



Comparison of Two Different Light Sources Affecting Visual Shade Perception

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ABSTRACT

Background: Visual shade matching is important for dental aesthetics and lighting conditions can be one of the key factors that influence the shade matching results. This study was started to analyse this correlation. **Objective:** The objective of this paper is to compare two different light sources i.e. natural daylight and operating light by two observers affecting visual shade perception. **Study design:** It was a cross-sectional study where both observers examined the subjects at one point in time. **Place & duration of study:** This study was conducted at dental hospital, Lahore medical and dental college, Lahore where random samples were taken for six months. Duration of study was from July 16, 2024 to January 15, 2025 after approval. The study was approved by CPSP via Letter, Ref No. CPSP/REU/DSG-2021-080-3877 Dated: July 15, 2024 and ERB of the Hospital. **Material and Methods:** Visual assessment was based on a comparison between two light sources while using a single shade guide by two observers. Observers with normal colour vision were asked to visually match the colour of the maxillary central incisor in a group of 67 subjects, aged 20-50 years. One shade guide VITA Vitapan Classical[®] was used in natural daylight as well as under artificial light. **Results:** Significant differences were found between light sources and shade matching results (p -value<0.05). Both observers showed 70.1% and 61.2% agreement using natural and artificial light respectively. **Conclusion:** Within the limitations of this study, natural daylight demonstrated superior agreement in shade selection as compared to artificial light

INTRODUCTION

Shade selection is an important procedure to provide patients with an aesthetic restoration that harmoniously blends to the patient's existing dentition. Inappropriate shade selection results in dissatisfaction and remake of ceramic restorations.¹ There are certain determinants of shade selection including tooth's own properties surrounding factors, patient's expectations, and dentist's personal perspective.²

Visual shade matching is performed using dental shade guides. Although it is a subjective method,³ and it has chances of error still it is the most common⁴, preferred and simple method being used in general dental practice. It is cheaper and less mechanics are involved.¹ According to a survey Vitapan classical (17%-67%) and Vita 3D master (0%-47%) are commonly used tabs.⁵ Factors such as fatigue, ageing, emotions, gender, clinical experience as well as some medications also influence observers understanding of colour stimulus.^{6,3,4}

Shade matching can also be performed using spectrophotometers, colourimeters, digital and spectral imaging.⁶ Machines are costly and are not available in general dental practice. These instruments work best on flat surfaces since tooth surfaces are curved so their working is questionable.¹

One of the factors influencing colour perception is the nature of the surrounding light in the room, its type, power, and input angle.⁶

Optimal conditions for tooth shade selection are colour temperature between 5500K and 6500K and colour rendering index (CRI) >90.⁷

One of the previous study conducted in Poland have shown that the visual tooth colour matching is dependent on lighting conditions (p <0.05).⁷ Another study showed that visual matching by examiners averaged 48% correct (standard deviation 2.7). Visual test demonstrated fair repeatability (correlation coefficient $r = .60$).¹¹ On

contrary a study conducted in Nepal showed insignificant difference between the shade matching ability of students under natural and clinical light.⁹ One study showed that light source did not significantly influence the matching scores ($p>0.05$).¹³

As previously most studies are done globally and in different countries and there is dearth of local data available. Digital instruments are not available in our country's general practices due to very high cost. There is a need of local study which will help clinician's a better understanding of shade selection. Patients can have improved benefits of esthetics.

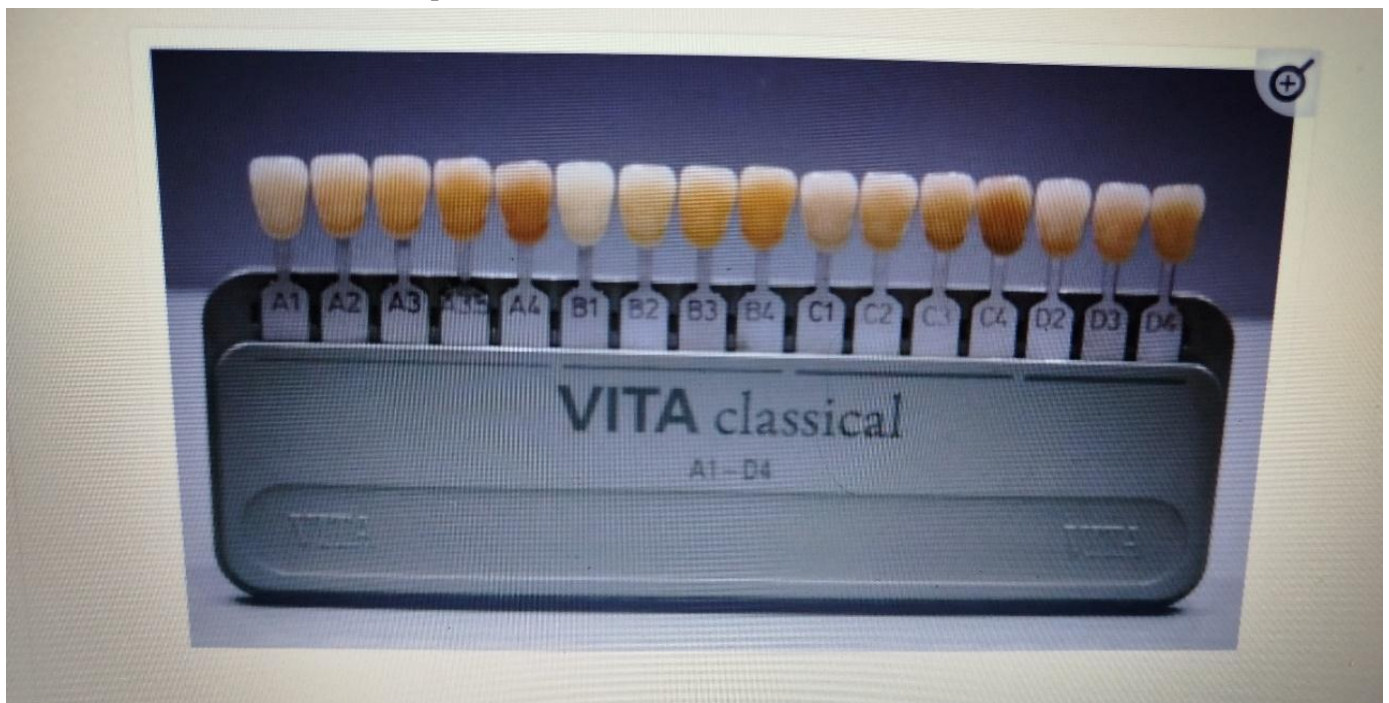
METHODOLOGY

After taking approval from ethical review committee of dental hospital, data was collected during the period between July 16, 2024 and January 15, 2025 from patients presenting in prosthodontic department of LMDC Dental Hospital, meeting inclusion criteria after taking informed consent. It was a Cross-sectional study and non-probability consecutive sampling technique was used. Basic demographic information such as name, age, gender and contact details were taken. Colour evaluation under two lights was done by two observers, one post graduate resident and one senior consultant. Observers were assessed by using Ishiara's colour blindness test which contains number of Ishiara's plates and measures

person's ability to tell difference between colours. One most commonly used shade guide VITAPAN Classic™ (VITA Zahnfabrik, Germany) was used. Both observers matched tooth colour templates Vita Classic™ (having multiple colour templates A1, A2, B1 etc) with the patient's incisor under two light conditions and showed agreement of similarity and dissimilarity. The population sample included all patients presenting in the out-patient department with age 20-50 years. Sample size was calculated as 67.

Sample included patient's permanent maxillary central incisor. Sample excluded patients with permanent maxillary central incisor with various lesions, restorations, endodontic treatment, intrinsic staining, extrinsic staining, tooth wear/abnormality, xerostomia and history of bleaching.

Shade selection was done under two lights: in natural daylight between 10am_2pm on one dental chair located by the window: operating light emerging from the dental unit. To ensure standardization, all subjects were seated in the same dental chair directed towards sunlight. Walls were of neutral shade so was the bib to match the criteria of subjective shade evaluation. Females were asked to remove the lip shades before matching. Observers examined each shade tab for few seconds to avoid eye fatigue.



IBM SPSS statistics 22 was used to calculate p-value. Frequency and percentages were calculated for qualitative variables i.e., gender and shade colour. Mean, standard deviation was calculated for quantitative variable i.e. age. $P < 0.05$ would be taken as significant. Pie chart would show the agreement of similarity and dissimilarity between observers under light sources.

RESULTS

Sample size of the population was 67 in total consisting of 31 males and 36 females and their tooth shades were observed under natural and artificial light. Mean age of the sample population was 30.63 with a $SD \pm 5.31$. Both observers showed 70.1% and 61.2 % agreement using natural and artificial light respectively which is shown in

the figure 1 and 2. Natural light conditions showed A2 as the most common shade with 43.3% match whereas artificial light showed B2 as the most common shade with 70% match. The frequency of A2 was found highest in both males and females under natural light showing percentages of 34.26% and 36.11% respectively. Under artificial light, males showed the highest frequency for A1 and A2 with 22.58% whereas females showed the highest frequency for A2 with 33.33%. The comparison of observations under both light conditions showed p-value of 0.03 which is significant (p -value <0.05). These p-value computations were done through SPSS 22.

Figure 1

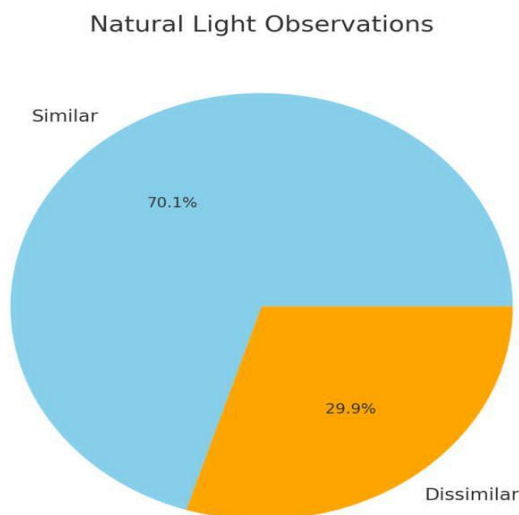
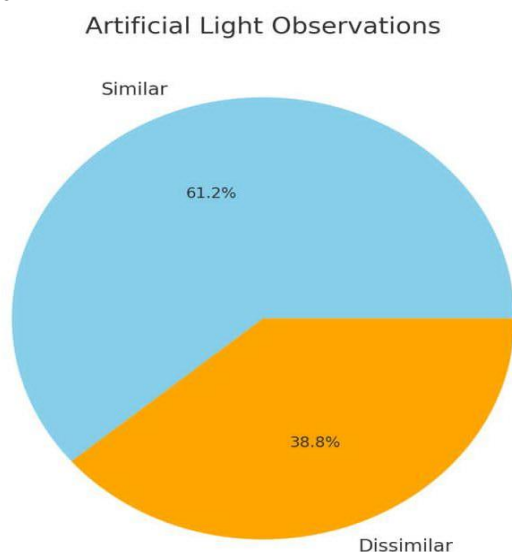


Figure 2



DISCUSSION

In this study, two observers were selected: one post-graduate resident and one senior consultant to minimize the variability of different factors such as age and degree of knowledge. Clinical experience and knowledge of

colour science in dentistry can lead to better performance in a clinical setting. Results of both observers showed that natural light has greater significance in shade matching than artificial light.

Previous 2020 study conducted in Poland on effects of different light sources on tooth shade selection shows that visual tooth colour matching is dependent on lighting conditions ($p<0.05$).⁷ This study validates and supports our results that light sources are greatly important for shade match.

Joshi R et al indicated that there was an insignificant difference between shade matching ability of dental students using two visual light sources.⁹ This contradiction may be due to that dental students need more training regarding shade matching. Gasparic et al in their study showed that subjects with higher competency group, light sources did not significantly influence matching sources with p value >0.05 .¹³ We can see that experience and knowledge also play an important role while selecting shade.

As our study showed significant dependency on natural light for correct shade matching ability, it is needed to either change the clinical setting/design so there is enough direct sunlight. In the existing setup with artificial light, it is better to use different existing technologies for result improvement. Dental unit light we used in our study was not colour corrected light. These technologies include colour correcting devices, digital photography and colour corrected dental unit lights.

Malcolm et al evaluated impact of instruments through their study and showed that visual matching by examiners averaged 48% correct with a SD ± 2.7 whereas it averaged 50% correct by colour corrected device.¹¹ In the article Miyajiwala et al called digital photography method as a reliable one for shade selection in a clinical setup.²

Both these studies support the narrative that use of technology can improve shade matching however, the limitation of both these technologies is that they are expensive and therefore, have not yet been introduced in Pakistan. For better aesthetics, there is a need to introduce these technologies to the Pakistani market.

One of the limitations of the study was a low sample size which may not give a very big picture of the overall situation. There is also a need to educate and train dental students and trainees on colour science and shade matching. With better understanding and clinical experience, they can provide their patients with aesthetically pleasant and correct shade matching services.

CONCLUSION

Within the limitations of this study, natural day light demonstrated superior agreement in shade selection as compared to artificial light.

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