ORIGINAL ARTICLE

AWARENESS OF TOOTH SHADE SELECTION PRINCIPLES AMONG DENTAL STUDENTS, INTERNS, GENRAL DENTISTS AND SPECIALISTS

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ABSTRACT

The purpose of this survey was to determine the knowledge and awareness about the principles of tooth shade selection among final year dental students, interns, general dentists and specialist prosthodontists / restorative dentists in Riyadh, Saudi Arabia. A self-administrative questionnaire especially designed for this study, was distributed among a conveniently selected sample. A total of 292 (response rate of 83%) questionnaires were completed. The results of this study showed that the specialists have a better awareness about the principles of tooth shade selection. There was a significant ($p<.05$) difference between the final year dental students, general dentists and specialists regarding the shade selection methods, timings, lighting conditions, surrounding factors, removal of stains, shade distribution charts and knowledge of the shade guide. On the other hand, no significant difference ($p>.05$) was found between the groups in relation to factors as using visual method, shade selection prior to procedure, position of the patients, seeking second opinion and patients' opinion during the shade selection. Further analyses indicated that specialist dentists have better understanding about the principles of tooth shade selection as compared to final year students, interns and general dentists.

Key Words: *Tooth shade selection, Shade matching, Knowledge, Dentists.*

INTRODUCTION

The success of any tooth-colored (anterior) restoration is directly related to the accuracy of chair side shade selection[1,2]. Patients are currently demanding esthetic replacement that must match their existing dentition, and are more concerned about the shade match of their restorations rather than quality of the restoration[1,3]. Consequently, chair side shade selection has become a very important step even for experienced dental practitioners, in the overall treatment of the patient[4]. Both visual and instrumental methods can be used for the shade selection. Both the methods carry merits and demerits over each other[4-12]. However, due to relative simplicity and low cost, the visual method is still the most commonly used method[5-7,13,14].

One of the main concerns in the visual method is its highly subjective nature; different individuals can have different shade perceptions for the same object[5-7,9,15]. Researchers have explained these differences on the basis of scientific principles and artistic qualities of human vision[10, 16]. Both the factors come into play whenever a shade selection is carried out. To ensure accuracy, various shade selection protocols have been devised for clinical setup, lighting, patient's setup, operator's position and use of a standard shade guide. A thorough knowledge of these protocols is important so that visual shade selections can be carried out with accuracy and repeatability[12,14,16-18]. However, these protocols are either not known or are not fully understood by majority of the dental community[13,15,19,20] including undergraduate students, interns and general dentists.

The aim of the present study was to determine the knowledge and practices of final year dental students, interns, general dentists and specialist practitioners about the principles and protocols of the shade selection.

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METHODOLOGY

The required information was collected through an anonymous questionnaire. The questionnaire was adopted from a previous similar study carried out in Glasgow DentalSchool[21], and modified to suit the requirements of the present study. The questionnaire basically consisted of two main parts; first part collected the demographic information, while in the second part questions were asked to assess the knowledge of the participants regarding scientific principles and artistic qualities involved in the tooth shade selection procedure.

The questionnaire was distributed among final year students, interns, general dentists and specialist dentists from both public and private sector hospitals and private clinics in Riyadh, Saudi Arabia between December 2010 to March 2011. A total of 350 questionnaires were personally distributed, out of which 292 (83%) were returned back.

The collected data were analyzed by Statistical Package for Social Sciences (SPSS) version #16. Chi square test was applied to generate the significance for each question asked. One way ANOVA, post-hoc Bonferoni test were used to determine any significant difference between responses of the various groups.

RESULTS

Three hundred and fifty questionnaires were distributed among the participants, and 292 questionnaires were completed giving a response rate of 83%. The respondents included 70 (24%) final year students, 111 (38%) interns, 61 (21%) general dentists and 50 (17%) specialist dentists.

The participants' answers related to the preference of shade selection method are presented in Table 1. Majority of the respondents faces difficulty "sometimes" or "always" during the shade selection process. Similarly, a Majority (88.3%) of the respondents "always" or "sometimes" uses visual method for shade selection. More than half (55.4%) of the participants select the shade at the end of the procedure. The second opinion and patients' opinion during the shade selection process were sought either always or sometimes by over 90% of the respondents.

Table 2 presents the participants' response to the questions about the lighting and effect of surrounding conditions during the shade selection process. Two-third of the participants (64.9%) "Never" use the dental unit light for the shade selection, and a majority (83.4%) "always" or "sometimes" uses natural light during the shade selection. More than half of the participants "never" consider the effect of surrounding objects like patients' clothing (59.8%) and presence of lipstick (57.4%) on the shade selection. Almost all (91.8 %) of the respondents were cleaning the teeth before the shade selection procedure.

The statistical comparison of the data pertaining to the participants' level of training and experience is presented in Table 3. The analysis shows that there were significant ($p<.05$) differences between the responses of the specialist group and all other groups. However, difference among the remaining three groups (general dentist, interns, and students) were not statistically significant ($p>.05$).

The results about the significance of letters and numbers on the shade guides demonstrate that the specialists were better informed of the meaning of numbers and letters on the shade tab as compared to the other groups (Figure 1).

DISCUSSION

The present study has provided information on knowledge about the principles of tooth shade selection in dental students, interns, general dentists and specialists. The present study has identified the areas where clinical training of the students and interns need to be enhanced in relation to tooth shade selection. Although similar trends were observed among the participant;, the final year students, interns and general dentists had different responses as compared to the specialists.

Tooth shade selection has been regarded as a challenging procedure even for the experienced clinicians. Like several previous studies, the present study also showed that majority of the participants faced difficulty during tooth shade[4-7,9]. The high level of difficulty faced can be attributed to the fact that routine shade selection is performed visually with the help of a dental shade guide; and the visual method has several known inaccuracies and deficiencies.[1,6,7,9,12].

TABLE 1: RESPONSE TO QUESTIONS ON PREFERENCE OFSHADE SELECTION METHOD

Q: Difficulty faced during shade selection?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	15.7%	74.3%	10%	0.001
Intern	7.2%	73%	19.8%	
Dentist	4.9%	88.5%	6.6%	
Specialist	2%	96%	2%	
Q: Use of visual method for shade selection?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	60.0%	21.4%	18.6%	0.18
Intern	61.3%	27.9%	10.8%	
Dentist	70.5%	24.6%	4.9%	
Specialist	72.0%	16.0%	12.0%	
Q: Use of instrumental method for shade selection?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	2.9%	12.9%	84.3%	0.03
Intern	1.8%	17.1%	81.1%	
Dentist	3.3%	8.2%	88.5%	
Specialist	.0%	32.7%	67.3%	
Q: Shade selection prior to any procedure?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	37.1%	51.4%	11.4%	0.16
Intern	51.8%	40.9%	7.3%	
Dentist	45.9%	36.1%	18.0%	
Specialist	52.0%	34.0%	14.0%	
Q: Shade selection at the end of the procedure?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	10%	47.1%	42.9%	0.00
Intern	6.3%	42.3%	51.4%	
Dentist	28.3%	36.7%	35.0%	
Specialist	28.0%	28.0%	44.0%	
Q: Second opinion during shade selection?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	38.6%	57.1%	4.3%	0.36
Intern	34.2%	60.4%	5.4%	
Dentist	23.0%	67.2%	9.8%	
Specialist	42.0%	52.0%	6.0%	
Q: Patients opinion during shade selection?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	52.9%	44.3%	2.9%	0.45
Intern	44.1%	46.8%	9.0%	
Dentist	36.1%	54.1%	9.8%	
Specialist	42.0%	50.0%	8.0%	

TABLE 2: RESPONSE TO QUESTIONS ON LIGHTING ANDSURROUNDING CONDITIONS

Q: Use of unit light during shade selection?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	5.7%	21.4%	72.9%	.02
Intern	6.3%	24.3%	69.4%	
Dentist	3.3%	43.3%	53.3%	
Specialist	14.0%	28.0%	58.0%	
Q: Use of natural light during shade selection?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	20%	44.3%	35.7%	.00
Intern	37.3%	48.2%	14.5%	
Dentist	39.3%	54.1%	6.6%	
Specialist	44.9%	49.0%	6.1%	
Q: Consideration of patient's clothing during shade selection?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	8.6%	24.3%	67.1%	.01
Intern	15.5%	23.6%	60.9%	
Dentist	8.2%	27.9%	63.9%	
Specialist	30.0%	28.0%	42.0%	
Q: Removal of lipstick before shade selection?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	7.1%	17.1%	75.7%	.00
Intern	9.1%	29.1%	61.8%	
Dentist	9.8%	42.6%	47.5%	
Specialist	48.0%	18.0%	34.0%	
Q: Cleaning the teeth before shade selection?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	34.3%	44.3%	21.4%	.00
Intern	55.9%	38.7%	5.4%	
Dentist	63.9%	32.8%	3.3%	
Specialist	70.0%	28.0%	2.0%	
Q: Having patients at eye level during shade selection?				
	Always	Sometimes	Never	*P*-value
Student	30.0%	60.0%	10.0%	.08
Intern	43.2%	45.0%	11.7%	
Dentist	48.3%	35.0%	16.7%	
Specialist	52.0%	40.0%	8.0%	
Q: Filling of Shade Distribution Chart?				
	Always	**Sometimes**	**Never**	***P*-value**
Student	20%	57.1%	22.9%	0.01
Intern	15.3%	53.2%	31.5%	
Dentist	19.7%	47.5%	32.8%	
Specialist	40.0%	46.0%	14.0%	

TABLE 3: RESULTS OF ONE WAY ANOVA-POST HOC-BONFERONI TEST

Participants	Compared to	P-value
Final Year students	Interns	0.15
	General dentists	0.06
	Specialist dentists	0.00
Interns	Final year students	0.15
	General dentists	1.00
	Specialist dentists	0.00
General dentists	Final year students	0.06
	Interns	1.00
	Specialist dentists	0.00
Specialist dentists	Final year students	0.00
	Interns	0.00
	General dentists	0.00

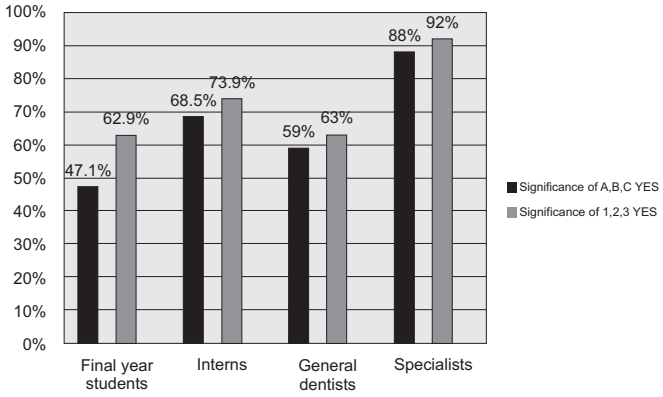

Fig. 1: Significance of the letters A, B, C, D and numbers 1, 2, 3 on Shade Guide tab.

The deficiencies can be controlled by utilizing the instrumental method, which provides an objective and scientifically accurate shade reading[4,6,7,9,12,20]. However, high-tech gadgets such as colorimeters and spectrophotometers are expensive and difficult to operate in the clinical setting; the reasons that the visual method remains the most commonly used for shade selection worldwide[6,7,12,13].

Teeth tend to dry out towards the end of a dental procedure or when rubber dam is applied. Therefore, it has been recommended to select shades prior to tooth preparation[2,10,22]. This is especially true for porcelain fused to metal restorations[10]. However, due to the requirement of preparation of a tooth colored die for the newer ceramic systems, shade has to be selected both before and after tooth preparation if all porcelain restorations are being planned[10]. In our study, a non-significant difference was found between the groups for the shade selection prior to the procedure and a significant difference was found for the shade selection at the end of the procedure. These results may have been influenced by the choice of the final restoration by the participants or may have been just a chance occurrence. Therefore, it needs to be investigated further.

Northern daylight is considered a standard for judging good lighting[23]. However, in everyday dental practice, one cannot rely on sunlight for shade selection, hence color-corrected fluorescent lights with a CRI of 90 or above are recommended for dental operatories[24,25]. The use of incandescent bulbs and dental unit lights is not recommended because of greater amount of yellow light emittence[10]. Majority of the participants seemed to understand the importance of good lighting. The knowledge of the final year students and interns was also satisfactory in this regard.

Colored structures or surfaces around the teeth, such as adjacent teeth, gingiva, lips, face skin, clothing of the patient and operatory walls, can influence the perceived tooth color possibly through the phenomenon of contrast[2,10,26-29]. Therefore, it has been recommended to ask the female patients to remove any lipstick before selecting a tooth shade. The specialists in the present study were asking their females patients to do this more frequently than the other participants.

Teeth should be cleaned of all the debris and stains before shade selection is carried out[2,10]. A significant difference was found in answers of the participants regarding cleaning of teeth prior to shade selection. The percentage of the students who will consider this step important was lower as compared to the other participants. The difference could be related to the fact that students usually focus on completing their clinical requirements and do not pay complete attention to minute details of technical nature. Another reason can be the completion of operative treatment and prophylaxis just before the patient reports to prosthodontic department for replacement or restoration.

The central field of vision is regarded as most color-sensitive and color-perceptive because there is a large collection of color-sensitive cones in the center of the retina, surrounded by rods which can perceive only

brightness. For this reason, researchers[10,30] have recommended to view the patient at the eye level so that central part of the retina is used in shade selection. In the present study, students mostly considered this fact only sometimes, which points to their lack of knowledge about importance of viewing the patient at eye level.

Wagenaar et al[31] have stated that whenever an object such as a tooth is viewed for longer than 10 seconds, the color vision capability of the eyes decreases rapidly and the perceived color does not remain stable. In order to overcome any inaccuracies arising from eye fatigue, it has been recommended to get a second opinion including opinion of the patient whenever shade selection is being made[10,26,31,32]. Most of the participants in the current study were aware of the importance of the second opinion and patients own opinion during the shade selection process.

Teeth are known to possess a gradation of color from the cervical to the incisal area[10]. According to Schwabacher et al[34] and O'Brien et al[35], the cervical color is modified by scattered light from the gingiva whereas the incisal color is most often translucent and is affected by its background. Therefore, shade should be selected separately for different regions of the tooth surface and recorded on a shade distribution chart. In this way, it is possible to copy individual tooth characteristics such as hairline fractures, areas of hypocalcification and proximal discolorations into the fabricated restorations. In the present study, filling of the shade distribution chart was not a common practice among the participants. A significant difference (p=.01) in response to filling of shade distribution chart was found among the groups. Lack of enough time for the filling of the chart at the end of the clinical sessions for the students and interns can be one of the possible reasons. The patients' workload on the dentists can be a reason for the dentists not filling the shade distribution chart.

The Vitapan Classical shade guide is regarded as the most commonly used and known among the shade guides in dentistry; many other ceramic systems have been based on the shades of this shade guide[2,10,11,26,36,37]. Hence it was referred to in this study to judge whether or not the participants had any idea about the significance of the letters ABCD and number 1234 represented in different shade tabs in this shade guide. This shade guide has 4 basic hue groups: "A" for reddish-brown shades, "B" for reddish-yellowish shades, "C" for grayish shades and "D" for reddish-gray shades. Each hue group has further 3 or 4 shade tabs with varying levels of chroma (intensity of the basic color). The present study found that majority of the specialists had the knowledge about both the letters and numbers on the shade tabs as compared to the rest of the participants. This could be due to inadequate time devoted for teaching the shade selection process in the undergraduate studies.

The findings of the present study clearly suggest that better clinical training and work experience of the specialists enable them to understand the significance and techniques of the shade selection process. The findings also indicates a need for devoting more time and training for the shade selection process in undergraduate students, who will become interns and dentists and will not overlook important aspects of shade selection in their routine clinical work. As regards the training the dentists, short courses about the shade selection process can be conducted, helping them to overcome their deficiencies and update their knowledge in this area.

CONCLUSION

It can be concluded that the specialist dentists had comparatively better understanding and knowledge about the principles of tooth shade selection than dental students, interns and general dentists.

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