ORIGINAL RESEARCH

A Clinical Evaluation of Difference in Shades among Maxillary Central Incisor, Canine, and First Molar in a Young Age-group Using Digital Spectrophotometer: An *In Vivo* Study

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Abstract

Aim: The aim of this study was to evaluate and compare the most common shades of maxillary central incisor, canine and first molar and to confirm the shade difference between maxillary central incisor and canine in a young population of 18–25 years.

Materials and methods: The shade of the maxillary central incisor, canine, and first molar of 100 study participants in a young population between 18 and 25 years were measured by digital spectrophotometer (VITA Easyshade). The shade of each tooth was assessed thrice with a digital spectrophotometer at the center of the tooth. Statistical analysis was performed; Chi-squared test was applied to assess the difference in shades.

Results: For the age-group of 18–25 years, the most common shade of maxillary central incisor is A1 and for canine and first molar the most common shade is B3. A highly statistically significant difference ($p < 0.001$) was observed between teeth, suggesting a definitive shade difference between teeth.

Conclusion: A definitive shade difference exists between the maxillary central incisor and the canine, with the canine being darker in shade than the central incisor. This result can be implied clinically while restoring maxillary anterior teeth to yield a better esthetic outcome.

Clinical significance: This study reveals that there is a definitive shade difference between the Anterior teeth which should be considered while smile designing to replicate the natural appearance in a patient. Using a digital spectrometer makes the process of shade selection objective thereby eliminating any subjective variations.

Keywords: Digital spectrophotometer, Maxillary central incisor, VITA Easyshade, Young population.

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Introduction

In modern day dentistry, providing a life-like appearance to a restoration imparts supreme esthetic and therefore contributes a great deal to creating a beautiful smile.[1] Many factors such as tooth anatomy, surface texture, tooth color, translucency, and alignment contribute to good esthetics.[2] Tooth color is one of the factors, which play a prime role in providing esthetically acceptable restoration to both the clinician and the patient. Selecting the exact shade of teeth is a complex procedure.

The characteristics of a typical smile involve the display of six maxillary teeth and premolars.[3] Many studies found a clear difference in color between maxillary central incisors and the canine.[4,5] It was found that the central incisor is the lightest in color, followed by the canine and molar.[6] Another important factor contributing to the color variations is the age of a person, the younger age-group have lighter-colored tooth compared to the older population.[7]

Various methods can be employed for shade selection like visual interpretation with the help of shade guides or with special instruments such as calorimeters, spectroradiometers, Spectrophotometer, etc.[8] In normal day-to-day practice, the shade selection is assessed by visually comparing the selected tooth to one of the tabs of commercially available shade guides.[9]

With visual shade assessment, the shade of the final restoration differs from the predetermined shade. Visual assessment is a subjective method. Various criteria such as lighting, environmental aspects, and the observer's vision contribute to the objective determination of tooth color.[10] Visual shade assessment has significant drawbacks that affect the definitive shade of restoration and lead to the discontent of the clinician and the patient.[2] These drawbacks of visual shade assessment can be improved by employing more standardized instrumental shade analysis

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methods. Digital shade determination is much more precise and accurate. Its objective, quantifiable and faster readings can be obtained. The major advantage of instrumental shade selection is the exact communication of tooth color with the technician.

It is a well-documented fact that each tooth differs from the other in shade and not only between teeth; shade difference exists within different areas of the single tooth as well.[11] Hence, there was a requirement to know the shade difference between teeth with a standardized shade assessment method. The study was conducted to evaluate the shade difference amongst different teeth, that is, maxillary central incisor, canine, and first molar.

Objectives of the Study

- To evaluate shades of anterior and posterior teeth in a young age-group of 18–25 years.
- To compare the shades of anterior and posterior teeth in a young age-group of 18–25 years.
- To analyze common shade found in a local population in an age-group of 18–25 years.
- To confirm comparative shade difference in between canine and incisor teeth in the same age-group.

Materials and Methods

Ethical approval from Institutional ethical committee with approval no DCRI/DEAN/ETHICALCOMMITTEE/PRCB-03/2019, 100 participants of both genders from the cross-section of the local population were selected randomly for the study over the period of 3 months. Informed consent was taken from each subject. The digital spectrophotometer, that is, VITA Easy shade advance 4.0 (VITA Zahnfabrik, Bad Sackigen, Germany) was used to take shades clinically for this study.

Inclusion Criteria

- Participants of both tenders of age-group 18–25 years.
- All participants should have undergone oral prophylaxis.
- Female patients without lipstick or bright makeup prior to shade selection.
- All three teeth, that is, maxillary central incisor, canine, and first molar should be free of any restoration, stain (including drug induced), tarter, fluorosis, hypoplasia, non-vital tooth and any other defects that affect the natural color of the teeth.
- Only individuals who gave prior consent to participate in the study were selected.

Exclusion Criteria

- Non-vital teeth.
- Teeth with any pathology or any developmental anomaly.
- Anatomically altered teeth.
- Teeth with any previous dental treatment.
- History of habits like tobacco chewing or smoking.
- Patients using mouthwash or under any drug prescription which could affect the tooth color.

Methodology

In this study, the participants were provided with a general questionnaire consisting of basic necessary details such as gender, age, and dental history. This questionnaire helped in screening out participants based on inclusion and exclusion criteria.

After the written consent from the screened candidates, the facial surface of each tooth (i.e., maxillary central incisors, canines, and first premolars) was thoroughly cleaned using polishing brushes and pastes followed by thorough rinsing with water. The tooth surface was then dried with gauze before the measurement was started.

In each participant, the shade of the maxillary central incisor, canine, and first premolar was taken using VITA Easy shade advance 4.0 (VITA Zahnfabrik, Bad Sackigen, Germany). The study was carried out by a single examiner. Since the participants were regular patients visiting the OPD their diet was not under the control of the Examiner.

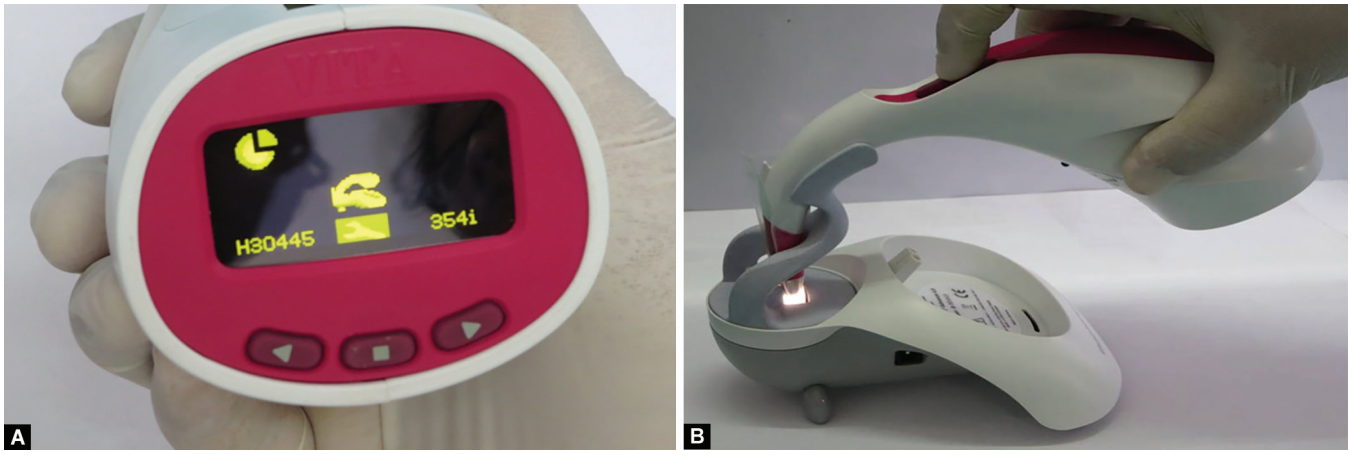
Before the evaluation/selection of the shade for every volunteer, the measuring probe of the digital spectrophotometer was covered with a sterile cover pocket to ensure efficient infection control.

The Digital spectrophotometer, that is, VITA Easy shade advance 4.0 was turned on and calibrated by placing the measuring probe of the spectrophotometer on the calibration block (Fig. 1). Basic shade measurement was selected and confirmed (Fig. 2).

After the calibration of the spectrophotometer, the measuring probe tip covered with a sterile cover pocket was held at a 90° angle to the middle third of the facial surface of the tooth. Up to three measurements were performed on every tooth to ensure exact shade (Fig. 3).

The measurements recorded were according to the VITA 3D master shade guide and VITPAN classical R shade guide.

Tooth shade was read on the screen of the spectrophotometer (Fig. 4). After evaluating the shade of each tooth, its shade was documented.



Figs 1A and B: The unit was ready to be calibrated

Fig. 2: Basic shade measurement was selected and confirmed

Fig. 3: Measuring probe was placed over the center of the tooth and then measurement was made

Fig. 4: Tooth shade was displayed on the screen of the spectrophotometer

Table 1: Age and gender distribution in study population; mean age = 20.35

Gender	*N (100)*	*%*
Male	16	16
Female	84	84

Collected data were tabulated, analyzed, and depicted in graphs. Statistical analyses were performed using a personal computer with statistical package for social sciences software (SPSS, version 16). Chi-squared test was applied to assess the differences in shades of maxillary central incisor, canine, and first molar. The data comparison was done by applying specific statistical tests to find out the statistical significance of the obtained results.

Results

A total of 100 subjects were studied with a mean age of 20.35 years and among the population 16% were male and 84% were female (Table 1).

For the age-group of 18–25 years, the most common shade for the maxillary canine is B3 with a mean value of 43.33 followed by A2, that is, 21.67 and then A3 (Table 2; Fig. 5).

For the age-group of 18–25 years, the most common shade for the maxillary central incisor is A1 with a mean value of 47.33 followed by B2, that is, 20.33 and then B1 (Table 2; Fig. 6).

For the age-group of 18–25 years, the most common shade for the maxillary first molar is B3 having a mean value of 42.33 followed by A3.5, that is, 20.67 and then A3 (Table 2; Fig. 6).

"A highly statistically significant" difference ($p < 0.001$) was observed when the shades of incisor, canine, and molar were compared using VITA Easy shade Advance 4.0 digital spectrophotometer (Table 2).

Discussion

A total of 100 participants with the age-group of 18–25 of both genders were selected in the study after considering inclusion and exclusion criteria as described in the materials and methods. The spectrophotometer used in the study was Easyshade.

Visual analysis using commercially available shade guides is a widely used method to assess shade in dental clinics, but it can be inconsistent and unreliable.[12,13] This is because of visual perception and outcome of a variety of physiological and psychological responses and can differ according to the environment.[14,15]

To reproduce exact tooth shade with the predetermined restorative material, a shade guide should be precise, standardized, easy to use, and should exhibit a high degree of repeatability.[4–6] Instrumental shade analysis yields better results with the help of a spectrophotometer. It was observed that there was a significant difference between instrumental and visual shade assessment with the instrumental analysis exhibiting better performance.[7]

The spectrophotometric shade analysis is more accurate, standardized, and reproducible than human shade assessment. Spectrophotometric analysis exhibited exact tooth shade by 83.3% whereas visual assessment only up to 26.6% matches tooth shade.[16] Silva et al. compared crowns fabricated using a spectrophotometer and a conventional shade-matching method and found that the spectrophotometer had a significantly better color match and a lower rate of rejection[17] Easyshade exhibited higher precision and

Table 2: Trend of scientific production by quartile of indexed journals

Incisor	*A1*	*A2*	*A3*	*A3.5*	*A4*	*B1*	*B2*	*B3*	*B4*	*ANOVA*
Mean	47.33	9.333	2.000	1.000	1.000	14.67	20.33	3.000	1.333	F (8, 18) = 3,770
SD	0.5774	0.5774	0.000	0.000	0.000	0.5774	0.5774	0.000	0.5774	$p < 0.0001$
A1 vs B2: Significant when $p < 0.0001$ B2 vs B1: Significant when $p < 0.0001$ *Note:* The study rejects the null hypothesis stating that the age group of 18–25 years, the most common shade for the maxillary central incisor is A1 followed by B2, then B1										
Canine	*A1*	*A2*	*A3*	*A3.5*	*A4*	*B1*	*B2*	*B3*	*B4*	
Mean	1.000	21.67	15.33	8.000	1.000	1.000	7.667	43.33	1.000	F (8, 18) = 4,045
SD	0.000	0.5774	1.000	0.5774	0.000	0.000	0.5774	0.5774	0.000	$p < 0.0001$
B3 vs A2: Significant when $p < 0.0001$ A2 vs A3: Significant when $p < 0.0001$ *Note:* The study rejects the null hypothesis stating that the age group of 18–25 years, the most common shade for the maxillary canine is B3 followed by A2 then A3										
Molar	*A1*	*A2*	*A3*	*A3.5*	*A4*	*B1*	*B2*	*B3*	*B4*	
Mean	1.000	8.667	13.00	20.67	3.000	1.000	7.333	42.33	3.000	F (8, 18) = 2,063
SD	0.000	0.5774	1.000	0.5774	0.000	0.000	0.5774	0.5774	0.000	$p < 0.0001$
B3 vs A3.5: Significant when $p < 0.0001$ A3.5 vs A3: Significant when $p < 0.0001$ *Note:* The study rejects the null hypothesis stating that the age group of 18–25 years, the most common shade for the maxillary first molar is B3 followed by A3.5 then A3										

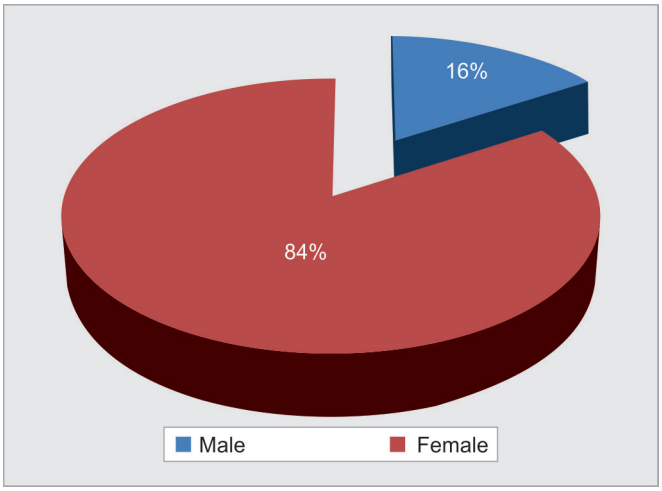


Fig. 5: Age and gender distribution of study population

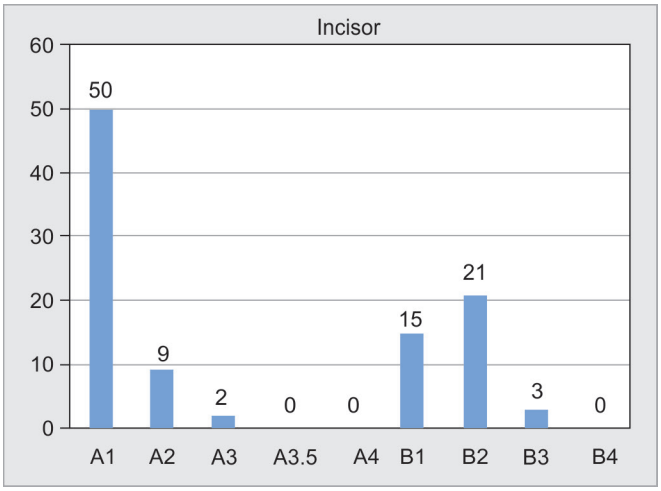


Fig. 6: Incidence of the most common shades of maxillary first molar in a young population of 18–25 years using digital spectrophotometer

matching repeatability than the other devices both *in vivo* and *in vitro*.[18] Probe of Easyshade measures 5 mm area in diameter in the center (middle third) of tooth. As in the center of the tooth, the principal shade of the tooth is represented.[19] The Easyshade spectrophotometer was specially designed for clinical shade selection of natural teeth and prosthetic restorations. The clinical accuracy of the Easyshade spectrophotometer has already been validated in several investigations.[20]

The color of teeth in an individual is influenced by extrinsic discoloration (smoking, tobacco chewing, specific food and beverage intake, acquired pellicle, improper oral hygiene), intrinsic discoloration (heredity, age, gender, demography, fluorosis, tetracycline staining, root resorption, etc.), internalized discoloration (developmental discoloration or acquired defects i.e., tooth wear, dental caries or restorative material).[3] Common tooth shade of maxillary central incisor in the age-group (10–20) and (21–30) is A3.[9] Most common shade of maxillary central incisor in the age-group of 15–25 years is A2.[2] In this study, the most common tooth shade of maxillary central incisor in a young population between the age-group of 18–25 years is A1. The above-mentioned studies were conducted in different geographical areas, indicating the influence of demography on tooth color. Various studies suggest the color of teeth becomes dark with age and teeth are darker in males than females.[2,9]

Lee[19] conducted a study to determine color correlations among six types of permanent anterior teeth and found a decrease in L*

value and an increase in b* value as moved from central incisor to canine indicating shade difference between teeth in an individual. The findings of the this study where the most common shade of maxillary central incisor is A1 and B3 is the most common shade of canine found in the young population of age-group 18–25 years indicating shade difference between two teeth in an individual. The most common shade for the maxillary first molar is B3.

The null hypothesis that no significant color difference can be noticed between spectrophotometric color coordinates of maxillary incisors, canines, and molars has been disapproved in our study. The higher L* Values established for incisors compared to canines and molars are in agreement with the results obtained in other studies.[21] Molars were darker than canines, which, in turn, were darker than incisors. Although the VITA Easyshade spectrophotometer has its own light source, the reduced lightness of the molars and canines, in comparison with the incisors, may be correlated with the reduced incidental light in the posterior area of the dental arch. Concerning a* and b* color coordinates, molars seem to be more chromatic than canines, with incisors having the lowest a* and b* values.[22] The results of this study are in agreement with the study conducted by Chakroborty et al. on South Indian population. They observed that the canines were darker in shade compared to the lateral incisor and the lateral was darker than the central incisor. The human eye is not proficient to detect an unlimited range of color differences.[23] In the clinical study conducted by Pop–Ciutrila et al., the result showed that a total of 48.4% of the incisors corresponded to A1 shade, while B3 was the best match for 44.7% of molars which is in accordance with our study.[22] In cosmetic dentistry, the perception and acceptance of color difference is a highly debatable topic. Hence, to eliminate subjective variability, a digital spectrometer can be an effective tool.

Limitations of this study involve selected age groups, sample size, as well as gender differences. The sample size was not large enough to draw inferences for the general population, with regard to the age-group most subjects were female and of young age between 18–25 years, this could possibly be the reason that most common shades found in this study are of a lighter shade. The tooth shade is darker in males and becomes more saturated as age progresses. The shade was determined at the center of the tooth, due to the convex surface of the teeth, making it difficult for the correct placing of probe tip that will affect the shade reading. In addition, positioning errors of the probe tip cannot be excluded despite the use of a measuring jig, even though a higher reproducibility of measurements has been confirmed when an adjustment aid was used.[24]

Summary and Conclusion

For shade selection, in-depth knowledge of teeth color and its variation is paramount. To create esthetically pleasing restorations, exact shade selection and communication with the dental laboratory are necessary.

A study was conducted to evaluate the most common shade of maxillary central incisor, canine and first molar and to establish shade differences among teeth.

Within the limitations of this study, the most common classical shade of maxillary central incisor is A1, and the common shade found of maxillary canine and the first molar is B3 in a young population of 18–25 years. A definitive shade difference was observed as moved from central incisor to the canine.

What is Already Known on This Topic?

Shade difference exists between teeth in an individual. The shade of teeth is lighter in the young population and in females.

What Does This Study Add?

Comparison of demographic data of common shade of maxillary central incisor and canine. Measurement of shade using a digital spectrophotometer (VITA Easyshade) ensuring reliability and accuracy.

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