Comparison of the color characteristics of central incisors among dental students

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Сравнение на цветовите характеристики на централни резци сред студенти по дентална медицина

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Abstract:

Introduction: *Shade determination in dental medicine is a key factor in achieving optimal aesthetic results, particularly in the restoration of central incisors, which often poses challenges in clinical practice. The use of modern devices, such as the Vita EasyShade V spectrophotometer developed by the German company Vita Zahnfabrik, significantly enhances the quality of dental work. This device enables more precise and objective shade determination, leading to better results and increased satisfaction for both patients and dentists.*

Aim: *The aim of this study is to compare the color characteristics of teeth in two groups of subjects*

Materials and Methods: *A clinical study was conducted using the spectrophotometric method for shade determination. The investigation was performed on the middle third of 200 teeth (central incisors) of 100 patients. To be included in the study, participants' teeth had to meet the following criteria: no composite or ceramic restorations, no fractures, no endodontic or periodontal compromises, and no severe orthodontic deviations.*

The spectrophotometric analysis was carried out using the Vita EasyShade V device, which is widely recognized as the "gold standard" for shade determination in dental medicine. The study was conducted under identical conditions, ensuring reproducibility of results and high precision in measurements.

Results: *The predominant tooth shade observed in the subjects was A1 according to the Vita Classical shade guide and 1M2 according to the Vita 3D-Master shade guide in both study groups.*

Conclusion: *The analysis of tooth shade distribution performed using the Vitapan Classical scale revealed that A1 is the most common shade for central incisors, demonstrating its predominant frequency within the studied population. Additionally, using the VITA Toothguide 3D-MASTER scale, it was found that the most frequently measured shade for central incisors was 1M2, highlighting the consistency of this shade characteristic across different methods of tooth color measurement.*

Key words: *spectrophotometry, Vita EasyShade, color characteristics*

Резюме:

Въведение: *Цветоопределянето в денталната медицина е ключов фактор за постигане на оптимални естетични резултати, особено при възстановяването на централните резци, което често представлява предизвикателство в клиничната практика. Използването на съвременни устройства, като*

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спектрофотометъра Vita EasyShade V, разработен от немската компания Vita Zahnfabrik, значително подобрява качеството на работа на денталните лекари. Това устройство позволява по-прецизно и обективно определяне на цвета, което води до по-добри резултати и удовлетвореност както на пациента, така и на денталния лекар.

Цел: *Настоящото изследвне има за цел да сравни цветовите характеристики на зъбите на 2 групи изследвани лица.*

Материали и методи: *Проведено е клинично проучване, базирано на метода на спектрофотометрия за цветоопределяне, като изследването е извършено върху средната трета на 200 зъба (централни резци) на 100 пациента. За да бъдат включени в изследването, зъбите на участниците е трябвало да отговарят на следните критерии: да са без композитни и керамични възстановявания, без фрактури, да не са компрометирани ендодонтски или пародонтално и да нямат тежки ортодонтски отклонения.*

Спектрофотометричният анализ е осъществен с помощта на апарата Vita EasyShade V, който е широко признат като „Златен стандарт“ за цветоопределяне в денталната медицина. Изследването е проведено в идентични условия, което гарантира повтаряемост на резултатите и висока прецизност при измерванията.

Резултати: *Преобладаващия цвят при изследваните лица е A1 по Vita Classical и 1M2 по Vita 3D Master и при двете изследвани групи.*

Заключение: *При анализа на разпределението на цвета на зъбите, извършен съгласно скалата Vitapan Classical, се установено, че при централните резци най-често срещаният цвят е A1, което демонстрира неговата преобладаваща честота сред изследваната популация. В допълнение, при използване на цветната скала VITA Toothguide 3D-MASTER, е установено, че при централните зъби най-често измерваният цвят е 1M2, което подчертава консистентността на тази цветова характеристика в различните методи за измерване на зъбния цвят.*

Ключови думи: *спектрофотометрия, Vita EasyShade, централни резци*

Introduction

Spectrophotometers are among the most accurate and valuable devices for comprehensive comparison and color determination in dental medicine [1]. They measure the amount of light energy reflected by an object within the visible spectrum in intervals of 1–25 nm [2].

A spectrophotometer includes:

- A light dispersion mechanism
- An optical measurement system
- A detector and a mechanism for converting the received light into a signal that can be analyzed.

The data obtained from spectrophotometers must be processed and presented in a form useful to dentists and dental technicians. The measurements derived from these instruments are translated into shades from popular tooth shade guides [3].

Compared to the conventional shade determination method, which relies on visual observation, spectrophotometers increase accuracy by 33% and improve objective matching by 93.3% [4].

Spectrophotometers, colorimeters, and imaging systems are useful and appropriate tools for measuring and analyzing tooth color and for quality control in color reproduction. Various measuring devices either analyze the entire tooth surface, providing a “color map,” or measure an “average” color of a limited area (3-5 mm) of the tooth surface, dividing it into thirds. These tools are valuable for color analysis in direct or indirect restorations, reproduction, and verification of color. Whenever possible, both instrumental and visual methods for shade matching should be used, as they complement each other and can lead to predictable aesthetic outcomes [5].

Conventional and digital methods for tooth color selection are widely employed in dental practice [6]. The conventional method, which is frequently applied [7], involves determining tooth color using tooth shade guides. Within this approach,

tooth shade is identified through visual comparison between the tooth and the shade guide under standardized lighting conditions and in the same environment. The accuracy of the method may be influenced by factors such as the light source and the subjective characteristics of the observer, including age, gender, professional experience, presence of color blindness, or eye fatigue, all of which can lead to variations in shade selection. Among the most commonly used guides are Vitapan Classic and Vita 3D-Master (Vita Zahnfabrik, Germany), which are key tools for achieving precise and acceptable shade matching [8].

A study by Marta Mazur et al. shows significant differences in aesthetic preferences and self-perception between genders, highlighting the shortcomings of conventional, gender-neutral paradigms. The inclusion of a gender-specific framework improves the precision and individualization of aesthetic assessments, promoting a more patient-oriented approach in aesthetic dentistry [9].

The CIE Lab* system is widely used in color research the teeth, due to its precision and ability to quantitatively measure colors differences. This system is based on three coordinates that describe the color. The coordinate L* reflects the lightness of the color, denoting lightness and darkness, while a* and b* describe the chromatic components – a* defines the color axis between red and green, b* – between yellow and blue. CIE Lab* enables detailed analysis of color differences between two objects, including teeth. In dental practice, the formula $\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$ is used to estimate the color differences between two different restorations or teeth [10].

Aim

The aim of this study is to compare the color characteristics of teeth in two groups of subjects – male and female central incisors.

Material and metods

The study was conducted at the Faculty of Dental Medicine at the Medical University – Sofia, involving 100 participants (dental students and staff), equally distributed by gender: 50 women and 50 men. The total number of examined teeth was 200 central incisors – left and right.

Inclusion Criteria: Participants were required to have intact central incisors and must not have undergone any tooth whitening procedures – either clinical or at home – in the past six months.

Exclusion Criteria: Patients with prosthetic constructions, composite restorations, endodontic or periodontal diseases, or those who had undergone whitening procedures were excluded. Additionally, individuals with tetracycline staining, congenital, acquired, or hereditary dysplasias, and severe orthodontic deformities were also excluded.

Participants were interviewed regarding tooth whitening performed in the past six months and screened for any exclusion criteria.

To ensure unrestricted access to the vestibular surfaces of their central incisors, participants were fitted with a mouth opener.

The tooth color measurements were performed using the Vita EasyShade V spectrophotometer, manufactured by the German company Vita. Before each measurement, the device was calibrated on a specialized factory stand, ensuring precision in the study. After each measurement, the spectrophotometer was recalibrated, the protective film replaced, and the device disinfected before the next procedure with a new patient.

The study was conducted over three weeks, with all measurements performed between 12:00 and 14:00 to ensure consistency. Statistical analysis of the data was carried out using SPSS.

Results

Tooth 11 in females: A1: 36%, A2: 18%, A3: 14%, A3.5: 8%, B1: 8%, B2: 16% (Figure 1).

Tooth 12 in females: A1: 32%, A2: 24%, A3: 16%, A3.5: 10%, B1: 6%, B2: 12% (Figure 2).

Tooth 11 in males: A1: 34%, A2: 22%, A3: 14%, A3.5: 8%, B1: 6%, B2: 15%, C2: 1% (Figure 3).

Tooth 21 in males: A1: 30%, A2: 21%, A3: 19%, A3.5: 12%, B1: 6%, B2: 12% (Figure 4).

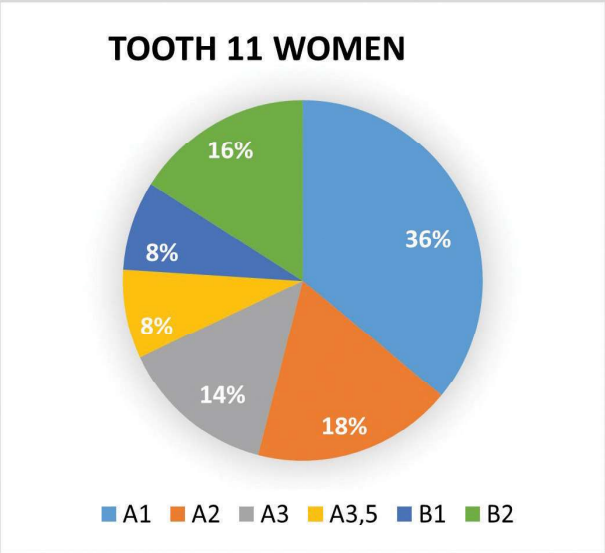

Fig. 1. Tooth 11 – women

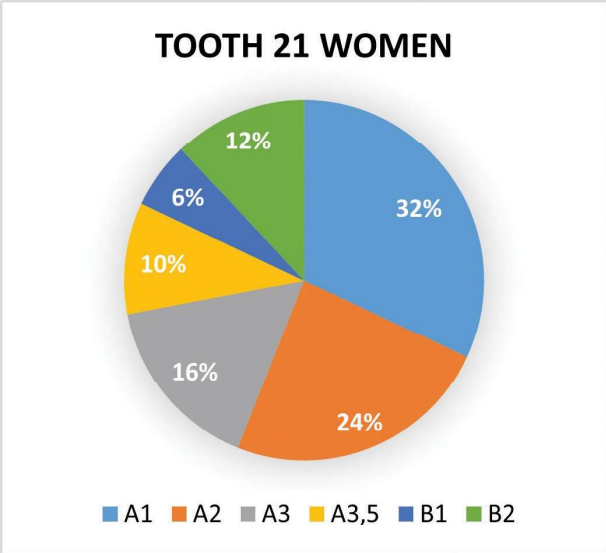

Fig. 2. Tooth 21 – women

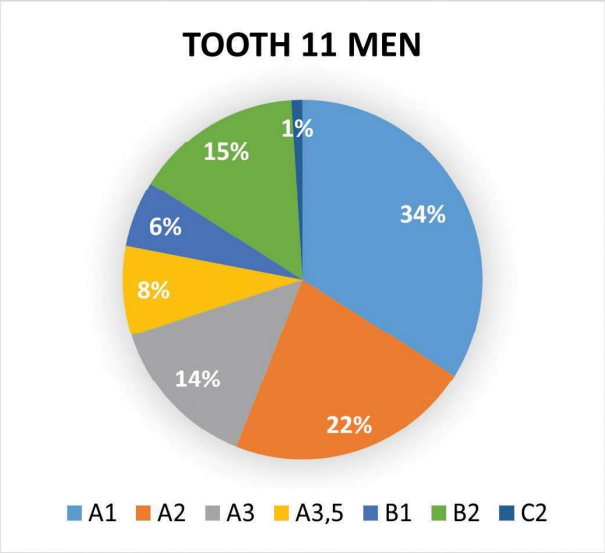

Fig. 3. Tooth 11 – men

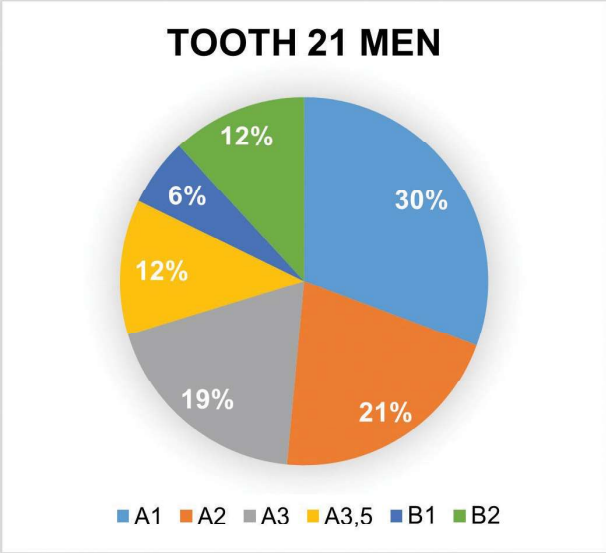

Fig. 4. Tooth 21 $ men

The predominant shade for the examined subjects was A1 according to the Vita Classical shade guide and 1M2 according to the Vita 3D-Master shade guide for both studied groups.

Discussion

The age and gender of the subjects influence the color characteristics of central incisors, as shown in a study by Diaz et al. [11].

Hasegawa et al. found that with increasing patient age, the color in the central part of the natural tooth becomes darker and more yellow. Both reddish and yellowish hues of natural teeth generally intensify from the incisal to the cervical portion, while transparency decreases [12].

The upper central incisor often serves as a reference point when evaluating tooth color [13].

The most commonly observed color is A3 according to the Vita Classical shade guide, with female teeth exhibiting a lighter hue compared to those of males. A relationship between ethnic origin and tooth color has also been identified [14].

Ju-Hwan et al. concluded that there were no significant differences in color distribution between genders for the upper canines. However, for the upper central and lateral incisors, differences

were observed in the middle and cervical thirds between men and women. Except for the upper canines, the upper anterior teeth displayed a diverse color distribution and gender differences [15].

Numerous studies indicate that spectrophotometers are the best choice for determining the color of natural teeth and various restorative materials [16, 17].

Ciucci et al.'s study on the position of the central incisors showed that there is a correlation between the perception of the color characteristics of central incisors based on their position. Orthodontic changes in the inclination of the upper incisors may cause changes in how the tooth color is perceived [18].

Conclusion

When analyzing the color distribution of teeth using the Vitapan Classical scale, it was found that the most common color for central incisors is A1. This highlights the predominant frequency of this shade in the studied population and provides useful guidelines for clinical practice in tooth restoration. Additionally, when using the VITA Toothguide 3D-MASTER color scale, it was found that the most frequently measured color for central teeth is 1M2, which confirms the consistency of this color parameter across different measurement methods. These results suggest that regardless of the scale used, A1 and 1M2 remain predominant, which is crucial for achieving predictable and aesthetically acceptable outcomes in dental practice.

FUNDING: The researches were provided under GRANT 2024 project,

CONTRACT No D131/29.05.2024, the Medical University of Sofia, Bulgaria.

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