Evaluating shade matching ability of general dentists in Rasht in 2018

Original Article

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Abstract

Introduction:

To evaluate the ability of dentists in Rasht, Iran, to determine the tooth color by sex, age, and clinical work experience.

Materials and methods:

A shade tab from the Vita 3D Master shade guide and a questionnaire were sent to each dentist. The questionnaire collected demographic information, namely age, gender, and work experience, so that the results could be examined separately for each variable. At this stage, the dentists answered the questions related to the characteristics of the color samples in terms of value, hue, and chroma, while their knowledge of color evaluation was also examined by certain items. Color evaluation was performed under standard conditions. Finally, the data were statistically analyzed by the chi-squared test at the significance level of 0.05.

Results:

The frequency of accurate determination of tooth color was 17.7 %. Generally, no significant difference was found in accurate tooth color identification in terms of sex ($p = 0.912$), age ($p = 0.22$), and clinical work experience ($p = 0.236$).

Conclusion:

Dentists had a poor ability in selecting the tooth color, which is affected by a lack of knowledge of the principles of light and color. In addition, dentists should use novel methods for determining color.

Key words:

•Dentist •Color matching •Vita 3D master

Introduction

Color plays an undeniable role in conservative aesthetic dentistry, and to perform cosmetic restoration, it is essential to possess a basic knowledge of color. Color is a physiologic sensation created by the reflection of light from objects as the human visual system perceives. Light is a form of energy; specifically, it is one form of the electromagnetic spectrum to which the human eye is sensitive. Radio waves, X-ray, ultraviolet and infrared rays are all electromagnetic waves, but the human visual system can detect only a small portion of wavelengths in the 360-780nm range(1, 2).

Perception of the color characteristics of natural teeth is essential for the selection of restoration materials with an appropriate and uniform color. Teeth are usually formed of color combinations with different concentrations. A color transition is usually seen from the gingival to the incisal area, where the gingival area is clearly darker due to the lower enamel thickness. Different colors of the restoration material may be needed for the cosmetic restoration of a tooth.(1, 3) Each color has three characteristics: hue, value, and chroma. Hue is an attribute and sensation expressed by observers of how they perceive a ray of light, and it depends on the presence of different wavelengths in the light ray. Value is the achromatic dimension of light which expresses the level of lightness/darkness of the color.(4) The higher the value, the lighter the light, and the lower the value, the darker the light. Value can be measured independently of hue, and various colors can be compared in terms of value. Chroma expresses the distance of a color from a gray sample with the same lightness. Higher chroma means a more intense/saturated color, and a higher color content. Still, colors with the same value and hue can have different chroma.(5)

The study of light is relatively complex, comprising both science and art. Different terms may be used for describing the same phenomenon even in disciplines related to color. Therefore, color perception is difficult due to the difficulty in establishing a precise connection/transfer as well as problems associated with training. Color perception is not complete yet. According to the Optical Society of America's Committee on Uniform Color Scales, the science of color is mostly a research project than a precise discipline of science. To perceive color, there must be a stimulus, a receptor, and an interpretation and report from the receptor of the transferred stimulation.

In dentistry, a failure to connect to colors, especially colors which cannot be found in the color sample, is a common weak point experienced by dentists and dental technicians. All these problems arise from a lack of a normal perception and a failure to use the three described components of color.(6)

The majority of dental clinicians are not familiar with the visual analysis of color, and may describe the color poorly when they want to transfer it to the laboratory technician. When clinicians are unable to perceive hue, chroma, and value, they cannot provide adequate information for an aesthetic restoration compatible with the patients' other teeth.(7) A study was conducted by Sadeghi et al. to examine the difference and changeability in color perception among dentistry students in Rafsanjan, Iran. The results showed that, in general, the students made a correct color selection in 54.9% of cases; no significant difference existed between girls and boys; and color identification by the human eye was significantly changeable.(8) Therefore, evaluating dentists' ability to determine color can demonstrate the depth of the problem and limitations, especially those associated with training, and assist purposive planning to resolve these problems. Thus, the present study aimed to evaluate dentists' ability to determine the tooth color in Rasht, Iran.

Materials and Methods

This cross-sectional descriptive study first tested ten dentists as a pilot in order to determine the sample size. The resulting values were analyzed by a statistician, and a sample size of 96 was obtained. Then, 96 general dentists working in Rasht were randomly selected; the sample included 61 (63.5%) men and 35 (36.5%) women. A shade tab from the Vita 3D Master shade guide (Vita Zahnfabrik, Bad Sackingen, Germany) and a questionnaire were sent to each dentist. The questionnaire examined different information, e.g. age, sex, and work experience, so that the results could be examined separately in each domain. At this stage, the dentists answered the items related to the characteristics of the sample in terms of value, hue, and chroma, while their

knowledge of color evaluation was also examined by certain items.

In this test, the dentists were asked to express the color of the sample based on the 3D Master system. Dentists first identified the value, and mentioned the selected value in the questionnaire. The color value of the Vita 3D Master sample is divided into five groups, and the dentists were supposed to choose one value. Subsequently, the dentists chose the chroma from the top down in the same group as that assigned for the value. Finally, the hue of the teeth was assessed based on L M R.

It was attempted to have the color evaluation performed under standardized conditions. This was achieved by performing color evaluation at the same time around noon in order to avoid fatigue and ensure optimal light conditions. A daylight corrected (k5500) light source, and a background with uniform color (Munsell N7 flat paper) were used for viewing the shade tab.(9) The dentists evaluated color at a 30 cm distance based on the two-degree CIE standard observer guidelines.(10) There was no time limit during the test, but the dentists were warned about the possibility of fatigue in case of a prolonged procedure. Since any visual impairment can negatively affect color selection, the dentists were examined in terms of color deficiency and color blindness by the Ishihara test. This instrument was developed for the rapid and accurate evaluation of congenital visual impairment. Based on this test, an accurate reading of 9 plates or less out of the 15 plates indicated impairment, and the individual would be excluded from the study. (11, 12)

Finally, the data resulting from the questionnaires were examined to measure the dentists' accurate color identification ability by sex, age, and work experience, which was then analyzed by the chi-squared test. The significance level was considered 0.05.

Results

In this study, 96 general dentists, including 61 men (63.5%) and 35 women (36.5%) participated. Of these, 11 men (18%) and six women (17.1%) accurately determined the color of the sample tooth; the chi-squared test showed no significant difference in terms of sex in accurate tooth color identification ($p = 0.912$).

Of all the dentists who participated, 11 dentists aged <30 years, 27.3% of whom accurately identified the tooth color; 50 dentists aged 31-40 years, 24% of whom accurately identified the tooth color; and 27 dentists aged 41-50 years, 7.4% of whom accurately identified the tooth color. Moreover, eight aged 51-70 years, none of whom accurately identified the tooth color. The chi-squared test showed no significant difference between different age groups in terms of accurate tooth color identification ($p = 0.22$).

The dentists were also examined in terms of clinical work experience; 45 dentists had less than 10 years of clinical work experience, 9 (20%) of whom accurately identified the tooth color; 35 had 11-20 years of clinical work experience, 8 of whom (22.9%) accurately identified the tooth color; and 16 had >21 years of clinical work experience, none of whom accurately identified the tooth color. The chi-squared test showed no significant difference in terms of work experience in accurate tooth color identification ($p = 0.236$).

The results showed that, of all the dentists examined, four (4.2%) use the 3D Master color sample for tooth color identification in the clinic, while 92 (95.8%) use the Vita classical shade guide for this purpose.

Moreover, the sample was evaluated in terms of the first criterion of tooth color identification; 43 people (44.8%) selected value as the first criterion, while 34 people (35.4%) selected chroma, and 13 people (13.5%) chose hue.

The selection of the best light for color identification was also evaluated; 79 people (82.4%) chose natural light as the best light for this purpose; eight (8.3%) chose fluorescence light; eight (8.3%) selected the dental unit light; and one person (1%) chose both natural light and unit light for this purpose.

The dentists were also evaluated in terms of detection of value, chroma, and hue; 60 people (62.5%) accurately identified the tooth color value; 64 (76.6%) accurately identified the tooth color chroma; and 30 (31.3%) accurately identified the tooth color hue.

Discussion

Selecting an appropriate color for teeth is a major part of dentists' scientific and artistic ability. Knowledge of the science of color is a major step towards the achievement of the best cosmetic results from dentistry treatments. This study evaluated the ability of dentists in Rasht to determine the general tooth color divided by sex, age, and clinical work experience.

Evidently, different factors affect the identification of the correct color; these include ambient light, visual acuity of the observer, color blindness, age, work experience, eye fatigue, light source, and psychological factors.(2) It has been reported that corrected light devices or shade matching lights improve color selection.(13) Accordingly, to standardize the condition for all the participants, the evaluation was performed around noon and under corrected light. Moreover, it has been suggested that a background with uniform color (Munsell N7 flat paper) be used for a better shade matching(14).

Another important point in standardizing the condition is the probability of some degree of color blindness in the participants. Thus, all the participants underwent the Ishihara test of color blindness. In a study by Moser et al. (1981), 9.9% of men showed some degree of color impairment, 2.8 % of people had high degrees of color impairment, and only one woman had moderate color impairment.(15) In the present study, to eliminate this confounding variable, a test of color blindness was performed for all the participants.

Based on the findings of the present study, no significant difference existed in tooth color identification in terms of gender ($p = 0.912$). This result is consistent with those of Curd et al.(12) and Negahdari et al.,(13) who reported no significant difference in color shade difference identification among female and male university students.

The findings of the present study in terms of a relationship between color selection ability and age revealed no significant difference in dentists' accurate color identification ability based on age groups; still, no dentist in the 51-70-year age group managed to accurately determine the tooth color; this may be due to their poor knowledge and awareness of tooth color selection, and the negative effects of aging on color detection due to lack of reconstruction of visual cells.

A commonly used color selection system in Iran is the Vitapan Classical system. Due to the limitations of this system, a newer system called 3D Master was introduced to the market. Results of the present study showed that the majority of dentists still use the classical system, which may lead to errors in color selection; out of 4 dentists who used the new 3D Master system, three accurately selected the color. These results are similar to those of Ghahramanlou et al (16) and inconsistent with those reported by Hamad et al (17).

Based on the findings of the present study and the results of previous studies, it is suggested that dentists use novel color selection methods as well as the right light and light source for this purpose.

Conclusion

Based on the limitations of the present study, it can be concluded that age, gender, and work experience of dentists do not affect their tooth sample color identification, and that dentists should use novel color identification methods.

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Investigation of Organ Dose in Dental CBCT Using GATE Monte- Carlo Code Investigation of Organ Dose in Dental CBCT Using GATE Monte- Carlo Code

Original Article

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Abstract

Introduction:
Patient dose is the most important concern for any new X-ray system. The dose received by the patients depends on the imaging technique, the optimization of the collimator, filtration and field of view (FOV). The purpose of this study is to evaluate the effect of various imaging parameters on dose received by different organs in a dental CBCT scanners.

Materials and methods:
In this study, dental CBCT system (Planmeca 3d mid) including the X-ray tube, flat panel detector and a voxelized phantom, was simulated by the GATE Monte-Carlo Code (Version 8). DICOM CBCT images of a person, and Alderson Rando phantom were segmented using MATLAB and 3D slicer software to identify various organs such as bone, bone marrow, soft tissue, brain and thyroid.

Results:
The half value layer of the simulated X-ray was found to be 2.6 mm which differed from the experimental value by approximately 6.47%. In some cases, the 3D dose distribution for Rando Phantom was less than that for Voxelized phantom simulated by CT images of a normal person.

Conclusion:
The reason of this difference is attributed to the different substances definition. The difference in experimental and simulation data can be due to several reasons i.e. the inaccuracy caused by the use of a limited number of TLDs in experimental measurements, the impossibility of simulating Gentry's actual rotation (hyperbolic's rotation) and the uncertainties caused by converting CT images to e Voxelized phantom.

Key words:
•Phantoms, Imaging • Radiometry
• Spiral Cone-Beam Computed Tomography