

## Anterior Tooth Shade Selection Procedure: Influence of Light Sources and Patient's Position

(Prosedur Pemilihan Warna Gigi Anterior: Pengaruh Cahaya dan Kedudukan Pesakit)

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### ABSTRACT

*Restoration of anterior teeth requires high precision in the shade selection of the restorative material due to its aesthetic appearance. Incorrect selection of shade for the restoration may result in patient's dissatisfaction due to unaesthetic appearance. This study was conducted to determine the optimum lighting condition and preferable patient's position that may influence the anterior tooth shade selection at the Faculty of Dentistry, Universiti Kebangsaan Malaysia. One hundred dental students from the 4<sup>th</sup> and 5<sup>th</sup> year were randomly selected to perform the shade selection procedure on the maxillary central incisor of two selected subjects. The shade of the tooth was predetermined using an intraoral spectrophotometer machine and the result was used as reference for the visual shade selection procedure done by the students. Four different clinical situations were selected and the shade selected by the students' was compared with the predetermined shade. The result showed that the shade selection for anterior composite resin restoration is more reliable using the first reading taken (46%) when the patient is in the upright position (35.5%) with dental chair light off (56%). As a conclusion, the patient's position, lighting condition and number of readings taken does influence the result of the shade selection for the anterior tooth.*

*Keywords: Anterior tooth; composite resin restoration; shade selection*

### ABSTRAK

*Tampalan pada gigi hadapan memerlukan ketelitian yang tinggi semasa proses pemilihan warna bahan tersebut kerana ia adalah penting bagi estetik pesakit. Pemilihan warna tampalan yang tidak tepat akan menyebabkan pesakit tidak berpuas hati kerana warna tampalan yang tidak sepadan dengan warna gigi yang asal. Kajian ini dilakukan bagi menentukan keadaan pencahayaan yang optimum, kedudukan pesakit serta kriteria lain yang mungkin mempengaruhi pemilihan warna bagi tampalan pada gigi hadapan di Fakulti Pergigian, Universiti Kebangsaan Malaysia. Seramai seratus orang pelajar pergigian daripada Tahun 4 dan 5 telah dipilih secara rawak untuk melakukan prosedur pemilihan warna bahan tampalan pada dua orang subjek yang dipilih. Sebelum pelajar melakukan prosedur pemilihan warna tampalan pada gigi subjek, warna pada gigi subjek yang dipilih telah ditentukan dengan menggunakan mesin spektrofotometer dan keputusan daripada mesin tersebut digunakan sebagai rujukan bagi prosedur yang akan dilakukan oleh pelajar. Pelajar dikehendaki membuat pemilihan warna pada empat situasi yang berbeza dan keputusan mereka akan dibandingkan dengan warna rujukan yang dikenal pasti menggunakan mesin. Keputusan ujian ini menunjukkan bagi prosedur pemilihan warna pada gigi hadapan, keputusan adalah lebih tepat apabila diambil pada bacaan pertama (46%), apabila pesakit di dalam keadaan duduk tegak (35.5%) dan cahaya lampu tumpu dipadamkan (56%). Kajian ini menunjukkan bahawa kedudukan pesakit, pencahayaan serta bilangan bacaan yang diambil mempengaruhi keputusan pemilihan warna bagi bahan tampalan pada gigi hadapan.*

*Kata kunci: Gigi anterior; pemilihan warna; tampalan komposit resin*

### INTRODUCTION

A correct colour matching between the restorative material and natural teeth is essential in the success for anterior restoration in restorative dentistry. If an anterior tooth were to be restored by composite resin such as technical skills, the ability to generate an excellent colour match between a tooth-coloured restoration and the tooth is critical to aesthetic success (Haddad et al. 2009).

There are two methods that can be used to match the colour of the natural teeth and the tooth – coloured restorative material i.e. visually or by using a shade

rendering devices (Okubo et al. 1998). The method that is widely used to select the shades for anterior restorations is by visually matching the shade of the natural teeth with the shade tabs provided by the manufacturer (Jarad et al. 2005). The digital shade rendering devices such as spectrophotometers and colorimeters uses computerized quantification of colour which provides a more accurate colour matching results. However, these devices have not been widely used in dentistry because it is expensive thus they are used primarily for research purposes only (Corcodel et al. 2009; Okubo et al. 1998). Thus, the visual

colour matching by comparison of a patient's tooth with a shade tabs is the most frequently applied method in clinical restorative dentistry (Corcodel et al. 2010; Meireless et al. 2008; Okubo et al. 1998; Van der Burgt et al. 1990). However, individuals vary in their ability to distinguish different shades (Curd et al. 2006). Moreover, the type of light sources can also affect shade selection as lighting is fundamental to colour perception and it significantly influences the quality of shade selection (Corcodel et al. 2009; Dagg et al. 2004).

External light conditions are important for visual colour assessment because spectral composition of standard light sources differs from that of daylight, leading to metamerism (Corcodel et al. 2009). Studies have reported that shade matching performed under different lighting is not consistent and it is very difficult to determine the effects of particular lighting on shade perception (Corcodel et al. 2009; Dagg et al. 2004)

The digital shade rendering devices have the potential to remove some subjectivity (Della Bona et al. 2009). The intra-oral spectrophotometer, VITA Easyshade®, has been shown to be the most reliable instrument in both *in-vitro* and *in-vivo* circumstances as it had both reliability and accuracy values greater than 90% (Dozic et al. 2007; Okubo et al. 1998). Clinically, the shade matching procedure is usually done under the dental office lamp light with or without turning off the dental chair light. As the colour perception of the tooth and restorative material might differ under these different conditions, choosing the correct lighting condition and correct patient's position is essential to get the closest colour match possible between the natural teeth and the restorative material in order to restore the function and aesthetic of the anterior teeth.

This study aimed to determine the influence of different lighting sources and patient's position in the shade selection procedure for anterior teeth at the Faculty of Dentistry, UKM using the digital shade rendering spectrophotometer, VITA Easyshade® as the reference.

## METHODS

Ethical approval was obtained from the Faculty of Dentistry Ethical and Research Committee (DD/004(2)/2010). The study was divided into two phase: selection of subjects and objects and shade selection procedures.

### SUBJECTS AND OBJECTS SELECTION

Two subjects of different race and skin colour (Chinese and Indian male students) were selected based on the predetermined inclusion and exclusion criteria and the right maxillary central incisors (tooth 11) of both subjects were chosen for the shade selection procedure. The inclusion criteria for the selected tooth include sound tooth and presence of complete set of maxillary anterior teeth. Exclusion criteria for the tooth selection were discoloured tooth, presence of restoration, non-vital tooth, existing crown or bridge associated with the tooth of interest,

moderate to severe malocclusion, smokers, poor oral hygiene and the presence of enamel or dentinal defects such as amelogenesis imperfect or fluorosis. Prior to shade selections procedure, the labial surface of the tooth was cleaned and wiped with gauze prior to measurement and the shades of the teeth were identified using an intraoral digital spectrophotometer (VITA Easyshade®). The shade identification using VITA Easyshade® was taken as the reference for visual shade selection procedure. The device was set to 'Tooth Single' mode and the probe tip was placed 90° to the tooth surface and flush on the area between the middle third of the crown and the incisal edge. The probe tip was held steadily against the tooth surface and the measurement button on the hand piece was pressed until the machine beeps to indicate completion of the measurement and the result was shown on the device's screen. The reading was repeated several times by one examiner until three constant readings were achieved and this reading was taken as the gold standard or reference for the tooth. Calibration of the digital shade rendering device was performed before the readings were taken using a ceramic block provided by the manufacturer.

A total of 100 dental students (50 from year 4 and 50 from year 5) were recruited to perform the shade selection procedure in this study. A colour blind test was carried out on every 4<sup>th</sup> and 5<sup>th</sup> year students and students who were identified as colour blind students were excluded from this study. The selected students were then divided into several groups for the shade selection procedure.

### SHADE SELECTION PROCEDURES

In order to reduce the environmental factors that may affect the results for the shade selection, the procedure was performed in the same dental clinic (Endodontic Specialist Clinic) throughout the study. This specialist clinic was selected as it provides comparable lighting condition as to the students' clinic, easily accessible and available most of the time. The students' clinics were not chosen as they were fully occupied, therefore it is impossible to use the same clinic throughout this study. The procedure was performed for two sessions, one in the morning at 10.00 am and the second one in the afternoon at 2.00 pm on the same day. For each session, a maximum of ten students were allowed to perform the visual shade selection procedure using Vita Classical® (VC) shade guide tab as the instrument for the shade selection procedure. The colour of the VC shade guide was measured and confirmed by digital Vita Easyshade® device. This procedure was performed by switching the device mode to 'Shade Tab' mode and the measurement were perform similar to the tooth measurement procedure describe earlier. Sixteen shade tabs from VC shade guide were measured and confirmed by the device.

Prior to the start of procedure, standard instructions were given to each student as described in Table 1. Each student was instructed to perform their shade selections procedure for different patient's position and lighting condition: chair in upright position with dental operating

light off, chair in upright position with dental operating light on, chair in supine position with dental operating light off and chair in supine position and dental operating light on. Patient's position was changed after every subject has completed their shade selections procedure. The most constant and repetitive shades selected by the students were used and compared with the reference value which was predetermined earlier. The shades were then classified as either accurate or inaccurate based on the reference value. The data was compiled and analysed statistically using Pearson chi square in SPSS 18.

## RESULTS

A total of 100 dental students were selected and participated in this study. Figure 1 shows the results of the shade matching procedure performed by the dental students at different patient's position and lighting condition. There was no statistically significant difference between the patient's position and lighting condition for the shade matching procedure. However, the result showed that 56% of the students achieved the most accurate tooth shade when the patient was in the upright position with the dental chair light switched off. Meanwhile, the least

accurate shade selection was achieved when the patient was placed in supine position with the dental light switched off (35.5%). When the patient was placed in the upright position with the dental chair light switched on, 44% of the students have accurately select the correct shade for the tooth. Whilst 47% of accuracy was achieved when the patient was placed in a supine position with the dental chair light switched on.

## DISCUSSION

A total of one hundred dental students participated in this study. The students were carefully selected after they have fulfilled the inclusion and exclusion criteria as described earlier. The 4<sup>th</sup> and 5<sup>th</sup> year dental students were selected to participate in this study as they have more clinical experience compared with the younger dental students. Two patients of different races and skin colour were selected after careful assessment of their anterior tooth was made. The shade of the selected anterior tooth was predetermined using a digital shade matching device known as VITA Easyshade® spectrophotometer. This device has been proven to produce a consistent and accurate result compared with visual shade matching guide, thus

TABLE 1. The standard instructions given to each student prior to start of procedure

1. Look into the middle third area of tooth 11 and select a shade for the tooth using the Vita Classical® shade guide provided.
2. You have three attempts for each clinical situation.
3. For each attempt, you are given maximum 15 s to select the most accurate shade.
4. After each attempt, you are given 5 s to write down your answer and to rest your eyes.
5. You are not allowed to discuss your results with your colleagues during the procedure.

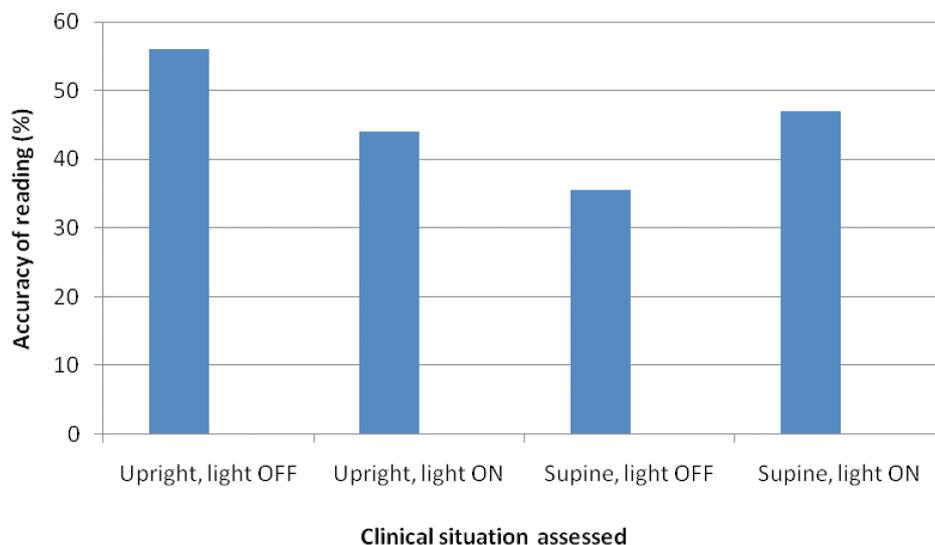


FIGURE 1. The accuracy of readings at the different patient's position and lighting condition

the results of this digital device were used as the reference for the study (Okubo et al. 1998).

Even though the results of this study were not statistically significant, the difference between the accuracy in shade matching procedure and clinical situation is of clinical significant. This is because the patient's health condition or the dental clinic surroundings may play a role in determining the accuracy of the shade selection process in the dental clinic. When comparing the lighting conditions during the shade matching procedure, the results showed that the accuracy of shade selection was higher when the patients were in the upright position with the dental chair light was switched off. During this procedure, only the dental surgery light was turned on thus providing the natural daylight condition. The use of a daylight lamp helps to standardize the lighting conditions and it improves the ability to match colours (Corcodel et al. 2009). Dental chair light should not be used for shade matching procedure because it is too bright and can cause glare and resulted in eyes' fatigues. A light which is too great in intensity and glare could reduce the accuracy of colour rendering. Therefore, instead of focusing the light directly to patient's mouth, the light should be diffused uniformly to avoid reflections. The quality of light is one of the most influential factors in shade matching procedure (Dagg et al. 2004). When the patient was in supine position, a more accurate shade matching was achieved when the dental chair light was switched on. This is because when the patient was in supine position, the tooth was shadowed by the observer hence less light was received from the object, thus decreasing the colour rendering accuracy. Therefore, additional light is required to improve the lighting condition hence increasing the accuracy of the result.

The shade matching is significantly less accurate than when the patient was in supine position with the dental chair light turned off. This is because the distance between the observer and the tooth is greater when the patient was placed in supine position. The farther the observer from the object, the lesser the amount of light received from the object, thus it could lead to inaccuracy. Conversely, when the patient was placed in upright position under the same lighting condition, higher accuracy was achieved because the colour-sensitive part of our retina was stimulated.

In the clinic, some patients cannot be placed in supine position due to their medical or health problems. When confronted with this situation, the dental clinicians are advised to perform the shade matching procedure with the dental operating light switched off in order to achieve a better and accurate result. Accurate shade selection between the natural teeth and the restorative material are important as it influenced the patient's aesthetic appearance and their self-esteem.

#### CONCLUSION

Within the limitation of this study, it was concluded that shade selection for anterior composite resin restoration was

more accurate when the patient was in the upright position with dental chair light switched off. The patient's position does influence the accuracy of the shade matching result under different lighting condition.

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