	48.3	34	53.1	50	67.5		
Q14	1	16	25.8	4	6.2	10	13.5	12.256	**0.04***
	2	7	11.2	21	32.8	11	14.8		
	3	17	27.4	25	39.0	30	40.5		
	4	22	35.4	24	37.5	23	31.0		

P≤0.05 is statistically significant

Discussion

Choosing the right shade of teeth for a prosthetic is a complicated procedure that necessitates a basic understanding of colour and aesthetics. The dentist's skill in selecting the right shade has an impact on both patient happiness and the efficacy of therapy. Many factors, such as background and light, can influence tooth colour. Therefore, the shade-matching ability will be enhanced when a reliable light source and suitable climatic conditions are used. While some studies support the use of traditional shade tabs, others take into account digital devices in order to achieve more accurate and precise measurements. Therefore, this study demonstrated the shade selection under clinical and correcting light by the clinical students. Shade matching depends on the source of light. While it is true that natural sunshine is the ideal light source for matching shades, the quality of daylight is inconsistent, making it difficult to match shades at all times of the day. As a result, employing a reliable light source in conjunction with an appropriate ambient setting might enhance shade-matching performance. This study demonstrated the shade-matching ability of posterior and anterior teeth by clinical male and female students under correcting and clinical lighting conditions. The degree of education and training received in shade matching both show a strong correlation with shade matching accuracy. Previous research has shown that dental professionals need to participate in hands-on learning opportunities, continuing education initiatives, and further instruction in order to enhance their shade-matching ability. In the present study, there was a significant difference ($p < 0.05$) between all shade tabs of the anterior tooth under clinical and correcting light among male and

female students, indicating that students' clinical experience with colour matching improves the accuracy of shade selection. These findings were endorsed by another study, and their data should motivate dentists to actively participate in using their knowledge, explore precise training for shade matching, and incorporate colour-corrected light devices into their dental skills. Similar to the current investigation, another study found that students' shade-matching abilities under a colour-correcting device improved shade selection in comparison to the traditional method under typical lighting circumstances. Shade matching differs depending on the type of light source. Therefore, dental professionals must employ the appropriate light source in order to achieve the optimum shade and provide the patient with the best possible, aesthetically pleasing outcomes. An additional investigation was intended to determine how the clinical experiences of different dental students and interns affected the accuracy of shade matching. When compared to clinical light and daylight, that study showed a noticeably higher percentage of correct responses for identifying the proper shade under the correcting light source. These findings were corroborated by the present study and revealed that the majority of students chose the appropriate shade under correcting light rather than clinical light. A light source that resembled daylight was used to obtain the second-best shade-matching responses. The present study revealed that the clinical experience of dental students plays a significant role in shade matching under lighting conditions. It was observed that most of the intern students selected the shade correctly under the correcting light. It is essential to advocate for and encourage students to practice this process more frequently, in addition to helping them make the right choices by increasing their knowledge, in order to prevent any issues in their future careers as dentists. Shade matching is a significantly more complex process than it first appears, particularly when considering hue, value, and chroma. Nonetheless, training, exercise, and experience all contribute to an improvement in color perception with time. Similarly, a study conducted in India, selected students from all academic years of the dental educational system demonstrated an increase in shade matching skills with their degree of dental training. As far as the present study is concerned, it was revealed that level of the dental education showed an improvement in the shade selection of anterior and posterior teeth. Additionally, it was demonstrated that shade matching under correcting light was noticeably superior to that under clinical light. Third-year dental students and other inexperienced observers did not obtain as accurate results as experienced practitioners, such as interns. Nonetheless, there was no distinction between experienced and inexperienced observers when exposed to a mixture of fluorescent and natural light. These findings were inconsistent with the present study that revealed the level of academic year had a significant influence on shade-matching abilities. Additionally, shade selection under correcting light was better than in clinical lighting conditions. The result of this study should be seen under certain limitations: multivariate analyses were not performed in this study as this research included only a limited number of variables. Additionally, there are spectrophotometers on the market that need further investigation in order to provide a thorough grasp of shade matching between the restoration and the tooth. At last, patients with other characteristics such as internal discoloration need further exploration.

Conclusion

In conclusion, this study highlights the significant influence of lighting conditions on the shade-matching ability of dental students. The superior performance observed under correcting light conditions underscores the importance of optimizing environmental factors to enhance visual perception in restorative dentistry. Additionally, the findings emphasize the positive impact of clinical experience on shade-matching proficiency, suggesting that hands-on practice plays a critical role in skill development.

To address the challenges identified, integrating standardized correcting light sources into dental education and clinical practice is recommended. Furthermore, increasing exposure to real-world scenarios through clinical rotations could further improve students' shade-matching accuracy. By adopting these measures, dental educators and practitioners can contribute to better aesthetic outcomes and improved patient satisfaction with restorative treatments. Future research should explore the integration of advanced technologies, such as digital shade-matching systems, and their role in complementing traditional methods. A continued focus on evidence-based approaches will ensure that dental students are well-equipped to meet the demands of modern aesthetic dentistry.

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