

RELATIONSHIP OF AGE, GENDER AND SKIN TONE TO SHADES OF PERMANENT MAXILLARY CENTRAL INCISORS

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ABSTRACT

The objective of this study was to correlate shades of teeth to skin color according to age and gender. The study sample comprised 200 patients ranging in age from 16 to 55 years, divided into four age groups of 50 each. Shade of middle third of labial surface of maxillary central incisor was recorded visually with the help of Vitapan 3D-Master shade guide under standardized lighting. Color of back of the hands was recorded with the help of Ideal Balance Quick Stick makeup shades, and divided into three skin tone groups. The paired samples T-test was applied at 95% confidence interval. Our results revealed a significant association ($P < 0.001$) when either age or gender was correlated with shades of teeth and color of the skin. It was concluded that both tooth shade and skin color were strongly related with each other and with the age and gender of the patients. This information can be used effectively for fabrication of more life-like dentures.

Key words: Tooth color, skin color, shade guide, age, gender

INTRODUCTION

Natural teeth are known to possess different shades in their surfaces¹. Moreover, it has been found that the color of natural teeth is influenced by many factors. Age is the commonest of these. Light is perhaps one of the most important factors^{2,3} and unfortunately also the most commonly over-looked one. Contrast, for example that imparted by different skin complexions, is yet another factor that may influence the shades of natural teeth^{4,5}. Physiological variables such as color blindness may worsen the case still further^{6,7}. Still, there are many other factors (e.g. smoking, betel quid chewing, intrinsic/extrinsic staining) that can influence the shades of teeth in vivo^{4,6,8}.

It has been noted that aging process has a profound effect on the shade of teeth, in that teeth become

darker (decrease in lightness and increase in yellowness) and less translucent with advancing age^{4,9}. Therefore while selecting a tooth shade during fabrication of complete dentures, it is routine practice to select lighter shades for younger people and darker ones for older people¹⁰.

However, color of the skin (complexion) is also important when considering shades of natural teeth. In a recent study conducted in New Jersey, it was found that persons with medium-to-dark skin tones were more likely to have teeth with higher values (lighter shades) whereas individuals with lighter skin tones tended to have teeth with lower values (darker shades), regardless of their gender or age⁴.

Our understanding of dental shades is entirely based upon studies carried out in western countries.

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Furthermore, no local literature or research work is available on our population in this regard. Therefore, the purpose of this study was to gather the basic demographic data regarding tooth shade distribution in our local population in relation to age and gender, and to establish their association to color of the skin. If such an association is established, this information will be utilized in complete denture construction for persons belonging to different age groups.

The objectives of this study were to record the shade of middle-third of labial surface of permanent maxillary central incisor by using the Vitapan 3-D Master Shade Guide and to investigate the possibility of a relationship between shades of teeth and skin color on the basis of age and gender of the subjects.

The word "shade" in this article refers to the shade of middle-third of the labial surface of the clinical crown. The word "shade guide" refers to the Vitapan 3D-Master shade guide. The word "makeup" would refer to the Ideal Balance Quick Stick makeup.

MATERIALS AND METHODS

This was a cross-sectional comparative study conducted in the Department of Prosthodontics at Armed Forces Institute of Dentistry, Rawalpindi (Pakistan), for a duration of six months, from 18th September 2006 to 17th March 2007.

Our sample size consisted of 200 patients, which were selected through convenience non-probability sampling technique. For inclusion, patients of both genders were selected who presented with completely erupted permanent maxillary central incisors and within the age range starting from 16 years up to 55 years. Patients with permanent maxillary central incisors (left or right) exhibiting any of the following findings were excluded from the study: caries; any type of restoration; endodontic therapy; intrinsic or extrinsic staining (e.g. betel quid chewing, smoking, tetracycline etc.); dental erosion, attrition or abrasion; fracture lines; developmental anomalies including fluorosis; and orthodontic brackets or bands. Those patients were also excluded who presented with xerostomia, a history of tooth bleaching, and a history of radiation therapy. Those female patients were also excluded who were not willing to remove lipstick prior to shade evaluation.

Two hundred (200) patients coming to the Department of Prosthodontics for treatment purposes, whose permanent maxillary central incisors met the selection criteria mentioned above, were included in this study. They were divided on the basis of chronological age into 4 groups of 50 each. Age groups were: Group I, 16 to 25 years; Group II, 26 to 35 years; Group III, 36 to 45 years; and Group IV, 46 to 55 years.

The shade of middle third of labial surface of permanent maxillary left or right central incisor was taken by using the Vitapan 3D-Master shade guide (manufactured by VITA Zahnfabrik, Bad Sackingen, Germany). The individual shade numbers as mentioned on the shade tabs (e.g. 2M1, 3M2) were noted. Two operators were selected to take all the shade readings, after passing the Ishihara Color-blindness Test^{11,12}. They were properly educated to use the selected shade guide satisfactorily.

All shade readings were made at the start of an appointment to overcome the effects of dehydration. To overcome the effects of fatigue and tiring of the operator, following measures were also adopted: all shade readings were made preferably between 10:00 PM and 12:00 noon; shades were established within 1 to 2 minutes; and not more than 5 patients were seen by an observer in a day.

Consent was obtained from the patients prior to shade evaluation. Shades were taken by using an artificial light source (Philips Cool Daylight Energy Saver Lamp; 23W; 6500K; 50-60Hz; manufactured by Philips Co. China) that simulates natural daylight. This light source was kept about 2 feet away from the mouth of the patient and it was turned on about 5 minutes before shade taking. Rest of the operatory was illuminated by standard tube lights (set of 4 tube lights; TLD 18W/54; Phillips Co., Australia) in the ceiling about 8 feet high. Dental unit light was turned off.

Patients were draped with a gray-blue napkin, which also served to cover any bright clothes. Patients were asked to remove spectacles. Female patients were asked to remove any lipstick. Patients were asked to rinse the mouth with normal tap water prior to shade evaluation. Patients were viewed at eye-level so that the most color-sensitive part of the retina was used⁵. Eyes were rested immediately before taking a

shade reading and after every 10 seconds during the entire process. This was done by focusing on a gray-blue cloth for 5 seconds at a time².

All shade readings were made swiftly, from an arm's length distance². Shade tabs were moistened before placing them in the correct position on the inside of the upper lip next to the tooth being matched. First of all, the value (1, 2, 3, 4 or 5) was selected, starting from the darkest group. Next, chroma was selected from the same value group in the middle (M) column. Lastly, hue was selected by determining whether the natural tooth was more reddish (R-column) or more yellowish (L-column) than the shade sample¹³.

Next, skin color/tone was matched by using the Ideal Balance Quick Stick makeup shades (manufactured by L'Oreal Paris, France) as a guide. Skin tones were divided into 3 categories: light, medium and dark. Various shades of the makeup were arranged into corresponding skin tone groups devised. This distribution was as follows: "light" skin tone group included the soft ivory, pale, nude beige and natural beige shades of the makeup; "medium" skin tone group included the sand, buff, golden beige and sun beige shades of the makeup; and "dark" skin tone group included the caramel beige, crème café, cappuccino and cocoa shades of the makeup. Skin tone determinations were acquired from back of the hands so that the area was free of makeup or residues.

Statistical Package for Social Sciences (SPSS) version 10 was used to analyze the data. Variations in the shades of permanent maxillary central incisors were determined in relation to gender (male to female distribution), in relation to age, i.e., intra-group (within an age group) and inter-group (within different age groups), and also on the basis of skin tone, by applying the paired samples T-test at 95% confidence interval ($P < 0.05$ was considered significant).

RESULTS

Our study comprised 200 patients, out of which 132 were males and 68 were females. They were equally divided into 4 groups of 50 each on the basis of chronological age (Table 1).

A total of 26 different shades are represented in our shade guide. Out of these, only 20 shades were re-

corded in our study sample. The shades that were not recorded at all included 4L1.5, 4R1.5, 4R2.5, 5M1, 5M2 and 5M3. When considering the distribution of shades on basis of gender, it was found that all 20 shades recorded were present in the male subjects whereas only 15 different shades were present among the female subjects (Table 2)

Overall, the most common shade recorded was 2M1 (14.0%) followed by 3M2 (11.5%), and 1M1 (9.0%) and 2R1.5 (9.0%). Among the males, however, the most common shade was 3M2 (9.0%), followed by 1M1 (7.0%), and 2M1 (6.0%). Among the females, the most common shade was 2M1 (8.0%), followed by 3M1 (4.0%), and 2L1.5 and 2R1.5 (3.5% each). A more detailed view is presented in Table 2.

Out of the 200 patients included in the study, 87 (43.5%) cases had tooth shades in the "Value 2" shade group of the shade guide, 62 (31.0%) cases in "Value 3" shade group and 31 (15.5%) cases in the "Value 1" shade group of the shade guide. No shade was recorded for the "Value 5" shade group in our study (Table 3). Out of the 87 subjects exhibiting "Value 2" shades, 50 (57.5%) were males and 37 (42.5%) were females.

In Group I, out of the 50 cases included, 11 (5.5%) exhibited tooth shade 2M1, 10 (5.0%) had shade 2L1.5 while shades 1M1 and 1M2 were demonstrated by 7 (3.5%) subjects. Out of the 50 cases included in Group II, 10 (5.0%) had shade 2M1, 9 (4.5%) had shade 2R1.5 whereas 6 (3.0%) cases presented with shades 2M2 and 3M1. In Group III, 11 (5.5%) cases exhibited the shade 3M1, 6 (3.0%) with shades 1M1 and 3M2, while 5 (2.5%) cases had the shade 2L1.5. Out of the 50 subjects in Group IV, shade 3M2 was demonstrated by 10 (5.0%) cases, shade 2R1.5 by 6 (3.0%) cases, while both shades 2M2 and 4M2 were recorded in 5 (2.5%) cases.

When considering the value groups of the shade guide in relation to age groups, interesting results were found (Table 4). In Group I and Group II, "Value 2" shades were most common whereas in Group III and Group IV, "Value 3" shades were most common.

In our study, we divided the color of the skin (called as skin tone) into 3 groups. This distribution is given in Table 5. The medium skin tone was found to be the most common, with 102 (51.0%) cases bearing this tone. However, when considering the skin tone in

Age Group	Gender		Total
	Male	Female	
Group I	32	18	50
Group II	35	15	50
Group III	33	17	50
Group IV	32	18	50
Total	132	68	200

TABLE 1: DISTRIBUTION OF PATIENTS ACCORDING TO AGE GROUP AND GENDER

Shade Selected	Gender of Patient		Total	Percentage
	Male	Female		
1M1	14	4	18	9.0
1M2	10	3	13	6.5
2M1	12	16	28	14.0
2M2	10	5	15	7.5
2M3	5	1	6	3.0
2L1.5	10	7	17	8.5
2L2.5	1	1	2	1.0
2R1.5	11	7	18	9.0
2R2.5	1	-	1	0.5
3M1	9	8	17	8.5
3M2	18	5	23	11.5
3M3	3	1	4	2.0
3L1.5	7	2	9	4.5
3L2.5	1	-	1	0.5
3R1.5	3	3	6	3.0
3R2.5	2	-	2	1.0
4M1	1	4	5	2.5
4M2	7	1	8	4.0
4M3	4	-	4	2.0
4L2.5	3	-	3	1.5
Total	132	68	200	100.0

TABLE 2: DISTRIBUTION OF PATIENTS ACCORDING TO SHADE SELECTED AND GENDER

Value Group	Gender of Patients				Total	Percentage
	Male	%age	Female	%age		
Value 1 shades	24	12.0	7	3.5	31	15.5
Value 2 shades	50	25.0	37	18.5	87	43.5
Value 3 shades	43	21.5	19	9.5	62	31.0
Value 4 shades	15	7.5	5	2.5	20	10.0
Total	132	66.0	68	34.0	200	100.0

TABLE 3: DISTRIBUTION OF PATIENTS ACCORDING TO VALUE GROUP AND GENDER

Value Group	Age Group				Total
	Group I	Group II	Group III	Group IV	
Value 1 shades	14(28.0%)	8(16.0%)	9(18.0%)	–	31(15.5%)
Value 2 shades	30(60.0%)	25(50.0%)	15(30.0%)	17(34.0%)	87(43.5%)
Value 3 shades	4(8.0%)	17(34.0%)	23(46.0%)	18(36.0%)	62(31.0%)
Value 4 shades	2(4.0%)	–	3(6.0%)	15(30.0%)	20(10.0%)
Total	50	50	50	50	200(100.0%)

TABLE 4: DISTRIBUTION OF PATIENTS ACCORDING TO VALUE GROUP AND AGE GROUP

Tone	Gender of Patients				Total
	Male		Female		
Light	43	32.6%	45	66.2%	88
Medium	83	62.9%	19	27.9%	102
Dark	6	4.5%	4	5.9%	10
Total	132	100.0%	68	100.0%	200

TABLE 5: DISTRIBUTION OF PATIENTS ACCORDING TO SKIN TONE AND GENDER

Value Group	Skin Tone			Total
	Light	Medium	Dark	
Value 1 shades	12(13.6%)	17(16.7%)	2(20.0%)	31(15.5%)
Value 2 shades	37(42.0%)	46(45.1%)	4(40.0%)	87(43.5%)
Value 3 shades	30(34.1%)	28(27.5%)	4(40.0%)	62(31.0%)
Value 4 shades	9(10.2%)	11(10.8%)	–	20(10.0%)
Total	88(100.0%)	102(100.0%)	10(100.0%)	200(100.0%)

TABLE 6: DISTRIBUTION OF PATIENTS ACCORDING TO VALUE GROUP AND SKIN TONE

relation to gender, the “medium” skin tone was most common among males (62.9%) whereas the “light” skin tone was most common among females (66.2%). When considering these skin tones in relation to the value groups of the shade guide, similar trends regarding tooth shades were seen in both “light” and “medium” skin tones, whereby “Value 2” shades were most common (Table 6).

The paired samples T-test was applied at 95% confidence interval to determine the significance of our study objectives. There was a strong correlation of the study variables i.e. tooth shade and skin tone with age and gender of the patients. The study was highly significant ($P < 0.001$) when either age or gender was correlated with tooth shades. When tooth shades were correlated with skin tone of the patients, again a high

level of significance ($P < 0.001$) was obtained. The study was highly significant ($P < 0.001$) when either individual tooth shades or shade groups were correlated with the skin tone, age and gender of the patients.

DISCUSSION

This study tried to establish a relationship between shades of teeth and skin color of the individuals according to their age and gender.

Two methods exist for in vivo recording of tooth shade. One is the use of hi-tech instruments e.g. a spectrophotometer while the other is to use a color standard in the form of a commercially available shade guide¹⁴. Both techniques have inherent inaccuracies⁴. However in spite of being regarded as unreliable¹⁵, visual shade analysis remains the most commonly used

method in clinical dentistry because it is both quick and cost-effective⁶.

For tooth shade determination, we used the middle site of the tooth because there is a color gradation in natural teeth from the incisal to the cervical areas. The middle site of the teeth is said to be best representative of its color because the incisal site is most often translucent and is affected by its background while the cervical color is modified by scattered light from the gingiva^{16,17}.

Our results show that there is 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 is in accordance with other studies on the subject^{1,4,18-22}.

In his study conducted in Baghdad, Hassan¹ found that the number of patients exhibiting colors of grey and red-grey increased with increasing age, thereby supporting the findings of our study on the whole. Similar correlation was reported by Jahangiri et al⁴, where a significant association was found between tooth color and age of the patients, in that with advancing age, teeth tended to become darker in color. In another study conducted in Japanese population, Hasegawa et al²⁰ found that lightness value of the teeth at the center site decreased linearly with advancing age. They attributed this to an earlier finding by Goodkind et al¹⁹. It was seen that after the age of 35 years, teeth tended to become darker and more saturated in color at the center site, whereas the cervical site remained relatively unchanged in color, which may have been due to already thin enamel layer at the cervical portion of the teeth. In a recent study conducted by Hartmann et al¹⁸, it was suggested that probably it was darkening of the dentine core that led to an altered color in aged teeth. They also suggested that older individuals should be provided with complete dentures made from shades 3 or 4 teeth, in order to create an aged appearance in the dentures. In a similar study conducted by Esan et al²², it was found that the percentage of lighter tooth shades decreased with age and that of darker ones increased with age within an age group. These results also support the findings of our study that tooth shade is influenced by age of the individuals.

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 is supported by studies conducted by Esan et al²² and Guo et al²³. Their studies have found that gender is significantly associated with tooth shades, in that men are more likely to present with darker tooth shades whereas women of the same age group were more likely to show lighter tooth shades. However, there was one study conducted in China by Zhu et al²⁴ where it was concluded that men and women did not present any difference in color of anterior teeth. This finding could be related to the interpretation of their results, as they only looked at the tooth color on the whole and did not consider the CIE Lab values recorded. Even in their results with a spectrophotometer, they have reported positive correlation between the value of b^* and age while a negative correlation between values of L^* and a^* with age.

When considering tooth color in relation to color of the skin (skin tone), our results show a strong correlation. We found that individuals with darker skin tone tended to have teeth of lighter shades while those with lighter skin tone presented with relatively darker shades of teeth. This might be related to the phenomenon of contrast. This finding is well-supported by Jahangiri et al⁴. They concluded that persons with medium or dark skin tones were more likely to have teeth with higher values (lighter teeth), whereas individuals with light skin tone tended to have teeth with lower values (darker teeth), regardless of gender or age. However, in contrast to this, we found that tooth shades and skin tone were correlated with both gender and age of the individuals.

However, a few studies also disagree with the possibility of a relationship of tooth color with skin tone. In their study, Esan et al²² divided the tooth shades into two groups and skin complexion into two groups. They used Vita Lumin Vacuum shade guide for tooth shade analysis. Their shade guide has now been regarded as not representative of the entire natural tooth color space and hence their results should be considered inaccurate. Dummett and colleagues²⁵ also found no association between the facial skin complexion and tooth shades. Their shade guides also did not cover the entire range of natural tooth color, which is properly covered in the Vitapan 3 D Master shade guide

used in our study. Therefore, it is our impression that results of the present study are more authentic.

In light of our findings, it is suggested that when dealing with the task of fabricating a complete denture, certain factors must always be kept in mind while selecting a suitable shade for use in their prostheses. These include age, gender and skin complexion of the patient. 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.

However, it was also felt that there is a lack of published literature in the form of books and research articles on the subject. It is suggested that further research should be carried out with different shade guides available in the market to identify any other more accurate shade guide than the one used in our study. Furthermore, it is also suggested to fabricate a separate shade guide which is more representative of our local tooth shades, as in our study only 20 out of the available 26 shades were recorded. By having a custom-made shade guide available, it should be easier to select a suitable shade for denture construction.

CONCLUSIONS

Within the limitations of this study, the following conclusions can be drawn:

- 1 Tooth shade is significantly associated with age of the individuals, in that teeth tend to darken in color with advancing age.
- 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.

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