

# Evaluation of Shade Differences between Natural Anterior Teeth in Patients of Different Age Groups, Skin Tone, and Gender: A Computerized Cross-sectional Study

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## Abstract

**Introduction:** Tooth shade is one of the most significant factors affecting esthetics. It is general misconception in people that white bright teeth are more attractive than yellow teeth. However, we as dentists are aware of the fact that teeth shade vary with skin color, age, and gender.

**Purpose:** The purpose of this scientific paper is to evaluate shade differences between natural anterior teeth in patients of different age groups, gender and skin tone of Puducherry population using a digital camera and to subsequently feed the data into software to determine the shade.

**Materials and Methods:** A total of 100 individuals aged above 16 years were divided into four age groups: Group 1 - 16-25 years; Group 2 - 26-35 years; Group 3 - 36-45 years; Group 4 - >46 years participated in this study. Photographs of all the individuals were taken using Canon 5D Mark II camera of 24 pixel resolution with lens zoom of 24-105 mm using two Photopro 23 photographic umbrella lights with 500 W under standardized conditions. Later, they were fed into Adobe Photoshop software to obtain the values of hue, saturation, and brightness of the middle third of maxillary central incisor. Tooth shades were divided into four categories according to value, and skin tones were divided into three categories (fair, medium, and dark) using Revlon makeup shades as a guide. These data were analyzed using Kruskal–Wallis ANOVA  $H$  value test.

**Results:** Significant tooth shade differences were discovered among the subjects with skin colors ( $P < 0.001$ ). Persons with medium to dark skin tones were more likely to have teeth with higher values (lighter), whereas with lighter skin tones have lower values (darker). A higher incidence of males with darker teeth as compared to females was evident, and significant darkening of teeth was found to occur with advancing age irrespective of gender predilection.

**Conclusion:** Within the limitation of the study, tooth shade value, skin color, gender, and age were significantly correlated.

**Key words:** Age, Digital camera, Gender, Skin color, Tooth color

## INTRODUCTION

Prosthodontists have always been faced with the challenge of harmonizing tooth shade with a facial appearance in

fully edentulous patients. They suggest that the color of the teeth must harmonize with the surrounding environment such as skin, hair, eye color, and age all with the aim of enhancing facial esthetics. It is also suggested that the hue of artificial teeth should harmonize with the patient's complexion (Boucher *et al.*, 1975; Winkler, 1979). These authors also advocated the use of the color of the facial skin as one basic guide in selecting color for artificial teeth in Caucasians. The knowledge of human tooth color and its distribution are a very important in understanding of matching in esthetic dentistry (O'Brien *et al.*, 1997). He also

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Month of Submission : 02-2016  
Month of Peer Review : 03-2016  
Month of Acceptance : 03-2016  
Month of Publishing : 04-2016

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reported statistically significant color difference between the gingival to the incisal regions of teeth and that these differences are clinically significant. The illusion of greater contrast between skin color and tooth shade explains the perception among prosthodontists and restorative dentists that individuals with darker skin colors have lighter shades of teeth (Richardson, 2001).

A smile is the most visible record of a dentist's care. The significance of tooth shade in one's perception of smile attractiveness cannot be underestimated. In today's beauty conscious society, the demand for esthetic dentistry has increased a lot in last few years. Tooth shade is one of the most significant factors affecting esthetics.<sup>1</sup> It is general misconception in people that white bright teeth are more attractive than yellow teeth. However, we as dentists are aware of the fact that teeth shade vary with skin color, age, and gender. Tooth color has a strong correlation with age, generally becoming darker and yellower with time. As the age advances, the pulp chamber which is large during young age becomes smaller as a result of deposition of secondary dentin, making tooth more opaque. Many studies have shown that women have lighter and less yellow teeth than men. The color of the facial skin serves as the basic guides to tooth shade. The face is the frame into which the portrait (the teeth) will fit. Therefore, the shade of the teeth should harmonize with the color of the skin of the face.<sup>2</sup>

In past, various studies and surveys were conducted investigating the relationship of skin color to tooth shade. Some of these found inverse relationship between skin color and tooth shade while others found no relationship. These varying results can be attributed to the differences in the ethnic origin of the population studied. Bearing this view in mind, a study was planned to evaluate the shade differences of the natural anterior teeth in different skin color, age groups, and gender using digital method.<sup>3</sup>

## MATERIALS AND METHODS

This study was conducted to investigate the relationship between tooth shade value, age, gender, and skin color in the population of Puducherry, India. A total of 100 subjects belonging to different age groups, of equal distribution visiting the Department of Prosthodontics and Implantology, Mahatma Gandhi Post Graduate Institute of Dental Sciences, Puducherry were selected. In this study, subjects with a full complement of maxillary and mandibular anterior teeth without any endodontic therapy or restorations, developmental defects or disease were selected, to determine the skin color and shade of teeth.

Subjects who had a history of bleaching procedures, intrinsic, extrinsic or tetracycline staining, xerostomia, radiation therapy, smoking, or abnormalities in tooth development were excluded. Female subjects were specially asked not to wear any make-up, lipstick, or lip gloss.

### Determination of Shade of Teeth

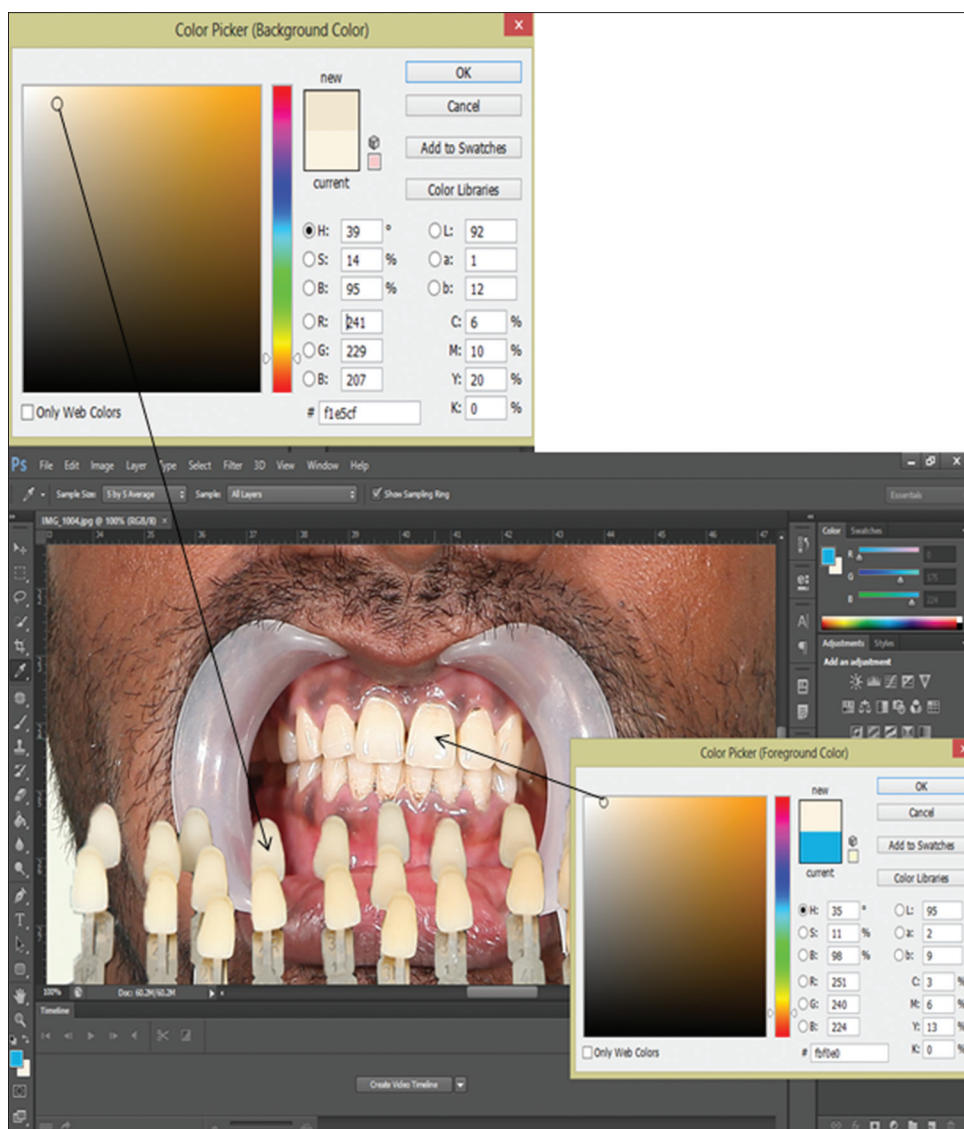
The subject was positioned upright with the mouth at the camera lens level and the camera's position at four feet distance from the subject (Figure 1). The camera used was Canon 5D Mark II of 24 pixel resolution with lens zoom of 24-105 mm using two Photopro 23 photographic umbrella lights with 500 W (Figure 2). Clinicians were screened for color vision deficiency with Ishihara test for color blindness, and no color vision deficiencies were found. Photographs were clicked and were fed into Adobe Photoshop software to obtain the values of hue, saturation, and brightness of the middle third of maxillary central incisor which was matched to the nearest values of Vita 3D master guide to obtain the tooth shade (Figure 3).



Figure 1: Standardization of lighting conditions and patient position



Figure 2: Canon 5D Mark II



**Figure 3: Tooth shade matching using Adobe Photoshop software**

### Determination of Skin Color

Skin tones were divided into three categories: Shade 1, fair; Shade 2, medium; Shade 3, dark with the use of Revlon foundation makeup shade guide. The vanilla, shell and nude shade groups of the Revlon compacts corresponded to the fair skin group; the natural beige, medium beige, and cool beige shades of the compact corresponded to the medium skin group, and the golden beige, rich ginger shades of the compact corresponded to the dark skin group. Shades beyond the deeper shades of the compact were categorized in the dark skin group (Figure 4).

## RESULTS

Variations in shades of permanent maxillary central incisor were determined in relation to gender, age and



**Figure 4: Revlon makeup shade guide for skin tone categorization**



also on the basis of skin tone, by applying Kruskal–Wallis ANOVA *H* value test. Our study comprised 100 patients, out of which 65 were males and 35 were females. They were equally distributed into four age groups of 25 each on the basis of chronological age (Table 1). A total of 26 different shades are represented in Vita 3D Master shade guide. Out of these, only 15 shades were recorded in our study sample. Overall, the most common shade recorded was 2R1.5 (14.0%) followed by 2R2.5 (12%), and 1M2 (12%) and LR1.5 (9.0%) (Table 2). In comparison to females, males had higher values (darker) (Table 3). When considering the value groups of the shade guide in relation to age groups, interesting results were found (Table 4). In Groups I and II, “Value 2” shades were the most common, whereas in Groups III and IV, “Value 3” shades were the most common. Relation to gender, the “medium” skin tone was most common among males, whereas the “light” skin tone was most common among females. When considering these skin tones in relation to the value groups, similar trends regarding tooth shades were seen in both “light” and “medium” skin tones, whereby “Value 2” shades were most common.

## DISCUSSION

This study tried to establish a relationship between shades of teeth and skin color of the individuals according to their age and gender. The importance of esthetics in dentistry has shown marked increase owing to new interest and public awareness. Tooth color was found to be one of the important factors affecting esthetics. Color is complex and encompasses both subjective and objective phenomena. The most popular method for describing color was the Munsell system (3,11-13).<sup>4</sup> It had been widely used in dentistry. The three attributes of color in this system were hue, value, and chroma. Hue was defined as the particular variety of a color, shade, or tint produced by a specific wavelength of light acting on the retina. Chroma was defined as the intensity of a hue that is amount of color saturating per unit area of an object. The value was defined as the relative lightness or darkness of a color or the brightness of an object. Value is considered to be of greater importance.

For tooth shade determination, we used the middle third site of the tooth because there was a color gradation in natural teeth from the incisal to the cervical areas. The middle site of the teeth was said to be best representative of its color because the incisal site was most often translucent and was affected by its background while the cervical color was modified by scattered light from the gingiva.

The color of the facial skin served as basic guide in shade selection of teeth. Specifically, it is suggested that the value

**Table 1: Distribution of patient's by age and gender**

Age	n (%)		
	Male	Female	Total
16-25	16 (24.6)	9 (25.7)	25 (25.0)
26-35	16 (24.6)	8 (22.9)	25 (25.0)
36-45	17 (26.2)	9 (25.7)	25 (25.0)
≥46	16 (24.6)	9 (25.7)	25 (25.0)
Total	65 (65.0)	35 (35.0)	100 (100.0)

**Table 2: Distribution of patient's by shade selected and gender**

Shade selected	n (%)		
	Male	Female	Total
1M1	1 (1.5)	1 (2.9)	2 (2.0)
1M2	6 (9.2)	6 (17.1)	12 (12.0)
2L1.5	7 (10.8)	3 (8.6)	10 (10.0)
2L2.5	1 (1.5)	0 (0.0)	1 (1.0)
2M1	4 (6.2)	6 (17.1)	10 (10.0)
2M2	4 (6.2)	4 (11.4)	8 (8.0)
2R1.5	8 (12.3)	6 (17.1)	14 (14.0)
2R2.5	9 (13.9)	3 (8.6)	12 (12.0)
3L1.5	5 (7.7)	1 (2.9)	6 (6.0)
3L2.5	7 (10.8)	2 (5.7)	9 (9.0)
3M1	3 (4.6)	0 (0.0)	3 (3.0)
3M2	6 (9.2)	3 (8.6)	9 (9.0)
3R1.5	1 (1.5)	0 (0.0)	1 (1.0)
4L2.5	1 (1.5)	0 (0.0)	1 (1.0)
4M2	2 (3.1)	0 (0.0)	2 (2.0)
Total	65 (65.0)	35 (35.0)	100 (100.0)

Kruskal–Wallis ANOVA *H* value=5.19, *P*=0.0228, *P*<0.05 (Significant at 5% level)

**Table 3: Distribution of patient's by value group and gender**

Value group	n (%)		
	Male	Female	Total
Value 1	7 (10.8)	7 (20.0)	14 (14.0)
Value 2	33 (50.8)	22 (62.9)	55 (55.0)
Value 3	22 (33.9)	6 (17.1)	28 (28.0)
Value 3	3 (4.6)	0 (0.0)	3 (3.0)
Total	65 (65.0)	35 (35.0)	100 (100.0)

Kruskal–Wallis ANOVA *H* value=5.14, *P*=0.0198, *P*<0.05 (Significant at 5% level)

**Table 4: Distribution of patient's by value group and skin tone**

Value group	Skin tone, n (%)			Total n (%)
	Light	Medium	Dark	
Value 1	6 (14.0)	6 (12.8)	2 (20.0)	14 (14)
Value 2	23 (53.5)	27 (57.5)	5 (50.0)	55 (55)
Value 3	13 (30.2)	12 (25.5)	3 (30.0)	28 (28)
Value 3	1 (2.3)	2 (4.3)	0 (0.0)	3 (3)
Total	43 (43.0)	47 (47.0)	10 (10.0)	100 (100)

of the teeth must correspond to darkness or lightness of the facial skin tone. Persons with medium and dark skin were more likely to have teeth in high-value category than

persons with fair skin color. These results are similar to the findings of Jahangiri *et al.*<sup>5</sup> who found inverse relationship between tooth shade and skin color in their study on multiracial population.

The results of this study showed that there was a significant relationship between shades of teeth and the age-groups selected. It was noted that with increasing age, there was a tendency for the teeth to be of darker shades, which was in accordance with other studies on the subject. In his study conducted in Baghdad, Hassan *et al.*<sup>6</sup> found that the number of patients exhibiting colors of gray and red-gray increased with increasing age and thereby supporting the findings of our study on the whole.

When considering the shades of teeth in relation to gender, we found that males exhibited darker shades than females of the same age group. This finding was supported by studies conducted by Esan *et al.*<sup>7</sup> and Guo *et al.* Their studies have found that gender was significantly associated with tooth shades, in that men were more likely to present with darker tooth shades, whereas women of the same age group were more likely to show lighter tooth shades.

In light of our findings, it is suggested that when dealing with the task of fabricating a complete denture, certain factors must always be borne in mind while selecting a suitable shade for use in their prostheses. The parameters included were age, gender and skin complexion of the patient. Thus, it is our impression that if all details are considered during tooth shade selection, a more life-like prosthesis can be provided to the patient.<sup>8</sup>

## CONCLUSION

Within the limitations of this study, the following conclusions were drawn:

1. Tooth shade is significantly associated with age of the

individuals, in that teeth tend to darken in color with advancing age which happens due to enamel wear and subsequent dentin exposure.

2. Tooth shade is also significantly associated with gender, in that males have relatively darker shade than females of the same age group.
3. Tooth shade is also significantly associated with color of the skin, in that people with lighter skin tones tend to have teeth with darker colors while those with darker skin tones possess teeth of lighter colors.<sup>9</sup>

## ACKNOWLEDGMENTS

The authors would like to thank Mr. Raja Raja Chozhan, MPR stills for his technical support.

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**How to cite this article:** Rekha SB, Padmasree S, Aparna N, Kumari R. Evaluation of Shade Differences Between Natural Anterior Teeth in Patients of Different Age Groups, Skin Tone and Gender: A Computerized Cross-sectional Study. Int J Sci Stud 2016;4(1):231-235.

**Source of Support:** Nil, **Conflict of Interest:** None declared.