ORIGINAL ARTICLE

Color differences between maxillar and mandibular incisors

Ali Riza Tuncdemir, Serdar Polat, Caner Ozturk, Makbule Tugba Tuncdemir[1], Ahmet Yalcın Gungor[2]

Department of Prosthodontics, Mustafa Kemal University, Hatay, [1]Department of Conservative Dentistry, Inonu University, Malatya, [2]Department of Orthodontics, Akdeniz University, Antalya, Turkiye

Address for corresondence:
Dr. Ali Riza Tuncdemir,
Department of Prosthodontics,
Mustafa Kemal University, Hatay, Turkey.
E-mail: alirizatuncdemir@gmail.com

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 incical 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.

Access this article online	
Quick Response Code:	Website: www.ejgd.org
	DOI: 10.4103/2278-9626.105381

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.

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

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

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	

(α=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 maxillar central incisors and higher b^* values on maxillar 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 maxillar central, and minimum L^* value was on maxillar canine, maximum b^* value was on maxiller canine, and minimum b^* value was on mandibular central teeth as reported by previous studies[15,16] in addition to this study Maximum a^* value was on maxillar canine and minimum a^* value was on maxillar central teeth for this study [Table 4].

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

(α=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	52-63	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	52-63	1.47	0.94

(α=0.05)

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

	Maxillar canine	Mandibular central	Maxillar 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)

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 fort 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 researchses 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,
- 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 in Turkish population.

ACKNOWLEDGMENT

This study was supported by Mustafa Kemal University Scientific Research Section.

REFERENCES

1. Hattab FN, Qudeimat MA, Al-Rimawi HS. Dental discoloration: An overview. Journal of Esthetic Dent 1999;11:291-310.
2. Nagai IS, Yoshida A, Sakai M, Kristiansen J, Silva JD. Clinical evaluation of perceptibility of color differences between natural teeth and all-ceramic crowns. J of Dent 2009;37:57-63.
3. Bilmeyer FW, Saltzmaan M. Principle of Color Technology. 2nd ed. Chichester, 85–89, Chapter 2, 34–47, Chapter 3, New York: John Wiley and Sons; 1981.
4. Paul SJ, Peter A, Rodoni L, Pietrobon N. Conventional visual vs spectrophotometric shade taking for porcelain-fused-tometal crowns: A clinical comparison. Int J of Perio and Rest Dent 2004;24:222-31.
5. Seghi RR, Johnston WM, O'brien WJ. Spetrophotometric analysis of Color differences between porcelain systems. J Prosthet Dent 1986;56:35-40.
6. Ten Bosch JJ, Coops JC. Tooth color and reflectance as related to light scattering and enamel hardness. J Dent Res 1995;74:374-80.
7. Heydecke G, Zhang F, Razzoog ME**.** *In vitro* colour stability of double layer veneers after accelerated aging. J Prosthet Dent 2001;85:551-7.
8. Setz J, Engel E. *In vivo* color stability of resin-veneered telescopic dentures: A double blind pilot study. J Prosthet Dent 1997;77:486-91.
9. Eiffler C, Cevirgen E, Helling S, Zornek J, Pritsch M, Hassel AJ. Differences in lightness, chroma, and hue in the anterior teeth of quinquagenarians and septuagenarians. Clin Oral Invest 2010;14:587-91.
10. Goodkind RJ, Schwabacher WB. Use of a fiber-optic colorimeter for *in vivo* color measurements of 2830 anterior teeth. J Prosthet Dent 1987;58:535-42.
11. Dozić A, Kleverlaan CJ, Aartman IH, Feilzer AJ. Relations in color among maxillary incisors and canines. Dent Mater 2005;21:187-91.
12. Karamouzos A, Papadopoulos MA, Kolokithas G, Athanasiou AE. Precision of *in vivo* spectrophotometric color evaluation of natural teeth. J of Oral Rehabil 2007;34:613-21.
13. Mayekar SM. Shades of a color illusion or reality? Dental Clinics of North America 2001;45:155-72.
14. Okubo SR, Kanawati A, Richards MW, Childress S. Evaluation of visual and instrument shade matching. J of Prosthet Dent 1998;80:642-8.
15. Hasegawa A, Motonomi A, Ikeda I, Kawaguchi S. Color of natural tooth crown in Japanese people. Color Res Appl 2000;25:43-8.
16. Hasegawa A, Ikeda I, Kawaguchi S. Color and translucency of *in vivo* natural central incisors. J Prosthet Dent 2000;83:418-23.
17. Paul S, Peter A, Pietrobon N, Hammerle CH. Visual and spectrophotometric shade analysis of human teeth. J Dent Res 2002;81:578-82.
18. Nagai I, Yoshida A, Sakai M, Kristiansen J, Silva JS. Clinical evaluation of perceptibility of color differences between natural teeth and all-ceramic crowns. Journal of Dent 2009;37:57-63.
19. Yuan JC, Brewer JD, Monaco EA, Davis EL. Defining a natural tooth color space based on a 3-dimensional shade system. J Prosthet Dent 2007;98:110-9.
20. Paravina RD, O'Keefe KL, Kuljic BL. Color of permanent teeth: A prospective clinical study. Balkan J Stomatol 2006;10:93-7.
21. Hassel AJ, Grossmann AC, Schmitter M, Balke Z, Buzello AM. Interexaminer reliability in clinical measurement of L*C*h* values of anterior teeth using a spectrophotometer. Int J Prosthodont 2007;20:79-84.
22. Van der Burgt TP, Ten Bosch JJ, Borsboom PC, Kortsmit WJ. A comparison of a new and conventional methods for quantification of tooth color. J Prosthet Dent 1990;63:155-62.
23. Jahangiri L, Reinhardt SB, Mehra RV, Matheson PB. Relationship between tooth shade value and skin color: An obsevational study. J Prosthet Dent 2002;87:149-152.
24. Odioso LL, Gibb RD, Gerlach RW. Impact of demographic, behavioural, and dental care utilization parameters on tooth color and personel satisfaction. Compend Contin Educ Dent Suppl 2000;21:35-41.

How to cite this article: Tuncdemir AR, Polat S, Ozturk C, Tuncdemir MT, Gungor AY. Color differences between maxillar and mandibular incisors. Eur J Gen Dent 2012;1:170-3.

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