

ORIGINAL ARTICLE

A Survey of the Practice of Shade Selection Protocol among Dental Practitioners

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ABSTRACT

Introduction: Shade selection is a crucial aspect of restorative dentistry, as it involves matching the colour of dental restoration materials to the natural colour of a patient's teeth. This study aimed to determine the knowledge and practices of dental practitioners about the principles and protocols of shade selection. **Methods:** This survey was a cross-sectional study. The modified questionnaires, comprised of three sections, were distributed to 134 participants, including dental students, general practitioners, and dental specialists, using Google Forms. The data analysis was performed using the IBM Statistical Package for Social Sciences (SPSS) V28.0. **Results:** The study showed that 89.6% of participants sometimes faced difficulty selecting shade, with the conventional method being the most commonly used (70.9%). The participants would always perform shade matching before the procedures (49.3%) and after procedures (57.5%), and nearly half sometimes verify the selected shade with colleagues (47.8%) or ask for the patients' opinion (43.3%). 48% of the participants primarily looked at the tooth for less than 5 seconds and selected the best shade. Lighting and the surrounding environment during the shade selection process were also considered, with the majority using natural daylight (79.1%) and always advising patients to remove bright lipstick (54.5%) respectively. **Conclusion:** The findings of this study indicate that participants had limited knowledge of shade selection protocols. Hence, this study highlights the need for increased attention to shade selection protocols among dental professionals. By improving dental education and establishing standard practices, they can ensure their patients receive the highest quality restorative dental care.

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INTRODUCTION

Shade determination is one of the crucial procedures in aesthetic restorative dentistry, which provides patients with highly esthetic direct and indirect restorations, ensuring quality treatment outcomes (1, 2). Matching the colour of dental restorative materials to the natural colour of a patient's teeth is always very challenging. Ideally, the restorations or prostheses should be constructed to mimic the patient's existing tooth shade and blend harmoniously with the existing dentition. The overall success of aesthetic restorative treatment relies on the dentist's ability to match the tooth shades precisely,

communicate with the technician, and reproduce the shade of the restorations (2).

The colour of natural teeth and shade guides can be analysed using two methods: visual comparison and instrumental assessment (3, 4). The visual method is the most commonly used conventional dental shade guide approach (5). The most popular shade guides are - VITA Classical (Vita Zahnfabrik, Bad Säckingen, Germany) (6), Chroma scope, and Vitapan 3D-Master shade guide (7). Dentists frequently use it to measure tooth colour due to its simplicity and cost-effectiveness (5). Its drawbacks are that it is unreliable and inconsistent in providing accurate and repeatable shade selection (8). Visual colour comparison is very subjective and is influenced by the dentist's perception of the colour, which depends on illumination, the surrounding environment and the operator (4, 6, 8). Another reason for inaccuracy in

visual shade matching is the limited number of shades available in the classical shade guide (9).

To date, shade-matching technologies have been developed to increase the success of colour matching and, ultimately, to improve the efficiency of esthetic restorative work. Tooth shade can be taken using electronic aids such as spectrophotometry, colourimeter, digital camera and RGB device (4,10). Instrumental shade assessment helps to overcome the drawbacks of the conventional method by improving the reliability and accuracy of shade matching (11). A colourimeter device measures colour (hue, chroma and value) as the human eye perceives (12). The dental spectrophotometer is a more complex instrument for colour matching in dentistry, providing the highest overall accuracy and precision (13, 14). It measures the light energy reflected from an object at 1–25 nm intervals along the visible spectrum (15). It analyses the principal components of a series of spectra and translates the spectrophotometric measures into helpful information for dental professionals.

Using visual comparison or a more advanced digital aid, the tooth shade selection is essential for correctly reproducing the shade into the new prostheses or restorations (16). Achieving a close shade matching of an artificial restoration with the natural dentition could be a complicated process as it requires a complete understanding of the colour, related properties of the restorative materials and clear communication with the technicians. Hence, a dentist's knowledge of shade selection protocol is vital to produce esthetic outcomes. This present study aimed to determine the knowledge and practices of dental practitioners about the principles and protocols of shade selection using an adapted questionnaire (17).

MATERIALS & METHODS

The UKM Research Ethics Committee approved this study. The questionnaire was adapted from a modified version of a previously conducted research at the College of Dentistry, King Saud University, in December 2012 (17), as similar studies or available questionnaires were limited. The questionnaire consisted of three sections:

1. The demographic information.
2. Questions regarding the dental practitioners' preference for shade selection.
3. Questions on the lighting and surrounding environment during the shade selection.

The participants will have to answer 14 questions about their standard practice of shade selection, divided into three categories: 'always', 'sometimes', and 'never'.

The list of participants was obtained from the Malaysian Dental Student Association (MDSA), the Dean's Office of Dental Faculty in Malaysia, and private

practitioners from the Malaysia Dental Council (MDC). The participants were approached through their official email and invited to participate in the study. The invitation letter, participants' information sheets, and consent forms were emailed. The questionnaires comprised three sections and were distributed to the consented participants using Google Forms. They were also distributed using a convenience sampling method.

The survey was conducted from October 2022 to December 2022. A total of 134 participants responded to the study. Among them were undergraduate dental students, postgraduate restorative dental students, general practitioners, and restorative specialists. All collected data were analysed using IBM SPSS Statistics 28.0. A chi-square test was performed. The significance level was set at $p < 0.05$ for each question asked.

The sample size of 134 participants was determined based on the total number of participants who provided consent and completed the survey. Although a formal sample size calculation was not initially performed, using Cochran's formula for cross-sectional studies, the minimum required sample size for a 95% confidence level and 5% margin of error would be approximately 169 for an estimated population size of 300. The obtained sample of 134 participants thus provides acceptable precision for exploratory analysis.

ETHICAL CLEARANCE

This study was approved by the Research Ethics Committee, The National University of Malaysia No. UKM PPI/111/8/JEP-2022-520.

RESULTS

The first part of the questionnaire was regarding participants' demographic information (Table 1). A total of 134 participants from the list Malaysian Dental Student Association (MDSA), the Dean's Office of Dental Faculty in Malaysia, and private practitioners from the Malaysia Dental Council (MDC) completed the online questionnaires. 96 (71.6%) participants were female and 38 (28.4%) were male. More than half of the participants (58.2%) were Year 4 and Year 5 undergraduate dental students, followed by general dental practitioners (35.1%), postgraduate dental students (6%) and the least was restorative and prosthodontics specialists (0.7%). When asked about their experience with teeth restorations, 49 (36.6%) participants completed more than ten restorations, while 85 (63.4%) completed less than ten restorations in a month.

The second part of the study asked about the participants' preference for shade selection method (Figure 1). The majority of the participants (89.6%) reported they sometimes faced difficulty, and 8.2% of them always faced difficulty during the shade selection process.

Table 1: Participants' demographic information

Demographics	N	%
Sex		
Male	38	28.4
Female	96	71.6
Qualification		
Year 4 & Year 5 Undergraduate Dental Student	78	58.2
General dental practitioners	47	35.1
Postgraduate dental student	8	6
Restorative and prosthodontics specialists	1	0.7
Experience		
Completed > 10 restorations in a month	49	36.6
Completed < than 10 restorations in a month	85	63.4

The conventional method (e.g. VITA classical A1-D4® shade guide) was the most commonly used method for shade selection, with 70.9% of the participants using it, compared to just 0.7% digital methods. The conventional method showed statistical significance, which indicates that the results were consistent and reliable enough to be considered valid in clinical application. Of most participants, 49.3% reported they always perform shade matching before restorative procedures. Nearly half of the participants (47.8%) sometimes verified the selected tooth shade with their colleagues, and 43.3% sometimes asked for the patient's opinion during the shade selection process with statistical significance. When asked how they usually choose the tooth shade, nearly half of the participants, 48.5%, selected it by looking at the tooth for less than 5 seconds and selecting the best shade.

The third part of this study asked the participants about

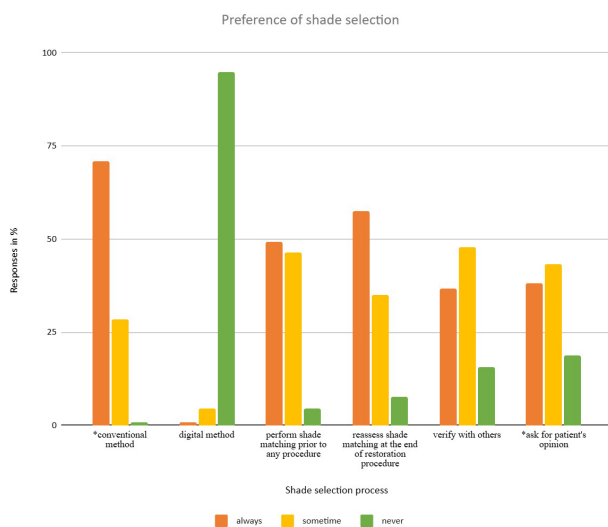


Figure 1: The participant's response to questions related to their preference for the shade selection method.

the effect of lighting and the surrounding environment on shade selection (Figure 2). Most participants (79.1%) used natural daylight, while only a small percentage, 0.7%, used the light of the dental unit. Around 20 % of the participants always considered the patient's clothing colour, and over 50% always advised the patient to remove their bright lipstick before shade selection. Around 34% of the participants constantly cleaned the patient's teeth (scale, pumice, and polish) before shade selection. In comparison, 38.8% of the participants constantly adjusted the patient's position at eye level during shade selection. The last question asked about the overall patient's satisfaction with the selected tooth shade. Most participants (88.8%) scored more than 70% of their patients were satisfied with the clinician's preferred shade.

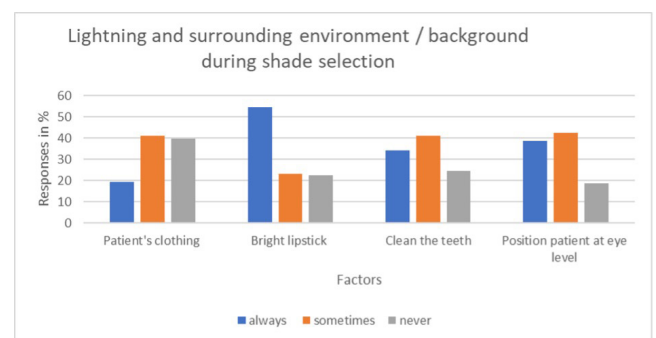


Figure 2: The participants' response to the questions about the lighting and effect of surrounding conditions during the shade selection process.

DISCUSSION

Shade selection is an essential part of aesthetic restorative dentistry, as it involves matching the colour of the dental restoration material to the natural colour of the patient's teeth. However, shade selection methods can vary widely among dentists. Thus, it is essential to evaluate dental professionals' current knowledge and practices to ensure a predictable esthetic restorative outcome of the final direct or indirect restorations. Hence, this study investigated the knowledge and practice of shade selection protocol among dentists. The results of the study indicated that there was a significant variation in shade selection protocol employed among dental practitioners.

Choosing a correct and high-quality shade matching has been regarded as a complicated process, even for experienced dentists. The results from the study showed that most participants reported they sometimes faced difficulty during the shade selection, which was similar to the findings of multiple other studies (17, 18). Hence, Ellakany et al. in the study stressed the need for improving continuing dental education and training on shade selection protocols for dentists (19). Dentists should receive sufficient formal training in shade selection from dental schools during their undergraduate training. Continuous education courses

should also stress the importance of shade selection and update the various advanced tools available. In addition, dental professionals should work to establish standard protocols for shade selection based on best practices and research.

Several techniques are available for shade selection, each with advantages and limitations. Traditional visual shade matching is still the most widely used method due to its simplicity and accessibility. However, this method has various flaws due to inconsistencies and is subjective (20). Digital matching methods like spectrophotometry would provide more precise and objective results. These advanced tools can help overcome the human eyes' shortcomings.

Results from Paul et al. showed that spectrophotometry dental shade analysis was 33% more accurate than visual shade matching (21). Similar to the study conducted by Habib et al., 70.9% of the participants always used the conventional method with the Vita shade guide, and only a few utilised the digital instrument for shade taking (17). It is worth considering shade determination by instrumental means, which have the potential to improve accuracy and reliability, overcoming the flaws of the human eye (8). Based on the available techniques, dentists should adopt a combination of methods to achieve the patients' best possible aesthetic outcomes. Dentists can begin with visual shade matching for routine cases but should consider digital or spectrophotometric systems for more complex and challenging restorative cases (3).

Most participants (57.5%) reported always performing shade matching before procedures and reassessing shade matching at the end of the restoration, which showed their commitment to achieving the best possible positive treatment outcomes. These findings corresponded to an earlier study by Habib et al., where (46%) of respondents performed shade matching before any procedure (17). Dentists were encouraged to assess the shade selection before rubber dam isolation as the tooth tends to be temporarily dehydrated after a rubber dam is applied or near the end of the restorative procedures (22).

Shade comparison should be made with 2-3 seconds short glances with rest periods. Prolonged stares of more than 10 seconds will cause eye fatigue, reduce colour vision and compromise visual perception (23). Some studies suggested using a neutral grey colour for resting the eyes as it has no complementary colour; hence, it is the ideal background (23-25). It has also been advised that a second opinion from the patient should be obtained whenever shade selection is performed to avoid any errors caused by eye fatigue (7, 18). It is noted that nearly half of the participants sometimes verified the selected tooth shade with colleagues, and 43.3% sometimes asked for the patient's opinions. This was similar to the study by Habib. et al., most participants

sought second opinions during the shade selection process, always or sometimes (17).

Choosing a shade can be influenced by the lighting conditions (26). Ideally, shade matching should be executed in natural daylight settings (27). Natural sunlight is the best light source since its spectrum is closest to white light. Most participants (79%) in this study used natural daylight in daily dental practice, almost similar to the survey by Raj et al. (74%). (18). However, dentists should not rely on natural daylight, as the quality of light depends on factors such as the time of day, location, and weather. Thus, colour-corrected fluorescent lights with a colour rendering index (CRI) of over 90 are advised for dental settings (28). Incandescent bulbs and dental operative light units should not be used in shade-taking as they produce yellow light (29).

The colour of the surrounding tooth structure, such as the gum, lips, skin tone, patient's clothes, and lighting conditions, may affect the human eye's perception of tooth colour through the contrast effect (30, 31). Jahangiri et al. also stated that someone with darker skin tones would likely have brighter teeth (high value). In contrast, individuals with lighter skin tones tended to have darker teeth with lower values (32). This finding supported the contrast effect on colour perception. Therefore, it is recommended to ask female patients to remove their lipstick before choosing a tooth shade. In addition, the patient's clothing, especially those with bright contrast colours, should be covered with a neutral-coloured bib or blanket (33).

In tooth shade selection, it is recommended that the patient's head is in an upright position and the dentist is at eye level (2). The main reason is to use the central part of the retina, which is the most colour-perceptive area. It contains many sensitive cones and is surrounded by rods stimulated by light (2). Most of the participants in the current study showed that they were aware of the significance of seeing the patient at eye level. This was similar to the findings of the previous paper by Habib et al., where more than 50% of participants would determine the tooth shade at the patient's eye level (17).

Most participants reported that 70-90% of their patients were satisfied with their shade of selection, while 35.1% reported an even higher satisfaction rate (more than 90%). The study by Alzegaibi et al. showed that 81% of the participants involved in the shade selection procedure were satisfied with the shade of their dental prostheses, 83.7% (34). By involving patients in the shade decision-making process, dental professionals may increase the overall satisfaction with their dental prostheses.

CONCLUSION

This study revealed significant gaps in dental

practitioners' knowledge of shade selection protocols. Most participants only rely on visual methods for shade selection, while using more precise digital technologies is still limited. The results also highlighted the need for increased attention to shade selection protocols among dental professionals. Dental education programs should emphasise standardised shade selection protocols, encourage the adoption of advanced digital shade-matching tools, and promote continuous learning in this critical aspect of restorative dentistry to improve aesthetic outcomes and patient satisfaction.

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