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# VARIJACIJA U BOJI LABIJALNE POVRŠINE GORNJIH CENTRALNIH SEKUTIĆA

## VARIATION IN THE COLOR OF THE LABIAL SURFACE OF THE UPPER CENTRAL INCISORS

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### Sažetak

**Uvod:** Tokom procesa starenja, organi i tkiva čoveka podležu strukturnim i funkcionalnim promenama, koje se takođe mogu registrovati i na zubima, usled promene njihove boje i strukture.

**Cilj** ove studije bio je da se utvrdi varijacija u boji labijalne površine gornjih centralnih sekutića u gingivalnoj, srednjoj i incizalnoj trećini.

**Materijali i metode:** Istraživanje je sprovedeno kod 52 pacijenta. Istraživanje je obuhvatilo 103 zdrava, vitalna gornja centralna sekutića. Analizirane su gingivalna, srednja i incizalna površina gornjih centralnih sekutića, vizuelnom metodom uz pomoć ključa za boju (Philips zoom shade guide). Nijanse za boju su podeljene u tri grupe: svetle, srednje boje i tamne. Statistička analiza je urađena korišćenjem Hi kvadrat i Mann-Whitney U testa u IBM SPSS verzija 26.0, sa nivoom statističke značajnosti postavljenim na  $p < 0,001$ .

**Rezultati:** Kod najvećeg broja muškaraca (46,8%) na gingivalnim trećinama zuba su registrovane srednje nijanse boja, dok su na srednjim i incizalnim trećinama zuba u najvećem broju slučajeva uočene svetle nijanse (66% i 80,9%). Kod većine ženskih ispitanika gingivalne, srednje i incizalne trećine labijalnih površina gornjih centralnih sekutića imale su svetle nijanse (69,6%, 92,9%, 94,6%). Uočeno je da boje nisu podjednako raspoređene prema trećinama zuba kod ispitanika oba pola ( $p=0,000$ ).

**Zaključak:** Boja zuba varira među ispitanim trećinama zuba. Ispitanici ženskog pola su imali svetlije nijanse zuba u odnosu na muškarce.

**KLjučne reči:** boja zuba, centralni sekutići, ključ za boju

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### Abstract

**Introduction:** During the ageing process, human organs and tissues undergo structural and functional changes which can also be registered in the teeth, due to changes in their color and structure.

**The aim** of this study was to determine the color variation of the labial surface of the upper central incisors in the gingival, middle and incisal thirds.

**Materials and Methods:** The research was conducted on 52 dental students and included 103 healthy, vital upper central incisors. The gingival, middle, and incisal surfaces of the upper central incisors were analyzed using a visual method, with the help of a color key. Color shades were divided into three groups: light, medium and dark. Statistical analysis was performed using the Chi-square and Mann-Whitney U test in IBM SPSS version 26.0, with the level of statistical significance set at  $p < 0.001$ .

**Results:** In the largest number of male students (46.8%), medium shades of color were registered in the gingival thirds of the teeth, while light shades were observed in the middle and incisal thirds of the teeth in the largest number of cases (66% and 80.9%, respectively). In the majority of female students, the gingival, middle, and incisal thirds of the labial surfaces of the upper central incisors had light shades (69.6%, 92.9%, 94.6%, respectively). It was observed that the colors were not equally distributed according to the thirds of the teeth in subjects of both sexes ( $p < 0.001$ ).

**Conclusion:** Tooth color varies among the thirds of teeth examined. Female subjects had lighter shades of teeth compared to males.

**Key words:** tooth color, central incisors, color key

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## Introduction

The phenomenon of tooth color has a significant social impact, as confirmed by numerous studies. The results of those studies indicate that people with whitened teeth are considered younger and more attractive<sup>1</sup>. Besides contributing to the aesthetic experience, the importance of tooth color is also reflected in the motivation to maintain oral health. A study by Vlasov et al.<sup>2</sup> concluded that after teeth whitening, patients showed a significantly greater interest in taking care of oral hygiene and regular dental examinations. These findings highlight a deeper social and psychological aspect of tooth color in the context of the perception of beauty and preservation of oral health.

Natural tooth color is the result of a complex set of factors such as illumination, light scattering and translucency. The color of the teeth is determined by numerous factors such as the structure and thickness of the hard dental tissues, which can vary from individual to individual. In addition, bad habits such as smoking and drinking colored drinks can affect the color of the teeth. Dental diseases as well as endodontic dental treatments, during which various medications are used, can affect the color of the teeth<sup>3</sup>.

During the ageing process, human organs and tissues undergo structural and functional changes. These changes can also be registered in the teeth, due to changes in their color and structure. Therefore, the color of the teeth and their structure can serve as an additional factor in estimating the age of a person<sup>4</sup>. While numerous studies have indicated significant changes in the color of the teeth that occur with ageing significantly more in men<sup>5</sup>, other studies have pointed out that women have significantly lighter teeth<sup>6</sup>. Researches that examined tooth color variations in different groups of teeth observed significant differences in the color of different groups of teeth of the same individuals<sup>5,6</sup>.

Studying tooth color variations in relation to the region of the tooth is important in order to obtain information that can be useful in achieving the desired aesthetic results during tooth restoration, which can be achieved by using restorative materials of different colors and shades.

Due to the greater and more serious demands of patients in the field of dental aesthetics, various methods for determining the color of teeth are being developed. We can measure tooth color by visual methods or

instrumental methods using a colorimeter<sup>3</sup>. The visual method is the most frequent method in modern dental practice for determining tooth color shades<sup>5</sup>.

The aim of this study was to determine the differences in the color of maxillary first incisors in dental students, specifically focusing on the gingival, middle, and incisal thirds of the teeth.

## Materials and Methods

The research was conducted at the Clinic of Dental Medicine, Faculty of Medicine, University of Niš in the period from January to March 2024. This research was conducted on 52 fourth-year dental students (24 male and 28 female students) aged 22 to 23 years. In the research, 103 maxillary upper incisors were examined.

The teeth included in this study were healthy, vital upper central incisors, without carious lesions as well as teeth that were not exposed to the bleaching process. Restored teeth as well as teeth with any prosthetic restoration or fracture were excluded from the study. Before the actual color determination procedure, each tooth was carefully cleaned of hard and soft dental deposits and polished with an eraser and abrasive paste.

Determining the color of the teeth was done visually using a color guide (Philips Zoom shade guide). By observing the labial surfaces of the upper central incisors, the shade of color was determined individually for the incisal, middle and gingival thirds. Dental observation was done by one researcher in daylight, without direct sunlight after a short observation without intense colors and contrast in the visual field. Color shades were divided into three groups: light, medium and dark.

Statistical analysis was performed using the Chi-square and Mann–Whitney U test in IBM SPSS version 26.0, with the level of statistical significance set at  $p < 0.001$ .

## Results

A statistically significant difference was observed in the distribution of colors according to the thirds of teeth in male students ( $p = 0.004$ ). In the largest number of males (46.8%), medium shades of color were registered in the gingival thirds of the teeth, while light shades were observed in the middle and incisal thirds of the teeth in the largest number of cases (66% and 80.9%) (Table 1).

The chi-square test revealed a significant difference in the distribution of colors according to the thirds of teeth in female students ( $p = 0.001$ ).

Although in the majority of female students the gingival thirds of the labial surfaces of the maxillary incisors were of a light

shade, a significantly smaller number of female subjects had light gingival (69.9%) thirds of the teeth, compared to the number of female subjects in whom a light shade of color was observed in the middle (92.9%) and incisal (94.6%) thirds of teeth (Table 2).

**Table 1.** Color distribution according to the thirds of teeth in male subjects

		Color			Number of examined teeth	Chi-square test
		Light	Medium	Dark		
Gingival third	Number	20	22	5	47	$\chi^2 = 15.53$ $p = 0.004^*$
	Percent	42.6%	46.8%	10.6%	100%	
Medium third	Number	31	14	2	47	
	Percent	66%	29.8%	4.2%	100%	
Incisal third	Number	38	8	1	47	
	Percent	80.9%	17.0%	2.1%	100%	

\*—significant at  $p < 0.05$

**Table 2.** Color distribution according to the thirds of teeth in female students

		Color			Number of examined teeth	Chi-square test
		Light	Medium	Dark		
Gingival third	Number	39	15	2	56	$\chi^2 = 18.63$ $p = 0.001^*$
	Percent	69.6%	26.8%	3.6%	100%	
Medium third	Number	52	4	0	56	
	Percent	92.9%	7.1%	0%	100%	
Incisal third	Number	53	3	0	56	
	Percent	94.6%	5.4%	0%	100%	

\*—significant at  $p < 0.05$

**Table 3.** Color distribution according to the thirds of teeth in students of both sexes

		Color			Number of examined teeth	Chi-square test
		Light	Medium	Dark		
Gingival third	Number	59	37	7	103	$\chi^2 = 29.80$ $p = 0.000^*$
	Percent	57.3%	35.9%	6.8%	100%	
Medium third	Number	83	18	2	103	
	Percent	80.6%	17.5%	1.9%	100%	
Incisal third	Number	91	11	1	103	
	Percent	88.3%	10.7%	1%	100%	

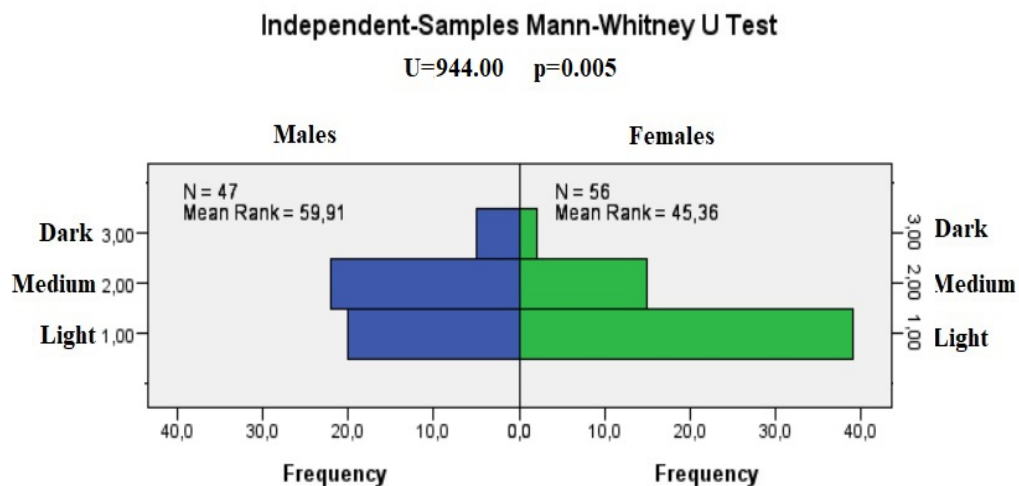
\*—significant at  $p < 0.001$

It was observed that the colors were not equally distributed according to the thirds of the teeth in subjects of both sexes ( $p = 0.000$ ). Although light shades predominated in all examined thirds of teeth, medium and dark color shades were significantly more represented in the gingival thirds of the teeth (35.9% and 6.8%) than in the middle thirds (17.5% and 1.9%) and incisal thirds (10.7% and 1.0%) of teeth (Table 3).

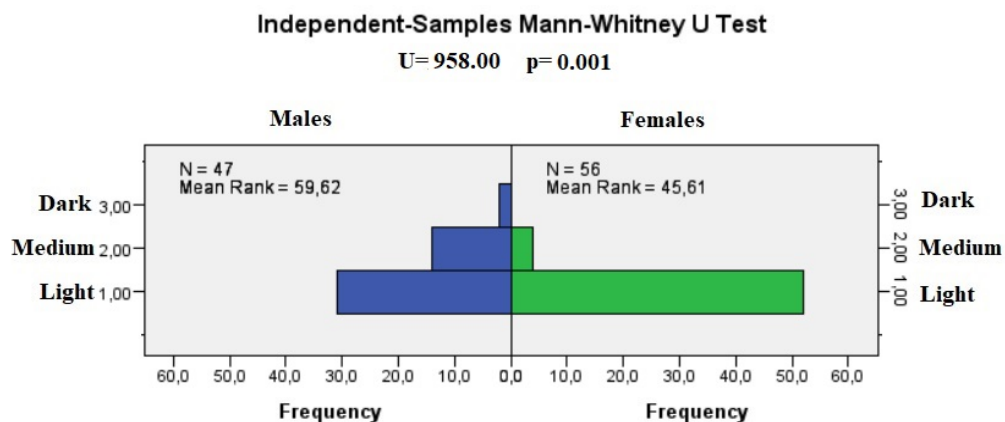
A statistically significant difference was observed in the distribution of colors in the gingival thirds between the sexes ( $p = 0.005$ ). While medium shades were more prevalent in the gingival thirds of teeth in male students, light shades were dominant in the gingival thirds of female students (Figure 1).

Although in both male and female students the middle thirds of the teeth were dominated by light shades of color, in a significantly higher percentage ( $p = 0.001$ ) of female students, light shades were observed in the middle thirds of the teeth, compared to male students, while medium and dark shades were observed in a higher percentage of male students compared to female students (Figure 2).

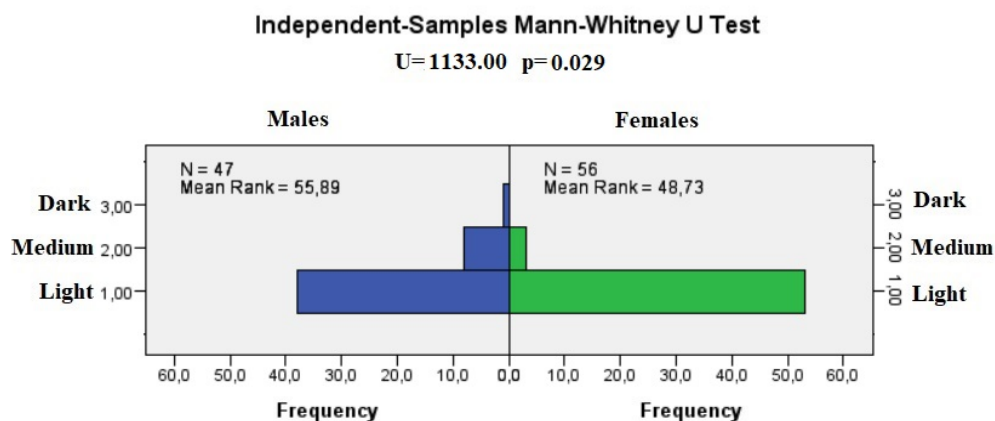
In subjects of both sexes, the highest percentage had incisal thirds of a light color, however, the results of the Mann–Whitney U test showed that the incisal thirds of female students were significantly more often ( $p = 0.029$ ) light, compared to the incisal thirds of male students (Figure 3).



**Figure 1.** Distribution of the color shade of the gingival third of the teeth according to gender



**Figure 2.** Distribution of the color shade of the middle third of the teeth according to gender



**Figure 3.** Distribution of the color shade of the incisal third of the teeth according to gender

## Discussion

Color represents the most important optical property that determines the aesthetics of patients' teeth. The optical properties of hard dental tissue are very complex and include color, translucency, opalescence and fluorescence<sup>7</sup>. Precisely, one of the basic tasks of aesthetic dentistry is to imitate the properties of dental tissues with modern restorative materials so that such a tooth has as natural an appearance as possible. Large variations in the color of the hard tooth tissue make the restoration of the upper central incisors particularly demanding, both in the incisal and in the middle and gingival thirds<sup>8</sup>.

Today, there are numerous methods used to determine the color of teeth, starting with visual, subjective methods based on the use of a color key, paper or colored porcelain, but also methods in the form of a spectrophotometer, colorimeter and image analysis technique<sup>3</sup>. In addition to numerous shortcomings that can be reflected in the limited presence of colors that will be compared with the teeth but also in the presence of artificial light, the visual method is one of the most popular methods for determining tooth color shades<sup>9,10</sup>. While the middle third of the teeth is the optimal place for color determination, when determining colors on the incisal third, the transparency of the enamel should also be taken into account. However, the determination of tooth color by visual method is a very common and useful method used in an everyday dental practice when choosing the appropriate color of restorative materials for restorative dental tissues or prosthetic restoratives. This technique

is often used because it allows easy and quick determination of tooth color. Research has shown that this method is not subject to the influence of examiner characteristics such as gender or experience, which further confirms its objective character<sup>11</sup>.

The importance of the distribution of different shades of color on the labial surfaces of the front teeth is reflected in the observations of the study by Karabaş et al.<sup>12</sup>, which suggest that based on the color of one third of the teeth, the color of the second third of the same tooth can be predicted. This may have clinical significance in cases of fractures and cavity IV, where it is necessary to compensate aesthetically for the tooth's incisal third whose color is unknown to us due to the lack of this part of the tooth.

In the majority of examined gingival thirds of maxillary central incisors in this study, in male subjects, medium shades of color were observed in the gingival third, which characterized this part of the teeth as darker compared to the significantly lighter middle and incisal thirds of the teeth. In one study that examined the color of upper central incisors, it was observed that the gingival thirds were darker compared to the middle and incisal thirds of the mentioned teeth<sup>13,14</sup>. This can be explained by the fact that the gingival third contains much more dentin and a significantly thinner layer of enamel, while the surrounding soft tissue that covers the neck of the tooth affects the color itself<sup>15</sup>.

In the study by Bosch et al.<sup>16</sup>, the important role of dentin in determining the color of teeth was confirmed, while the role of enamel was reduced to adding bluish shades to the color of teeth. When removing the labial

surface of the enamel for veneer preparation, it was observed that the prepared teeth were yellower after preparation. All this indicates that surfaces covered with enamel have lighter shades<sup>17</sup>.

Examination of tooth color in this study in females showed that the gingival thirds were mostly of lighter shades. The presence of lighter natural teeth in women has been confirmed in numerous studies<sup>6</sup>. In the study by Stošić et al.<sup>6</sup>, who examined the degree of change in the color of upper central incisor teeth with the age of the patient and in relation to gender, it was shown that females had a significantly lighter color of the upper central incisors compared to men. The mentioned study also showed that younger patients had a significantly lighter shade of teeth.

In a recent study conducted by Wee et al.<sup>18</sup> it was observed that women have a significantly lighter shade of color compared to men, and that in addition to gender, the color of the teeth is also influenced by ethnic differences.

## ***Conclusion***

The results of this study showed that female students had lighter shades of teeth compared to male students. Also, this study showed that in the majority of males, medium shades of color were registered in the gingival thirds of the teeth, while in the middle and incisal thirds of the teeth, light shades were observed in the majority of cases, i.e., that in the largest number of females, a lighter shade was observed in all examined thirds of the labial surface.

## ***Conflicts of Interest***

The authors declare that they have no conflict of interest.

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## LITERATURA/REFERENCES

1. Newton JT, Subramanian SS, Westland S, Gupta AK, Luo W, Joiner A. The impact of tooth colour on the perceptions of age and social judgements. *J Dent*. 2021; 112:103771.
2. Vlasova N, Samusenkov V, Novikova I, Nikolenko D, Nikolashvili N, Knyazeva M. Influence of professional teeth whitening on oral hygiene: Long-term results. *J Int Soc Prev Community Dent*. 2021; 11(4):408.
3. Joiner A. Tooth colour: a review of the literature. *J Dent*. 2004; 32:3–12.
4. Aggarwal P, Saxena S, Bansal P. Incremental lines in root cementum of human teeth: An approach to their role in age estimation using polarizing microscopy. *Indian Journal of Dental Research*. 2008; 19(4):326.
5. Gómez Polo C, Gómez Polo M, Montero J, Martínez Vazquez De Parga JA, Celemin Viñuela A. Correlation of natural tooth colour with aging in the Spanish population. *Int Dent J*. 2015; 65(5):227–34.
6. Stošić N, Popović J, Gašić J, Mitić A, Nikolić M, Barac R, Dačić S. Examination of tooth shade in relation to age and gender. *J Anthropol Soc Serb*. 2019; (54):41–51.
7. Villarroel M, Fahl N, de Sousa AM, de Oliveira OB. Direct Esthetic Restorations Based on Translucency and Opacity of Composite Resins. *Journal of Esthetic and Restorative Dentistry*. 2011; 23(2):73–87.
8. Vanini L. Light and color in anterior composite restorations. *Pract Periodontics Aesthet Dent*. 1996; 8(7):673–82.
9. Hammad IA. Intrarater repeatability of shade selections with two shade guides. *J Prosthet Dent*. 2003; 89(1):50–3.
10. Dozić A, Kleverlaan CJ, El-Zohairy A, Feilzer AJ, Khashayar G. Performance of Five Commercially Available Tooth Color-Measuring Devices. *J Prostho*. 2007; 16(2):93–100.
11. Aswini KK, Ramanarayanan V, Rejithan A, Sajeev R, Suresh R. The effect of gender and clinical experience on shade perception. *Journal of Esthetic and Restorative Dentistry*. 2019; 31(6):608–12.
12. Karabaş A, Manav TY, Kamalak H. Relation in color of three regions of human maxillary incisors and canines. *International Journal of Applied Dental Sciences*. 2021; 7(3):407–11.
13. Winkler S, Boberick KG, Weitz KS, Datikashvili I, Wood R. Shade matching by dental students. *J Oral Implantol*. 2006; 32(5):256–8.
14. Hasegawa A, Motonomi A, Ikeda I, Kawaguchi S. Color of natural tooth crown in Japanese people. *Color Res Appl*. 2000; 25(1):43–8.
15. Singh V, Sethi P, Saluja R, Singh D. Role of Enamel Colour in Age Estimation Using a Dental Shade Guide: A Study in the Tricity Region of Chandigarh, Mohali and Panchkula. *J Punjab Acad Forensic Med Toxicol*. 2010; 10:76–8.
16. ten Bosch JJ, Coops JC. Tooth Color and Reflectance as Related to Light Scattering and Enamel Hardness. *J Dent Res*. 1995; 74(1):374–80.
17. He W, Park CJ, Byun S, Tan D, Lin CY, Chee W. Evaluating the relationship between tooth color and enamel thickness, using twin flash photography, cross-polarization photography, and spectrophotometer. *J Esthet Restor Dent* 2020; 32(1):91–101.
18. Wee AG, Winkelmann DA, Gozalo DJ, Ito M, Johnston WM. Color and translucency of enamel in vital maxillary central incisors. *J Prosthet Dent*. 2023; 130(6):878–84.