

Color differences between maxillar and mandibular incisors

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ABSTRACT

Context: Color difference between maxillar and mandibular incisors is an anticipated subject, and it will help dentists during color matching. **Aim:** The aim of this study was to evaluate color differences of the maxillar and mandibular incisors and to find out relationships between gender and age. **Materials and Methods:** This study was conducted on 125 participants (51 males and 74 females) between 16-63 age groups and totally over maxillar and mandibular 480 healthy teeth by using spectrophotometer. Color differences between teeth were calculated by using ΔE formula. One way ANOVA statistical analysis determined statistically significant differences between maxiller-central and mandibular-canine teeth for ΔL and Δb parameters ($P < 0.05$). **Results:** According to *t*-test result there were not a statistically significant color differences for women and men teeth ($P < 0.05$). Scheffe statistical analysis results showed statistically significant differences between mandibular central and mandibular canine for ΔL parameters on 16-27, 28-39, and 52-63 age groups; for Δb parameters, there were statistically significant differences between 16-27 and 40-51 age groups ($P < 0.05$). **Conclusion:** Women have more lighter teeth than men. Maxillar canines are more yellow and Maxillar centrals are more lighter than other incisors. 16-27, 28-39 age groups have more lighter teeth than 52-63 age groups and 16-27 age groups have more yellow teeth than 40-51 age groups.

Key words

Age, color, gender, incisors, mandibular, maxillar, population

INTRODUCTION

A smile is very important feature for personal communication.^[1] Beautiful smile needs to be pleasing tooth arrangement in harmony and esthetic restorations. Not only the surface form size and translucency of the material but color is also very important for esthetic restorations.

Color matching still remains one of the most discussing topics in clinical dentistry. When patients pay more attention to esthetics, precise color matching becomes even more integral to the success of an esthetic restoration.^[2] Dentists switch out of spectrophotometers for an accurate color matching.

Color perception can be affected by several factors such

as exhaustion, make up, aging, emotion, light in the room, and metamerism.^[3] Thus, spectrophotometers are considered as the most accurate, useful, and flexible instruments of overall color matching to eliminate subjective errors.^[4] In spectrophotometer, L^* is a measure of lightness, a^* and b^* values represent positions on a red: green and yellow: blue axis, respectively ($+a$ red, $-a$ green, $+b$ yellow, and b -blue).^[5]

According to a study tooth color is determined mainly by the color of (associated with the light scattering and absorption property) dentin.^[6] Dentin color of the teeth can be different each other for a person. For example, canine teeth seem to more muddy than other teeth in the mouth, but there is no study about amount of the color differences between canine and other teeth and also maxillar and mandibular incisal teeth. It may help dentists to production of dentures with natural appearance.

The aim of this study was to evaluate color differences of the maxillar and mandibular incisors and found out to relationships between tooth color and gender, age. The research hypothesis was that color differences would occur between canines and centrals, women and men, ages each other.

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MATERIALS AND METHODS

This study was conducted on 125 patients (51 males and 74 females) who consulted to Mustafa Kemal University Faculty of Dentistry. This research's Ethic committee number is B.30.2.MKU.0.01.01.00/3143/33-34. It was provided from Mustafa Kemal University department of Ethic committee. The age range of the patients is 16-63. In this study, the measurements were acquired over 480 healthy teeth in total (maxillar, mandibular canines, and central incisors) by using spectrophotometer ((Easyshade 1, Software version: 11 R(b), illuminant D65, 2° observer, Vita Zahnfabrik, Bad Sackingen, Germany). The patient's teeth were polished with pumice and water mixture before the color measurement was performed. The measurements were performed on the middle third of teeth. The measured teeth were completely healthy, and the teeth which were restored, cracked-sang, externally discolored, and abrasion or bleaching-applied were not included in this study. During the measurements, the teeth were not exposed to any direct light source and the measurements were performed under daylight [Figure 1]. Before each measurement, the device was calibrated and isolated with a single-use plastic cover in order to avoid contamination [Figure 2]. For each tooth, 3 measurement was performed, and L^* , a^* and b^* values were recorded. The color difference between teeth was calculated by using “ ΔE ” formula.^[7,8] The same examiner made all colorimetric measurements.

$$\Delta E = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

$$\Delta E = [(L_1^* - L_2^*)^2]^{1/2} + [a_1^* - a_2^*]^2 + [b_1^* - b_2^*]^2]^{1/2}$$

Statistical analysis

t-test statistical analysis was used for comparison of the colors according to gender. One-way ANOVA along with F test statistic analysis were used to find out if there were statistical differences between teeth, and also Scheffe analysis was used to determine between ages group differences.

RESULTS

According to *t*-test results, there was not a statistically significant color difference for maxiller-canine and maxiller-central incisors and also mandibular-canine and mandibular-central incisors between women and men ($P > 0.05$) [Table 1].

One-way ANOVA along with F test statistical analysis determined statistically significant differences between maxiller-central and mandibular-canine teeth for ΔL and Δb parameters ($P < 0.05$) [Table 2].

Scheffe statistical analysis results showed statistically



Figure 1: Color measurement of the tooth



Figure 2: Calibration of the spectrophotometer

Table 1: *t*-test results for maxillar and mandibular canine and central teeth color differences according to gender

Teeth	Gender	n	SD	P
Max canine-Max central ΔE	Woman	74	4.63	0.82
	Man	51	4.66	
Max canine-Max central ΔL	Woman	74	5.06	0.09
	Man	51	5.03	
Max canine-Max central Δa	Woman	74	1.54	0.84
	Man	51	1.69	
Max canine-Max central Δb	Woman	74	5.53	0.97
	Man	51	6.05	
Mand canine-Mand central ΔE	Woman	74	8.29	0.22
	Man	51	4.45	
Mand canine-Mand central ΔL	Woman	74	9.63	0.22
	Man	51	5.85	
Mand canine-Mand central Δa	Woman	74	1.69	0.21
	Man	51	1.72	
Mand canine-Mand central Δb	Woman	74	4.45	0.11
	Man	51	4.9	

($\alpha = 0.05$) SD: Standard deviation, Max: Maxillar, Mand: Mandibular

significant differences between mandibular central and mandibular canine for ΔL parameters on 16-27, 52-63, 28-39, and 52-63 age groups; for Δb parameters, there was a statistically significant difference between 16-27 and 40-51 age groups ($P < 0.05$) [Table 3].

DISCUSSION

The hypothesis was partially rejected. Color differences between central and canine teeth vary in different countries and regions because of ethnic variety and environmental factors. In our study, we have found that the highest L^* values measured from maxillary central incisors and higher b^* values on maxillary canine teeth, which is consistent with previous studies.^[9-11]

Among the measurement of different tooth area's color coordinates, the middle third of labial surface showed the most confident results.^[12] In general, the actual color of a tooth is stated in only middle third of the tooth, because the range of color changes from the incisal to gingival areas.^[13,14] According to studies,^[15,16] different 5 areas of the labial surface of the central incisors found significant differences in $L^*a^*b^*$ values. The translucency of teeth was also stated to decrease from the incisal site towards the central site.^[16] Therefore, color measurements were performed from the middle third of the teeth.

The use of spectrophotometer is more objective and reliable method to conventional shade guides (%93.3)^[17] because of elimination of the subjective variance and environmental effects. A spectrophotometer was used to measure tooth colors to have precious results.^[18]

According to studies,^[19,20] which performed with using spectrophotometer, reported nearly the same color coordinate ranges of natural teeth: $L^*=55.5-89.6$ and $L^*=58.7-88.7$; $a^*=4.2-7.3$ and $a^*=3.6-7.0$; and $b^*=3.6-38.9$ and $b^*=3.7-37.3$. L^* and a^* values color coordinate intervals are consistent but a^* values are inconsistent from our study. It may arise from regional differences.

The central incisor's color coordinate measurement was easier because of their flatter surface, but errors in measurements appeared mostly because of their high translucency, which is greater than canines.^[21,22] Therefore, 3 measurements were acquired for each tooth, and mean values of the measurements were calculated in order to increase the reliability of the results

Maximum L^* value was on maxillary central, and minimum L^* value was on maxillary canine, maximum b^* value was on maxillary canine, and minimum b^* value was on mandibular central teeth as reported by previous

Table 2: One-way ANOVA results for color differences in ages

Teeth	P
Max central-Max canine ΔE	0.59
Max central-Max canine ΔL	0.33
Max central-Max canine Δa	0.85
Max central-Max canine Δb	0.85
Mand central-Mand canine ΔE	0.46
Mand central-Mand canine ΔL	0.00
Mand central-Mand canine Δa	0.30
Mand central-Mand canine Δb	0.02

($\alpha=0.05$)

Table 3: Scheffe test results for age groups

Dependent variable	Age	Age	Std. error	P
Mand central-Mand canine ΔL	16-27	28-39	1.7	0.95
		40-51	2.13	0.38
		52-63	2.21	0.02
	28-39	40-51	2.15	0.19
		52-63	2.23	0.01
		40-51	2.57	0.64
Mand central-Mand canine Δb	16-27	28-39	0.97	0.82
		40-51	1.22	0.05
		52-63	1.27	0.25
	28-39	40-51	1.23	0.24
		52-63	1.28	0.65
		40-51	1.47	0.94

($\alpha=0.05$)

Table 4: L, a, b mean values of the teeth

	Maxillary canine	Mandibular central	Maxillary canine	Mandibular canine
L	82.04 (4.85)	80.94 (5.57)	78.23 (5.06)	79.66 (8.20)
a	-0.25 (1.52)	0.65 (1.48)	2.06 (1.52)	1.68 (1.49)
b	20.02 (5.75)	19.77 (4.67)	29.81 (5.08)	29.31 (4.24)

studies^[15,16] in addition to this study Maximum a^* value was on maxillary canine and minimum a^* value was on maxillary central teeth for this study [Table 4].

There are no significant differences in tooth color between males and females for this study as other studies.^[15,23] Women had lighter ($+L^*$), more green ($-a^*$) and less yellow ($-b^*$) teeth than men for his study as previous study.^[24] L^* value was approximately 2.2 units higher, a^* value was 0.4 unit more green and $b^*=2.9$ unit lower in females than in males for maxillary central incisors in this study.

The limitations of this study were: Number of the participants may be limited for the prevalence study, and it was acquired from only one province of the Turkey, so further researches are needed to explore tooth color differences among each other.

CONCLUSION

Within the limitations of this study, results suggest that:

- Women have more lighter incisor teeth than men,
- Maxillary canines are more yellow and maxillary centrals are more lighter than other incisors,
- 16-27, 28-39 age groups have more lighter teeth than 52-63 age groups, and 16-27 age groups have more yellow teeth than 40-51 age groups in Turkish population.

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