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Effect of the Age on Central Incisors and Canine Teeth Color Correlation

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Abstract

Aim: The objective was to determine whether there were significant correlations in the three color coordinates of central incisors and canine teeth with age such as the Commission Internationale de l'Eclairage (CIE) L*, a*, b* system.

Materials and Methods: The natural maxillary central incisor and maxillary canine teeth of a sample of 302 individuals (n=104 male, n=168 female) were measured by the Vita Easyshade V spectrophotometer. Pearson correlations between each pair of the color coordinates were determined ($p<0.01$).

Results: Based on correlation analyses, for central incisors all the color coordinate parameters showed significant correlations but there was no correlation for canine teeth with all of three parameters.

Conclusions: When age increases, the central incisors become darker, more red, and more yellow. The same correlation was found for the canine teth but the result is not significant.

Keywords Canine; Central incisor; Color correlation; Spectrophotometer

Introduction

Color matching of teeth in dentistry is a difficult task [1]. The high aesthetic demands of patients has led to the development of color measurement devices that allow an objective choice of shade values.

The ability to measure tooth color accurately is one of the most important challenges in maintaining the aesthetic appearance of dental restorations because each material has its own unique spectral reflectance. Even if the color of the two materials looks the same under certain lighting conditions may not look the same under different lighting conditions due to metameric matching phenomenon [2].

The primary requirement for the conversion of spectrophotometric measurements to color parameters is the specification of both the illuminant and the observer. The lack of standardization in production leads to inconsistent results from shade guides even if they are produced by the same manufacturer [3]. Additionally the color and appearance of the teeth are influenced by many factors such as environment lighting condition, translucency, opacity, light scattering, surface structure, optical properties of the material used, irradiance and human perception [4]. Yet the human eye has the ability to perceive even very small color differences as comparable. Thereby, the contact of color deviation and validation is currently unsatisfying [5].

Color of teeth is strongly determined by dentin, with more translucent enamel who plays the lesser role through scattering at wavelengths in the blue range [6]. The main source of light scattering in the dentin is the tubules and hydroxyapatite crystals is a significant contribution to the scattering in the enamel [7].

The CIE color model is a color space model created by the International Commission on Illumination known as the Commission Internationale de l'Elcairage (CIE). It is also known as the CIE XYZ color space or the CIE 1931 XYZ color space [8].

The CIE color model is a mapping system that uses tristimulus values, which are plotted on a 3D space [9]. When these values are combined, they can reproduce any color that a human eye can perceive. The CIE specification is supposed to be able to accurately represent every single color the human eye can perceive [10].

CIELAB indicates the values with three axes: L^*, a^*, and b^*[11]. The central vertical axis represents lightness (L^*) whose values run from 0 (black) to 100 (white). Other axes values run from positive to negative. On the a-a' axis, positive values indicate amounts of red while negative values indicate amounts of green. On the b-b' axis, yellow is positive and blue is negative [12]. For both axes, zero is neutral gray.

Previous studies on the color correlations investigated only maxillary central incisor [13,14]. Therefore, quantification of the color correlations among the canine and central incisor teeth would provide broader insights for the color selection. The working hypotheses were the color coordinate parameters of this teeth were significantly correlated with age. The purposes were to determine whether there were significant correlations.

Materials and Methods

Human subject approval was obtained from The Ethical Board of Necmettin Erbakan University. A detailed case history was taken for all

patients. Maxillary central incisor and maxillary canine teeth was used for shade matching.

The following criteria's were used for selection of patients. Exclusion criteria is medical and physical systemic problem, gingival inflammation or gingival hyperplasia, gingival recession, history of bleaching treatment, visible tooth staining, caries and composite fillings. Inclusion criteria is healthy maxillary central incisor and maxillery canine tooth.

The natural maxillary central incisor and maxillary canine teeth of a sample of 272 individuals (n=104 male, n=168 female) were measured.

Color recordings were performed by clinician using a Vita Easyshade spectrophotometer (Vita Easyshade V; Vita Zahnfabrik) according to the manufacturer's instructions. This digital shade matching device which uses D-65 illumination for color selection had previously been subjected to a validation test, in order to evaluate its reproducibility and reliability. Each tooth was measured once, so that a total of 544 teeth were measured in the final. Before measurements in every volunteer, an infection control shield was placed on the probe tip. To prevent the probe tip from slipping on teeth surfaces and to ensure that measurements were obtained from the same position, respectively from the middle third of the labial tooth surface. In order to mimic a standardized clinical situation, all measurements were performed under artificial light conditions, in a same dental clinic. The L^*, a^*, b^* variables were recorded.

The data were analysed using SPSS 10.0 statistical software (SPSS Inc., Chicago, IL, USA). The correlation between central incisors and canine teeth color were analyzed with pearson corelation coefficient. It is the method of measuring the association between variables of interest because it is based on the method of covariance. It gives information about the magnitude of the association, or correlation, as well as the direction of the relationship.

Results

This study comprised 272 individuals, out of which in the age range of 15 years to 75 years. The mean age of these participants was 32.76 and the standard deviation was 12.44.

The minimum and maximum values were 61,8 and 89,5 for central incisors L^* parameter, -3,1 and 5,1 for a^*, 9,9 and 39,7 for b^*. Canine teeth L^* parameter, the minimum was 51,5 and the maximum was 84,8; and for a^* , the minimum was -3,5 and the maximum was 8,5, and for b^* , the minimum was 8,6 and the maximum was 39,5.

Table 1 shows mean values and standart deviations of the age and L^*, a^*, b^* values of central incisors and canine teeth. Central incisors L^* parameters mean value is higher than canines but a^* and b^* parameters mean value are lower.

Table 2 shows the pearson corelation coefficient and significant result among them. There was a significant positive correlation between age and central incisors a^* and b^* parameters and significant negative correlations age and central incisors L^* parameter, but no correlation was found for age and canine teeths all off three parameters.

	Age	L^*-I	a^*-I	b^*-I	L^*-C	a^*-C	b^*-C
Mean	32,76	76,71	0,48	18,72	72,33	2,44	24,22
Std. Deviation	12,44	5,79	1,32	5,43	6,63	7,07	7,39

Table 1: Mean values and standart deviations of the age and L^*, a^*, b^* values of central incisors and canine teeth; $p<0.01$; L^*-I : central incisors L^* parameter; a^*-I : central incisors a^* parameter; b^*-I : central incisors b^* parameter; L^*-C : canine teeth L^* parameter; a^*-C : canine teeth a^* parameter; b^*-C : canin teeth b^* parameter.

		L^*-I	a^*-I	b^*-I	L^*-C	a^*-C	b^*-C
Age	**Pearson Correlation (r)**	-,31	,21	,35	-,1	-,01	,14
	Sig. (2-tailed)	**	**	**			*

Table 2: Pearson corelation coefficient and significant result among them; L^*-I : central incisors L^* parameter; L^*-C : canine teeth L^* parameter; a^*-I : central incisors a^* parameter; a^*-C:canine teeth a^* parameter; b^*-I : central incisors b^* parameter; b^*-C : canine teeth b^* parameter** ; Correlation is significant at the 0.01 level, * : Correlation is significant at the 0.05 level.

Discussion

The first working hypothesis that the 'color coordinate parameters of the teeth were significantly correlated with age' was accepted for central incisors but not for canine teeth because the color parameters of central incisors were significantly correlated but there was no correlation for the canine teeth.

As shown in Table 2, a significant negative correlation was observed between the central incisors L^* parameter and age, which is r=-0,31. L^* value is the value of brightness of the tooth. The increase in this value indicates that the tooth color is approaching white. That is, as the age increases, brightness value of the central incisor decrease. For the a^* parameter, the value of r was found to be a 0,21. The a^* parameter indicates the red-green value of the tooth, in which there is significant positive corelation between the a^* value of central incisors and age. For the b^* parameter, the value of r is found to be 0.35, which is significant positive correlation was found for central incisors b^* value and age. The b^* parameter indicates the yellow-blue value of the tooth color, and as the age increases yellow and red value of the central teeth increase too. For the canine teeth there was a negative correlation between age and L^* value, and positive correlation between a^* and b^* values but none were significant ($p<0.01$). A lack of correlation in the canine teeth might be have a thicker and darker dentin structure which is the main factor affecting tooth color [15]. Although the enamel color has probably changed with age but the thicker and darker dentine color masks this situation [16].

Along with the increase in demand for aesthetic appearance, the choice of color and restorations with proper anatomical form have become more important for dentists. In addition to providing the natural morphology of the teeth in the aesthetic success of the prosthetic restorations made, it is also a very important parameter that the color is harmonious [17].

In this study, tooth color measurement was performed with Vita Easyshade V device. The reason for this is the innovative software concept in combination with the VITA V Brain neural network guarantees exact tooth-shade determination in accordance with the internationally established shade systems VITA classical A1-D4, VITA SYSTEM 3D-MASTER and VITABLOCS, as well as the bleached shades defined by the American Dental Association.

Conventional and digital systems were used to measure tooth color in previous studies [18]. Digital devices provide more reliable results than conventional systems because they can provide a standard measurement of color [19]. It has been reported that digital devices give better results when these systems are compared. Chen et al. reported that spectrophotometer measurements gave more accurate results in their review study [20].

There are studies investigating the effect of background color when measuring tooth color. Ma et al. reported that the background color of the study did not affect the restoration color [21], but some studies have reported otherwise [22].

Dozic et al., were found positive correlations between the central and canine teeth in all of the L^*, a^* and b^* values [23].

Limitations of this study; Increasing the number of samples will make the result more significant. The morphology of the teeth being measured is also an important factor in terms of the precise of the result. Although the central teeth have a more flat labial surface, the labial ridge of the canine teeth prevented a clear connection with the flat end of the device, thus affecting the accuracy of the measurement [24]. In addition, all measurements in this study were made in the same device. The use of different devices can change the results.

Conclusion

Within the limitations of this study, age is correlated with each CIELAB color parameter ofcentral incisors. When age increases, the central incisors become darker, more red, and more yellow. The same correlation was found for the canine teeth but the result is not significant.

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