

“Comparative evaluation of the effects of lighting conditions on the shade selection of ceramics using visual method”

Abstract:

Background: Tooth shade selection in prosthodontic restorations largely affects the patient satisfaction. Natural daylight is considered as the most recommended and standard source for shade selection. However, due to its inconsistency, shade matching lights have been introduced as an attempt to standardize the effect of light source. **Objectives:** Comparative evaluation of the effects of daylight, shade matching light and dental operating light against the grey background on visual shade matching of natural teeth with VITA Classic shade guide. Daylight will be taken as the control group. **Methodology:** Shade matching will be conducted in a well illuminated area with grey background. A group of 5 observers with superior color discrimination competence as determined by Pseudo Isochromatic colour test will be chosen for teeth shade matching. The matching will be carried out for 125 subjects under the three lighting conditions. The visual assessment will be done by matching the shade of maxillary central incisor of the subject with VITA Classic shade guide. Comparison will be done for two lighting conditions, each observer will perform this test three times that is for grey background in daylight, shade matching light and dental operator light. **Expected Result:** This study will determine the lighting condition that could be used as a possible alternative of daylight. **Conclusion:** It will depict the lighting conditions that will best help the clinician to select the shade that will enhance the esthetics of the prosthesis and restorations.

Keywords: Tooth Shade Matching, Shade Selection, Visual Method, VITA Classic shade guide.

Introduction:

Esthetics in dentistry has always been of prime concern for the fabrication of an appealing prosthesis. Esthetic dentistry relies on the artistic abilities of the dentist as well as on the knowledge of the scientific principles of color and its optical properties. Accurate

color evaluation and shade matching of ceramics in prosthetic restorations is important to satisfy the patients' expectations of highly esthetic results^{1,2}.

The color perception of natural teeth relies on the illuminating light and is critical to the translucency, opalescence and fluorescence^{3,4}. The selection of shade of a tooth in Prosthodontics is a routine clinical procedure. Achievement of optimal color of the prosthesis and consequently the esthetics poses a challenge due to the intricacy of the optical properties of the teeth that is the dental structures. There are different methods of selection of tooth shade which include the visual and instrumental methods (using digital photography, spectrophotometers, colorimeters, and computer-imaging)³. Even after the emergence of these technologies the visual method remains as the predominant method of shade selection.

The visual method of shade selection⁵ being subjective, is influenced by various factors both observer dependent and independent³. These include gender, colour vision competency, multiple firings⁶, professional experience, background of the tooth, colour of surroundings as well as the lighting conditions^{7,8}. The light source being most important, natural daylight is the most recommended and standard source for shade selection. Recommendations regarding the colour temperature and the colour rendering index of the light sources to be approximately 5500° K and >90 respectively^{2,4}. Since the daylight is not consistent, shade matching lights have been introduced as an attempt to standardize the effect of light source⁴.

The background and the surrounding area of the dental operatory also has effect on the shade matching of the ceramics and a neutral grey background of the operatory walls and also the patient to be draped in a neutral grey cloth⁸. There have been studies regarding the effects of various backgrounds on shade matching^{4,8} but there are no studies regarding the effect of grey background with different light sources on the shade selection. Hence, this study aims to evaluate and compare the effects of light source against grey background on visual shade matching of natural teeth with ceramic shade guide.

Selection of shade in dentistry is essential to meet the patients' esthetic demands so as to positively influence their self-esteem⁵. To achieve attractive restorative and Prosthodontic outcomes, precise shade determination is essential. This depends on the clinical skill, lighting conditions, shade guides as well as the background. There have been studies regarding the effect of lighting conditions and backgrounds that has given us insights regarding their effects on colour matching. However there has not been a comparative study regarding the

combinations of different lighting conditions against grey background on ceramic shade selection. So, the rationale of this study is to evaluate as well as compare the effects of lighting conditions against the grey background on the shade selection of dental ceramics.

Objectives:

- To evaluate the effect of daylight on visual shade matching of ceramic shade guide.
- To evaluate the effect of shade matching light on visual shade matching of ceramic shade guide.
- To evaluate the effect of operating light on visual shade matching of ceramic shade guide.
- Comparative evaluation of efficacy of daylight with operating light & shade matching light on visual shade matching of ceramic shade guide.

Materials and Methods:

Participants:

The participants for this study will be the 125 subjects and the 5 observers of Department of Prosthodontics, Sharad Pawar Dental College.

Statistical analysis

- Statistical analysis will be done by using Students unpaired t-test (To compare the average difference between two unrelated groups i.e. comparison of shade matching light with daylight and that of operating light with daylight), Students paired t-test (As there will be 5 variables for a subject due to the presence of 5 observers).
- Chi square test will be applied for analysis.
- The software that will be used in the analysis will be SPSS 24.0 version and $p < 0.05$ is considered as level of significance

Study size: Sample size formula for difference between two proportions⁹:

$$n = \frac{(Z\alpha + Z\beta)^2 [P_1(1 - P_1) + P_2(1 - P_2)]}{(P_1 - P_2)^2}$$

Where,

$Z\alpha$ is the level of significance at 5% i.e. 95%

Confidence interval = 1.96

$Z\beta$ = Power of the test = 80% = 0.84%

$P_1 = 45.8\% = 0.458$ (The difference between shade matching of shade matching light and control i.e. daylight)

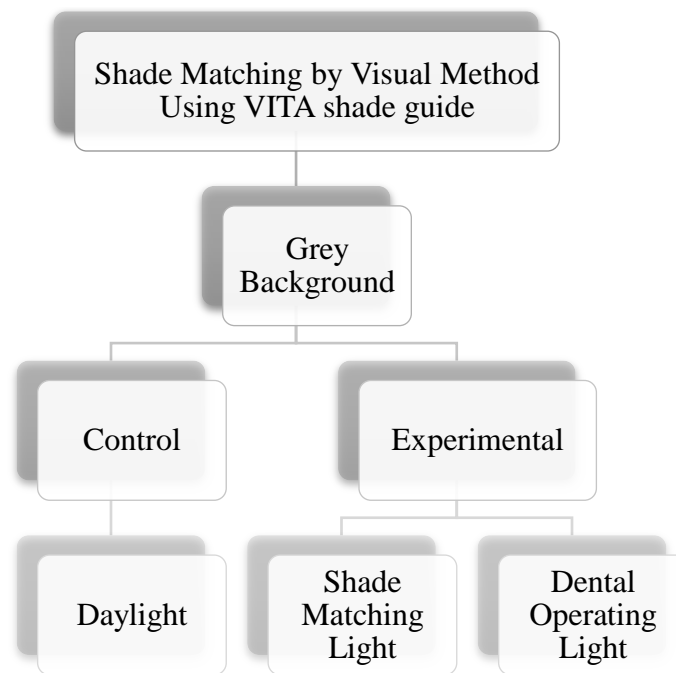
$P_2 = 28.9\% = 0.289$ (The difference between shade matching of operating light and control i.e. daylight)

$$n = \frac{(1.96 + 0.84)^2 [0.458(1 - 0.458) + 0.289(1 - 0.289)]}{(0.458 - 0.289)^2}$$

$$= 124.54$$

$$= 125$$

Study design:



Inclusion criteria

1. Observers willing to participate in the study.
2. Observers who pass the PIP color vision test will only be qualified as observers.
3. Subjects without and restorations or prosthesis in their anterior teeth.

Exclusion criteria

1. Observers not willing to participate in this study.
2. Observers who do not pass the PIP color vision test.
3. Subjects with malocclusion, fractured, discoloured, restored, root canal treated and incisors with prosthesis.

Materials

- VITA Classic shade guide
- Background sheet
 - i. Grey

Instruments

- Shade matching light (Smile Lines Shade Matching Light)
- Dental operating light

Methodology

This is an in vivo cross-sectional qualitative study, which will be carried out in the Department of Prosthodontics, Sharad Pawar Dental College, DMIMS (DU), Sawangi (Meghe), Wardha. This study comprises of 125 subjects of 20 to 30 years of age. They will be given complete information regarding the study and written consent will be obtained. Study comprising of 5 participants who will be the observers from the Department of Prosthodontics of SPDC, Wardha. This group of five observers will be tested for their color vision discrimination competence using Pseudo Isochromatic Plate (PIP) Color Vision Test which is a test for red-green deficiencies in color perception. The observers included in this experiment will be with average or superior dental color discrimination competence (matched samples percentage 75 and 100 %). In case of a tie, the observer with less amount of time taken for completion of test will be selected.

For the vision test, a computer will be set-up in a room with no lights. The 24 plates version of the PIP test will be displayed on the screen. The observers will be seated at a distance of 60 cm from the computer screen. The viewing angle for the observers with the centre of the monitor will be 0°. The observers will have 2s for assessing each plate, after which they will have to write down the symbol formed by the dots in the displayed plate which is in the form of a circle (number or continuous line between two dots); if no symbol is seen by the observer, they will be asked to indicate no sign. For the shade matching test, the observers will be asked to match shade of the Maxillary central incisor of the subject. The visual assessment will be done with the VITA Classic for matching the shade of maxillary central incisor of the subject with VITA Classic shade guide. The shade matching will be carried out with daylight taken as the control.

Comparison will be done under two types of lighting conditions and, at a distance of 30 to 35cm, at an angle of 0°-45°. Each observer will perform this test three times that is for grey background in daylight, shade matching light and dental operatory light. The qualitative differences between colour matching of the grey background under the lighting conditions will be compared that of grey background with daylight.

Expected Outcomes/Results:

Expected outcome of the present study is that the accuracy of the shade matching light and the operating light will be compared and analysed which will give the clinician as to which light amongst the shade matching light and operating light will result in the shade matching that will be closest to that done in the daylight. As the daylight is inconsistent hence the result

of this study will reflect the correct lighting conditions that will help the clinician to select the shade that will enhance the esthetics of the prosthesis and restorations.

Discussion:

Bruce Marucci¹ in 2003 published a study in which he proposed a shade selection technique, presenting a variation in the standard technique of shade selection. This was done using the Vitapan 3-D master “tooth” guide and the Vitapan 3-D master “dentin” guide together. He used the dentin guide first to select the shade determinants and then used the tooth guide to verify them. He concluded that the proposed technique gave the practitioner a wider range of choices. This technique allowed the dental practitioner in anterior and posterior shade selection¹.

H. Dagg⁷ et al in 2004 conducted a study on the influence of some different factors on the accuracy of shade selection. They elucidated some of the factors on which accurate shade taking depended that is the difference between the effect of light quality, the effect of porcelain thickness, the types of porcelain used and the experience of the observer. They concluded that the quality of the light was the most important factor that influenced the correct selection of shades. They obtained better results when ideal light was used especially when thicker samples were tested. The experience of the observer was also found to be the factor of importance. They concluded that when shade guides had the reflectance properties and thickness of porcelain that was more similar to the restoration, improved and more accurate colour matching of restorations was performed⁷.

Kim Pusateri³ et al in 2007 conducted a study to evaluate the accuracy and reliability of a dental shade matching instrument. They used the shade-matching instrument (ShadeScan), made color measurements of 3 commercial shade guides (VITA Classical, VITA 3D-Master, and Chromascop). It was concluded that a significant difference was discovered in the mean accuracy measurements of all 3 shade guides. This study also revealed that the reliability and the accuracy for ShadeScan was variable and that it depended on the type of shade guide used³.

D. Dudea⁸ et al in 2015 carried out a study on the influence of background/surrounding area on accuracy of visual color matching. The conclusion was derived that the achromatic backgrounds had no effect on the quality of color matching. The blue background had the worst effect on the shade selection. The performance of observers with higher ranked color matching competence was notably better than the ones with average

competence. The shade tabs that were most frequently mismatched were A3.5, B3, B4, and D4⁸.

Najafi-Abrandabadi S⁴. et al in 2018 carried out a study on the effects of a shade-matching light and background color on reliability in tooth shade selection. After the selection of four members from the department of Prosthodontics, they were asked to match 10 shade tabs against different shades of a shade guide. Average levels of agreements were found in the value of matching the shade tabs. Results of pink background were better than blue taken any of the light. The use of Shade matching Light amplified the shade selection against the pink background⁴.

Limitations:

This study is restricted to the visual method by using VITA Classic shade guide only.

Conclusion:

This study will apprise the clinicians while choosing the lighting effect so as to achieve the best results in shade selection. This will give the clinicians an insight regarding the best combination of grey background with lighting condition that is closest to daylight in accuracy which will help them with esthetic matching of shades.

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