

TOOTH SHADE PERCEPTIBILITY OF UNDERGRADUATE STUDENTS, HOUSE SURGEONS AND POSTGRADUATE RESIDENTS

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ABSTRACT

The objective of the study was to assess the shade perception abilities of undergraduate students in comparison to house surgeons and postgraduate residents on the basis of their clinical experience and technical education and training received on tooth shade selection. For this, a cross-sectional comparative study was carried out on a sample of 80 subjects, equally divided into two groups: Group I included undergraduate students and Group II included graduates doing house job or postgraduate training. All subjects were randomly divided into two further groups: the ET-group, which received proper education and training in shade selection; the non-ET-group, which did not receive such education. A shade selection exercise was devised using two Vitapan Classical shade guides. The number of correct matches established the participant's score, which was used in data analysis through the Chi-square test. Only 10 participants scored the maximum of 4 points including 2 students of Group I (2.5%) and 8 postgraduate residents of Group II (10.0%). All of them belonged to the ET-group, which was a significant finding ($P < 0.05$). It was concluded that clinical experience and technical education and training received enables the observer to perform better at shade selection.

Key words: Shade selection, Vitapan Classical shade guide, experience, education

INTRODUCTION

Tooth shade selection remains a testing procedure, even for the experienced clinicians.^{1,2} This is mainly because it is most commonly performed with the naked eye, which introduces certain inaccuracies related to physiological and psychological variables affecting the capability of the eyes to percept tooth shades.³⁻⁶ Since patients are becoming more demanding towards the placement of esthetic tooth-colored restorations, it is all the more important for dentists to understand the process of tooth shade selection and all its related factors. This includes knowledge of one's shade selection ability in addition to the influencing effects of the light source being used, operator

fatigue, eye fatigue, operator positioning and patient's makeup.⁷⁻⁹

Shade selection ability, known as shade perceptibility, demonstrated by dentists, their assistants and laboratory technicians plays the decisive role in the outcome of a tooth-colored restoration such as a crown or a bridge.¹⁰⁻¹² Although accurate tooth shade perceptibility is a learned ability,¹³ some researchers have claimed that clinical experience or the amount of time spent in dental practice is not important during shade matching.^{8,14} However, it was suggested by Sorensen and Torres¹⁵ that proper education and training is important to achieve success in routine shade selections. Also, it has been shown that the use of one shade

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guide rather than the other can also influence the shade perceptibility of the operator.^{16,17}

Keeping various factors in the foreground, the present study was planned to investigate the tooth shade perceptibility demonstrated by undergraduate students, house surgeons and postgraduate residents in relation to their clinical experience and also in relation to technical education and training received on shade selection irrespective of the observer's experience.

This information would provide a means of understanding the role of clinical experience alone on the shade selection ability of the observers. Furthermore, the study would provide useful information about the role of proper education and training on the shade perceptibility of the observers irrespective of their clinical experience.

Hypotheses

- Clinical experience of house surgeons and postgraduate residents should enable them to perform better at shade selection as compared to the relatively inexperienced undergraduate students (Experience hypothesis)
- Educating and training some of the participants on the technique of shade selection should enable them to perform better than those who do not receive such education/training, regardless of their clinical experience (Training hypothesis)

Objective of the study

To determine the influence of clinical experience and shade selection education/training on shade perceptibility of undergraduate students, house surgeons and postgraduate residents.

METHODOLOGY

This was a cross-sectional comparative study carried out in the Department of Prosthodontics at Armed Forces Institute of Dentistry (AFID), Rawalpindi through August 2009. Convenience non-probability sampling technique was used. The study sample of 80 included both male and female participants of 3rd and 4th year BDS classes of Army Medical College/NUST, house surgeons and postgraduate residents (in 3rd year

of training). The exclusion criteria was limited to omit only those who demonstrated color blindness (on the basis of Ishihara Color Charts) or presented with a history of cataract or eye surgery for any reason.

Participants were divided into two main groups: Group I included 40 undergraduate students whereas Group II included a total of 40 house surgeons and postgraduate residents. Group II was further subdivided into Subgroup IIa for the 20 house surgeons and Subgroup IIb for the 20 postgraduate residents (PGRs). In order to judge the influence of technical education and training, half of the participants in each of these groups, selected randomly, were given proper education and training in using the shade guide (the ET-group) while the remaining half subjects were not given any formal training in this regard (the non-ET-group).

All participants were asked to complete a shade selection exercise specially devised for the study. For this, two Vitapan Classical shade guides (manufactured by VITA Zahnfabrik, Bad Sackingen, Germany) were used. One of the shade guides was taken as the color standard (labeled as the main shade guide) while sets of 4 shade tabs each from the second shade guide were selected to be matched with the main shade guide. All tab numbers of the main shade guide were masked with a white tape, and numbered from 1 to 16, and arranged in order of increasing values as suggested by the manufacturer. The 4 shade tabs to be matched were also masked with a white tape, and numbered in English language letters (i.e. A, B, C and D). Participants were required to write down the number of shade tab of the main shade guide against the lettered shade tabs from the second shade guide on the performa.

In order to standardize the results of the study, a simple shade selection apparatus was devised, which consisted of a gray blue cloth measuring 2x2 feet. The main shade guide was placed on the cloth, along with the 4 tabs of the second shade guide to be matched. To overcome any bias and to ensure proper execution of the study, the primary author devised 25 different sets of 4 shade tabs each beforehand to be matched during the entire course of the study.

A standardized lighting environment was also created in a small room illuminated by tube lights (set of 4 tube lights; TLD 18W/54; Phillips Co., Australia) in

the ceiling about 8 feet high. There were no windows in the room, so no natural daylight came into the room from any direction. For shade matching purpose, an artificial light (Philips Cool Daylight Energy Saver Lamp; 23W; 6500K; 50-60Hz; manufactured by Philips Co. China) was used that is said to simulate natural daylight. This light source was kept about 2 feet away from the shade selection apparatus at all times.

All participants were given 5 minutes to complete the shade selection exercise. Participants were asked to rest the eyes immediately before start of the procedure, and after every 20 seconds during the entire procedure. This was done by asking the participants to focus on the gray-blue cloth for 5 seconds at a time.

After filling out the personal details, the semi-filled performa was handed over to the participant to complete the shade selection exercise, after which the participant left the room. Then the number of shade tab set used was recorded on the performa, which was later on kept in a standard file cover face downwards. This ensured that the participant was not aware of the shade tab set used for him/her. Later on, the final score (minimum zero and maximum 4) was established by calculating the number of correct matches done.

Data analysis was performed by using Statistical Package for Social Sciences (SPSS) version 17. Shade perceptibility was determined on the basis of the final score obtained, which was correlated to clinical experience of the participants and also to shade selection education and training received. For this, the Chi-square test was applied at 95% confidence interval ($P < 0.05$ was considered significant).

RESULTS

The eighty participants ranged in age from 21 years upto 41 years, with a mean age of 24.65 years and standard deviation of 4.80. The sample was divided into two main groups: Group I included 21 (52.5%) students of 3rd year and 19 (47.5%) students of 4th year BDS classes; Group II comprised of 20 (50.0%) house surgeons and 20 (50.0%) PGRs working in various clinical departments. Subjects of Group II were further divided into two equal subgroups: Subgroup IIa for the house surgeons; Subgroup IIb for the PGRs, including 9 (22.5%) from Prosthodontics, 6 (15.0%) from Operative

Dentistry, 3 (7.5%) from Oral and Maxillofacial Surgery and 2 (5.0%) from Orthodontics.

Table 1 represents the final scores obtained by the study subjects in relation to their clinical experience. The maximum score of 4 was obtained by 10 (12.5%) subjects only, including 2 (2.5%) subjects from Group I (both from 3rd year BDS class) and 8 (10.0%) subjects from Group II (PGRs from Prosthodontics and Operative Dentistry). The mean score obtained by the study subjects was 1.96 on a scale from zero to 4. In Group I, the overall mean score was 1.72: among 3rd year students it was 1.86 and for final year students it was 1.58. In Group II, as a whole, the mean score remained 2.20. In Subgroup IIa (house surgeons), the mean score was 1.50. In Subgroup IIb (PGRs), the overall mean score was 2.90. In this subgroup, the mean scores obtained were as follows: 3.22 by PGRs from Prosthodontics, 2.67 by PGRs from both Operative Dentistry and Oral and Maxillofacial Surgery Departments, and 2.50 by PGRs from Orthodontics.

Chi-square test was applied to determine the significance of final score obtained with clinical experience by the subjects. When compared among Groups I and II, a non-significant association was returned (P value 0.073). However, when the final scores were correlated among Group I and Subgroups IIa and IIb, a highly significant association was established (P value 0.001).

Table 2 represents the final scores obtained by participants on the basis of technical education and training received. Very interestingly, no subject of the ET-group scored zero while no subject of the non-ET-group scored the maximum of 4 points. The mean score obtained by subjects of the ET-group was 2.77 as compared to 1.15 obtained by subjects of the non-ET-group. Ten (12.5%) study subjects who scored the maximum of 4 points all belonged to the ET-group: these included 2 (9.5%) students of 3rd year BDS class, 6 (66.7%) PGRs from Prosthodontics and 2 (33.3%) PGRs from Operative Dentistry department.

Chi-square test was applied to determine the significance of final score obtained by the subjects in relation to technical education and training received, which returned a very highly significant association between these variables (P value < 0.001).

TABLE 1: FINAL SCORES OBTAINED BY STUDY SUBJECTS IN RELATION TO CLINICAL EXPERIENCE

Final Score Obtained	Grouping of Subjects				Total	%age
	Group I	%age	Group II	%age		
0	6	7.5%	6	7.5%	12	15.0%
1	9	11.3%	7	8.8%	16	20.0%
2	17	21.3%	8	10.0%	25	31.3%
3	6	7.5%	11	13.8%	17	21.3%
4	2	2.5%	8	10.0%	10	12.5%
Total	40	50.0%	40	50.0%	80	100%

TABLE 2: FINAL SCORES OBTAINED BY STUDY SUBJECTS IN RELATION TO TECHNICAL EDUCATION AND TRAINING RECEIVED

Final Score Obtained	Grouping of Subjects				Total	%age
	ET-group	%age	Non-ET-group	%age		
0	0	0.0%	12	15.0%	12	15.0%
1	1	1.3%	15	18.8%	16	20.0%
2	17	21.3%	8	10.0%	25	31.3%
3	12	15.0%	5	6.3%	17	21.3%
4	10	12.5%	0	0.0%	10	12.5%
Total	40	50.0%	40	50.0%	80	100%

DISCUSSION

From the onset of the research process, it was felt that very little work had been reported in literature on the topic under consideration. To this end, no local study was cited in a thorough search of various databases including PakMedinet and various local dental journal websites.

Study participants were divided into two main groups on the basis of their graduation status. Hence, all undergraduate students were placed in Group I while all graduates (house surgeons and PGRs) were placed in Group II. It was assumed that subjects in Group I did not have any clinical experience whereas those in Group II had varying degrees of experience. For instance, house officers were assumed to have at least some basic experience while PGRs in third year of training were assumed to have a definite working experience. PGRs and house officers were placed in the same group in order to simplify the data analysis. Furthermore, at the time of the study, the minimum required number of house surgeons and PGRs, who

met the inclusion criteria, was not available at the institute.

The experience hypothesis was partially proved true. This is because when the final score was correlated among Groups I and II, a non-significant association was returned. However, when final score was correlated among Group I and Subgroups IIa and IIb, a highly significant association was returned. This difference in the significance may have been due to the statistical analysis itself as it was based on the final scores obtained by the participants or it may have been due to the relatively poor performance of the house officers in Group II. This was revealed by their mean scores: for students it was 1.72 as compared to 1.50 for house surgeons and 2.90 for PGRs.

Very interestingly, PGRs from different clinical departments differed in their mean scores as well, which was not expected at the start of the study. For instance, the mean score of PGRs from Prosthodontics (3.22) was higher than the mean score of PGRs from all other departments. This also points towards the influ-

ence of clinical experience on the shade selection ability of the observer. This same effect of specialist training was highlighted by Hammad¹⁶ in his work on intrarater repeatability of shade selections, in which the prosthodontists were found to select more shades accurately and reliably as compared to the general practitioners with the help of the Vitapan Classical shade guide which was used in the present study.

However, in their work on shade selection through the use of a light-correcting device, Curd et al¹⁴ reported clinical experience not to be a factor in shade selection. This finding could be related to their study design since it was confined to undergraduate students only, not taking into consideration the performance of more experienced dental surgeons.

The training hypothesis was proved true, in that educating some of the participants about the technique of shade selection enabled them to perform better than those who did not receive such education regardless of their clinical experience. To test this hypothesis, the study sample was randomly divided into 2 equal groups: ET-group and non-ET-group. Both groups comprised of half of the subjects in each of the main study groups. Subjects in the ET-group were given a detailed overview of the shade selection process with the Vitapan Classical shade guide followed by a practical demonstration before they were allowed to complete the shade selection exercise. Subjects in the non-ET-group were not given any formal training or education on the use of the shade guide.

Very interestingly, subjects in the ET-group, whether students, house surgeons or PGRs performed significantly better than the subjects of the non-ET-group as revealed by their final scores and mean scores obtained. This finding suggested that with proper training and education, even the inexperienced undergraduate students could perform better than the relatively experienced house surgeons.

Education in color science and relevant clinical experience both have been suggested to be the most significant factors influencing a person's ability to select tooth shades accurately.^{18,19} Ironically, the dental curriculum devised by Pakistan Medical and Dental Council, Islamabad and University of Health Sciences, Lahore does not mention anything about teaching of

color science to the undergraduate students nor the course outline mentions any specific topics related to shade selection on the clinical side. This is an alarming situation because the lack of such basic training makes the fresh graduates vulnerable towards committing mistakes in their clinical careers whenever they have to face a shade selection procedure. Internationally these procedures are taught during the final year studies and ample amount of time is spent in rendering such education to the students.²⁰ The same needs to be implemented in Pakistan as well.

In the shade selection exercise devised, shade tabs from two Vitapan Classical shade guides were used. No live patient contact was established. This was done to determine the very basic tooth shade perceptibility demonstrated by the participants irrespective of their knowledge or training. The same was reported by Jaju et al¹⁹ in their research work on shade matching ability of dental students. They found that when shade tabs were used, students from 1st year to 4th year performed similarly. However, when live patient cases were matched, the more complex shade selections were done more accurately by the senior students only. This is another proof of the results of the present study that shade selection ability increases as the level of experience and shade selection education/training increases.

Different sets of 4 shade tabs each were formulated at the start of the study by the primary author, utilizing one tab each from the four main hue groups of the shade guide (e.g. A1, B2, C3, D4). This type of shade tab grouping may have resulted in some error while matching the shades because some shades are known to produce a more reliable match than the other shades of the shade guide. For instance, the Vita C shades are the ones least likely to be matched correctly.^{14,21} This aspect was overlooked during the present study since all shade tab groups had one tab from the Vita C hue group. Further research is needed to determine the influence of different shades on the shade perceptibility of the observer by using shade tab grouping from within the same hue group of the shade guide.

CONCLUSION

Within the limitations of the study, the following conclusions can be drawn:

- 1 Clinical experience alone can enable the observers to perform better at tooth shade selection as compared to the relatively inexperienced observers.
- 2 Education and training received on tooth shade selection can enable the inexperienced observers to perform better than even the relatively experienced observers who do not receive such education/training.

REFERENCES

- 1 Yilmaz B, Karaagaciloglu L. Comparison of visual shade determination and an intra-oral dental colourimeter. *J Oral Rehabil.* 2008;35:789-94.
- 2 Klemetti E, Matela A-M, Haag P, Kononen M. Shade selection performed by novice dental professionals and colorimeter. *J Oral Rehabil.* 2006;33:31-35.
- 3 Ahmad S, Habib SR, Azad AA. Scientific and artistic principles of tooth shade selection. A review. *Pak Oral Dent J.* 2011;31: 222-26.
- 4 Okubo SR, Kanawati A, Richards MW, Childress S. Evaluation of visual and instrument shade matching. *J Prosthet Dent.* 1998;80:642-48.
- 5 Hugo B, Witzel T, Klaiber B. Comparison of in vivo visual and computer-aided tooth shade determination. *Clin Oral Invest.* 2005;9:244-50.
- 6 Joiner A. Tooth colour: a review of the literature. *J Dent.* 2004;32:3-12.
- 7 American Dental Association. Dental shade guides. *J Am Dent Assoc.* 2002;133:366-67.
- 8 Barna GJ, Taylor JW, King GE, Pelleu GB, Jr. The influence of selected light intensities on color perception within the color range of natural teeth. *J Prosthet Dent.* 1981;46: 450-53.
- 9 Alvin G. Description of color, color-replication process, and esthetics. In: Rosenstiel SF, Land MF, Fujimoto J, eds. *Contemporary fixed prosthodontics*. 4th ed. New Dehli: Elsevier 2007:709-39.
- 10 Sim CP, Yap AU, Teo J. Color perception among different dental personnel. *Oper Dent.* 2001;26:435-39.
- 11 Wagenaar R, Smit R. Shade taking: factoring out human error. *Dental Laboratory.* 2004;29:26-29.
- 12 Chadwick RG. Factors influencing dental students to attend for eye examination. *J Oral Rehabil.* 1999;26:72-74.
- 13 Shulman JD, Maupome G, Clark DC, Levy SM. Perceptions of desirable tooth color among parents, dentists and children. *J Am Dent Assoc.* 2004;135:595-604.
- 14 Curd FM, Jasinevicius TR, Graves A, Cox V, Sadan A. Comparison of the shade matching ability of dental students using two light sources. *J Prosthet Dent.* 2006;96:391-96.
- 15 Sorensen JA, Torres TJ. Improved color matching of metal-ceramic restorations. Part I: a systematic method for shade determination. *J Prosthet Dent.* 1987;58:133-39.
- 16 Hammad IA. Intrarater repeatability of shade selections with two shade guides. *J Prosthet Dent.* 2003;89:50-53.
- 17 Hassel AJ, Koke U, Schmitter M, Beck J, Rammelsberg P. Clinical effect of different shade guide systems on the tooth shades of ceramic-veneered restorations. *Int J Prosthodont.* 2005;18:422-26.
- 18 Winkler S, Boberick K, Weitz K, Datikashvili I, Wood R. Shade matching by dental students. *J Oral Implantology.* 2006;32: 256-58.
- 19 Jaju RA, Nagai S, Karimbux N, DaSilva JD. Evaluating tooth color matching ability of dental students. *J Dent Educ.* 2010;74:1002-10.
- 20 Paravina RD, O'Neill PN, Swift EJ, Jr, Nathanson D, Goodacre CJ. Teaching of color in predoctoral and postdoctoral dental education in 2009. *J Dent.* 2010;38 Suppl 2:e34-40.
- 21 Lagouvardos PE, Diamanti H, Polyzois G. Effect of individual shades on reliability and validity of observers in colour matching. *Eur J Prosthodont Restor Dent.* 2004;12:51-56.