



Dental Students Knowledge in Colour Determinationaccuracy of Fixed Partial Denture in RSGM USU

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DOI:

10.59141/comserva.v3i10.1188

ABSTRACT

The aesthetics of fixed denture treatments are important factors that determine the success of the treatment. The optimal esthetic results in the manufacture of crowns and bridges require several considerations such as the size, shape, and color of the denture. The right color is one of the factors that influence the success of fixed bridges (GTJ) from an aesthetic aspect. In this descriptive survey research, the author examined the color of the ceramic metal that would be attached to the patient and compared it to the color guide and then the author distributed a questionnaire to assess the level of knowledge from clinical clerkship students at Prosthodontics Department Universitas Sumatera Utara regarding the procedure in determining the color of dentures. A colorimeter is used as a tool in determining the color accuracy of fixed dentures. The mean difference in color between the fixed denture and the color guide was tabulated and univariate analysis was performed. The results showed no significant color difference between the fixed denture and the color guide. 80,95% of respondents had a good knowledge level in the determining color procedure.

Keywords: *Aesthetics, Color Accuracy, Color Determination Procedure, Students Knowledge Level*

INTRODUCION

A dental bridge is one type of denture which was becoming more popular in society, to restore natural teeth that were damaged or lost. A dental bridge consists of a crown and bridge and is used as an alternative to restore teeth because this denture design is smaller, comfortable, and aesthetic, and improves the wearer's confidence compared to other removable dentures (Veeraiyan, 2003) (King et al., 2015).

In treatment with crowns or bridges, apart from mastication and phonetic functions, patients also demand good esthetics. Optimal aesthetic results of crowns and bridges require several considerations, namely the size, shape, and color of the denture (Ioannidis et al., 2010). The right color is one of the factors that influence the success of dental bridges from an aesthetic aspect. However, determining the color is not as easy as one might imagine because many factors affect the accuracy of color selection to match the color of natural teeth. Knowledge of the physics, physiology, and psychology of color is important in determining tooth color selection (Saleem et al., 2013) Hue, saturation (chroma), and brilliance (value) are important parameters in selecting tooth color (Ahmad et al., 2013). Nowadays, the determination of color accuracy is developing based on the growth of technology in increasing the aesthetic value of the bridge produced. The development of this technology introduces a color guide with 16 color choices that resemble the color of natural teeth and continues to

expand to 29 color choices aimed at producing more precise color accuracy and replacing direct vision as the most commonly used method of determining color (Chu et al., 2010) (Douglas et al., 2007).

Correct color selection of the denture is an important aspect of restoration and esthetics. In general, the desired denture color will be informed to the laboratory assistant using a color guide (King et al., 2015). The results of color selection are very dependent on the results of direct vision and the ability of the clinician (Depkes, 2009). The success of color selection in manufacturing the metal-ceramic bridge is influenced by three factors, including factors for determining color in the clinic, good communication between dentists and technicians in the laboratory, and factors for color adjustment in the laboratory (Shah et al., 2014). Factors for determining color in the clinic include staining technique, light source, environmental conditions, and operator experience. Meanwhile, the color adjustment factor in the laboratory covers several aspects such as the porcelain condensation technique, the porcelain firing cycle, the porcelain glazing cycle, porcelain type, the ratio between porcelain powder and liquid during mixing, metal type and porcelain layer thickness (Milardović Ortolan et al., 2012).

Many challenges arise in the selection of colors for high-esthetic dental restorations. Clinical studies have reported that the occurrence of color mismatch is approximately 44% to 63% in ceramic restorations. This is because the problem of color matching in dentistry depends on a series of visual assessments that are usually communicated between two or more people, namely the doctor, the patient, and the technician. The high public demand for good dental bridges and aesthetic quality encourages dentists to continue to improve their clinical and theoretical abilities. Consumer knowledge of the resulting dental bridge is also an important factor in determining the success of a denture (Levi, 2001). Nowadays, digital devices, one of which is a colorimeter, are intended to help determine tooth color. Based on this explanation, the authors wanted to know the level of knowledge of clinical students in the Prosthodontics Department in color determination and color accuracy of metal-ceramic bridge dentures at USU Dental Hospital.

METHODE

Knowledge of Prosthodontic Department Student in Color Determination Procedure

The author explains how the study was carried out to the respondents, then the respondents were given an informed consent to sign. The author conducted interviews using a questionnaire and answered honestly by the respondents. The questionnaire consists of fifteen questions regarding the color determination procedure. Each question in this questionnaire consists of 3 answer choices namely; yes, undecided, and no. The values for the assessment of the three answer choices are as follows: No (0), Undecided (5), Yes (10). Each value collected from the choice of answers to these questions is then summed up, resulting in understanding criteria, which are divided into three criteria as follows; do not understand (0-33), unsure (34-66), and understand (67-100). Data from the interviews are collected, tabulated, and processed with the help of a computer. Respondents are divided into two groups, namely the group that had done dental bridge treatment and the group that had never made dental bridge to assess the knowledge between students who had done dental bridge and students who had not.

Color Difference Between Metal-Ceramic Bridge and Shade Guide

Before conducting the study, the author obtained a research permit from the ethics committee, Faculty of Dentistry University of North Sumatera, as well as a research permit at the Industrial Services Unit (UJI) of the Faculty of Dentistry University of North Sumatera. The author collected samples of

anterior and/or posterior metal-ceramic bridge dentures produced at the Industrial Service Unit of the Faculty of Dentistry according to the inclusion criteria and a predetermined amount. A colorimeter (CS-10) was used in this study. The color determination was carried out three times and the average value was recorded. The colorimeter is placed 90° to the sample. The color difference between the shade guide and the metal-ceramic GTJ is calculated, then the ΔE value is recorded on the result sheet. All data were evaluated and statistical tests were carried out.

RESULTS AND DISCUSSION

Results

Knowledge of Prosthodontic Department Student in Color Determination Procedure

In the group that had done metal-ceramic bridge dentures, 17 students understood the procedure for determining the color of ceramic-metal bridge dentures, 4 students were hesitant and there were no students who did not understand the procedure for determining the color of metal-ceramic bridge dentures. In the group who had never done the treatment, 13 students understood the procedure for determining the color of ceramic-metal bridge dentures, 8 students who were unsure, and no students who did not understand the procedure for determining the color of metal-ceramic bridge dentures.

Table 1. Experience of Clinical Students on Color Determination

Knowledge Levels	Students who had done metal-ceramic bridge treatment		Students who had never done metal-ceramic bridge treatment		total
	n	%	n	%	
Understand (67-100)	17	80.95	13	61.90	30
Uncertain (34-66)	4	19.05	8	38.10	12
Did not Understand (0-33)	0	0	0	0	0
Total	21	100	21	100	42

Discussions

Knowledge of Prosthodontic Department Student in Color Determination Procedure

Teeth color selection has been considered a quite complicated procedure that even dentists have to consider the basic knowledge of color besides the artistic aspects of color selection (Lang et al., 2004). Previous study stated that most of the clinical students faced difficulties during the procedure for determining tooth color (Chezhian, 2016). The high level of difficulty can be attributed to the routine color selection which is done visually with the help of shade guides and the visual method has some known inaccuracies and flaws. Eye sensitivity to lightness, chroma and hue is believed to have different values, and it is important to visually select these three color elements to obtain more accurate colors

(Sinmazisik et al., 2014). Color blind and different genetics in males and females are also believed to influence the results of color adjustment (Habib, 2012). This deficiency can be controlled by utilizing instrumental methods that provide scientifically accurate readings

The results of interviews using a questionnaire showed that, at the stage of determining the color in the laboratory, the majority of respondents who had (47.61%) and never (38.09%) had done bridge dentures knew that a Clinical Colorimeter could assist in determining the color of bridge dentures more accurately. However, digital tools such as colorimeters and spectrophotometers are quite expensive and difficult to operate, so visual color determination is the most commonly used method in the Prosthodontics clinic, Faculty of Dentistry University of North Sumatera. The results of the interviews also showed that the majority of respondents who had and had never done a bridge denture knew that it was necessary to communicate about the bridge denture shade guide used by the operator to the dental laboratory. Dental laboratory facilities in the area of professional education and communication methods that have been taught during lectures are expected to overcome the possibility of inaccurate color selection by operators (Imbery et al., 2018); (Bhat & Malli, 2014).

At the stage of determining the color at the clinic, the majority of respondents who had (76.19%) and who had never (57.14%) done bridge denture knew the ideal distance between the operator and the patient. When determining the color of a bridge denture using a shade guide, it should be done at a distance 25 to 35cm. However, it was also found that respondents who had never done bridge denture did not know the ideal distance between the operator and the patient (42.85%). The majority of respondents who had (76.19%) and had never (66.67%) done fixed dentures knew that color adjustments to bridge dentures must always be made prior to preparation of the teeth to be restored. The prepared teeth were not only dehydrated and discolored during preparation, but the resulting debris in the form of grinding enamel, metal, and cement flakes can cover everything in the mouth. The majority of respondents who had (100%) and had never (85.71%) done fixed denture knew that natural light (sunlight) was considered as the standard when determining the color of metal-ceramic crown bridge dentures. So, with this knowledge, as many as (9.52%) of respondents who had and (28.57%) of respondents who had never done fixed denture did not use the dental unit light during the color determination of the fixed denture. The use of incandescent lamps and dental lamps in the dental unit is not recommended because incandescent lamps have a dominant red-yellow color and lack blue light. In contrast, the dental unit light source has a high blue-green energy content and a low red content, where the blue color will be strong when the red color becomes weak. The majority of respondents who had (95.23%) and had never (71.42%) done fixed dentures knew that it was necessary to remove the patient's facial makeup when determining the color of the fixed dentures. Surfaces around the teeth such as adjacent teeth, gingiva, lips, facial skin, and patients clothes can influence the color determination of the fixed denture. It is therefore recommended that patients remove all distracting make-up prior to color adjustment. Some things such as lip gloss, eye glasses, earrings, facial makeup such as blush, clothing that is light or dark are believed to interfere with accurate color adjustment. The majority of respondents who had (57.14%) and had never done fixed dentures (33.33%) did not know that it was necessary to cover the patient's clothes with a gray (neutral) cover when determining the bridge colors even though they had been taught at the college. Based on time, the majority of respondents who had (71.42%) and had never done fixed dentures (57.14%) knew that the ideal time to determine denture color was during the day. This is due to the uneven distribution of colors in the morning. The most ideal

time for determining color is during the day (12 noon) until three o'clock in the afternoon, when the sun is directly overhead, thereby reducing the atmosphere's exposure to color change. Majority of respondent who had (76,19%) and had never done fixed denture, (61.90%) know that the ideal time to determine the color of the bridge denture is 5-7 seconds. When carrying out the procedures, the majority of respondents who had (66.67%) and had never done a bridge denture (47.61%) knew that as an operator, it was necessary to look away for a moment when the operator's eyes were saturated in determining the color. Observation of the eye must be done quickly (5-7 seconds) to prevent retinal fatigue (Sinmazisik et al., 2014). The longer the operator observes, the less his ability to distinguish colors and the retina becomes sensitive to the complement of the color he observed (Shah et al., 2014). The majority of respondents who had (66.67%) and never had done fixed dentures (71.42%) knew that they had to communicate bridge denture shade guide to patients. The participants in this study recognized the importance of a second opinion and the patient's opinion during the color selection process.

One of the main concerns in the visual method is its very subjective nature, different individuals can have different color perceptions for the same object. Operator experience will be able to influence the suitable color results of the denture (Habib, 2012). The students experience in choosing the denture color also differs depending on the individual, even though they receive the same teaching and lecture materials during their lectures. Stated that it was necessary to increase lecture time on color adjustment in dentistry to increase the knowledge of clinical students regarding color determination (Pohlen et al., 2016). Stated that clinical students lacked confidence in color selection and they rely on laboratory technicians to select colors, so it is necessary to add additional time in the curriculum dedicated to educating students in color science and color adjustment (Imbery et al., 2018).

Color Accuracy Between Metal-Ceramic Bridge Denture and Shade Guide

The study design used a descriptive survey, namely a study conducted to describe a phenomenon that occurs. This study aimed to see the possibility of an influence between several study groups by observing one or more study groups, then the results of the groups that were given the treatment were compared with the conditional value, namely $\Delta E \leq 3.7.31$ Measurement of color values L^* , a^* , b^* on metal-ceramic bridge samples and shade guidance was carried out using a colorimeter on the grounds that the availability of this laboratory tool had a higher accuracy value for the observed porcelain color difference values when compared to direct vision (Chang et al., 2012). Authors controlled lighting using a special black background to place dental bridge samples while conducting research so that they are not affected by outside light. Ideally, a metal-ceramic bridge should produce a color that matches the adjacent natural teeth to achieve a satisfactory esthetic result for the patient. Clinicians and laboratory assistants must have the expertise and ability to adjust the color of the metal-ceramic bridge with a shade guide that functions as a guidance. Vita 3D Master was used in this study due to the availability of shade guides used in the study locations. The Vitapan 3D Master shade guide was arranged from the highest light level to the lowest light level starting from the shade code 1M, 2L, 2M, 2R, 3L, 3M, 3R, 4L, 4M, 4R, and ended with 5M. The highest L^* value among the seven color groups was the 4M 2.5 group, namely 66.25; which showed whiter and lighter colors of the desired color of the bridge produced. The highest a^* value of the 2L 1.5 group was 1.21. The highest b^* value of the 2L 1.5 color group was 14.43. The lowest L^* value among the seven color groups was in the 2L

1.5 group, namely 56.07. The lowest a^* value of the 4L 2.5 group was 0.24. The lowest b^* value of the 4L 2.5 group was 8.68. In the color group 2L 1.5, 2R 1.5, 3L 1.5 and 4M 2.5; the bridge L^* value was higher than the shade guide L^* value. A bridge L^* value that was higher than the L^* value in the shade guide means that the color of the bridge sample was lighter than the shade guide. A thin layer of dentine is expected to produce a bright metal-ceramic bridge denture color. In the 3R 1.5, 4R 1.5, and 4L 2.5 color groups; the bridge L^* value was lower than the shade guide L^* value. A bridge L^* value that was lower than the L^* value in the shade guide means that the color of the GTJ sample was darker when compared to the shade guide. A thick layer of dentine is expected to produce a dark metal-ceramic bridge denture color.

In the color group of 2L 1.5, 2R 1.5 and 3R 1.5; Bridge a^* values were higher than the shade guide a^* values. If the Bridge a^* value was higher than the a^* value in the color guide, meaning that the color intensity of the bridge sample was redder when compared to the shade guide. Possibly, this was thought to occur due to an increase in the thickness of the dentine layer which resulted in an increased a^* value, meaning that thicker the dentine layer produces a higher red chromatic color. In the color group of 3L 1.5, 4R 1.5, 4L 2.5 and 4M 2.5; bridge a^* values were lower than the shade guide a^* values. If bridge a^* value was lower than the a^* value in the color guide, it means that the color intensity of the bridge sample was greener when compared to the shade guide. Possibly, this was thought to occur due to a reduction in the thickness of the dentine layer which resulted in a decreased a^* values, meaning that thinner dentine layer produces a higher green chromatic color.

In the 2L 1.5, 3R 1.5, 3L 1.5 and 4M 2.5 color groups; the bridge b^* value was higher than the shade guide b^* value. A higher b^* value than the b^* value in the shade guide means that the color intensity of the bridge sample was more yellow when compared to the shade guide. It was possible that an increase in the dentin layer resulted in an increasing b^* value, meaning that thicker dentine layer produces a higher yellow chromatic color. Corciolani et al (2010) stated that a thicker layer of dentine produces a higher chromatic color. In the 2R 1.5, 4L 2.5, and 4R 1.5 color groups; the bridge b^* value was lower than the shade guide b^* value. The bridge b^* value was lower than the b^* value in the shade guide, meaning that the color intensity of the GTJ sample was towards blue when compared to the color guide. It was possible that a decrease in the thickness of the dentin layer resulted in a lower b^* value, meaning that thinner dentine layer produces a higher blue chromatic color (Pohlen et al., 2016).

The ΔE value is the value of the total color difference in each sample. However, intraoral color matching depends on visual discrimination and the ability of the individual clinician. There are several threshold values that can be used for the occurrence of color changes (Capa et al., 2011).

The color matching threshold value ΔE varies according to various literatures. In this study, all shade guide groups had color differences between the metal-ceramic crowns and shade guides, but there were no significant differences. According to Kuehni and Marcus, observers found differences in color at the threshold value $\Delta E = 1.0.32$ Meanwhile, none of the color groups in this study were below the threshold value $\Delta E = 1.0$. According to Douglas et al (2009) the threshold value is $\Delta E = 1.7$ and stated that 50% of prosthodontists will reject metal-ceramic results because they can see color differences and there are also no color groups from this study below the cutoff value $\Delta E = 1.7.32$ Seghi et al. (1989) stated that at a threshold value of $\Delta E = 2.0$ the porcelain samples were assessed correctly by observers and none of the color groups from this study were below the cutoff value $\Delta E = 2.0.32$ Based on Ruyter's study, 3R 1.5, 4R 1.5, and 4M 2.5 color group from this study was below the cutoff value $\Delta E = 3.3$.

Johnston & Kao (1989) and (Samar et al (2012) stated that the mean color difference between metal-ceramic bridge dentures which was suitable to the oral environment was <3.7 . The color difference value in this study was estimated to be below the cutoff value $\Delta E = 3.7$ for all color groups. Stated that the values of L^* , a^* , b^* on metal-ceramic dentures were higher when compared to the values of L^* , a^* , b^* on the shade guide (Reddy et al., 2012). This was because the shade guide does not contain metallic copings, but was completely covered by a porcelain layer.

The limitations in this study were that researchers did not control color adjustment factors in the laboratory including porcelain layer thickness, porcelain condensation technique, porcelain firing cycle, porcelain glazing cycle, type of porcelain, ratio between porcelain powder and liquid during stirring and type of metal.

CONCLUSION

In the group who had done metal-ceramic bridge dentures, 80.95% of students understood the procedure for determining the color of ceramic-metal bridge dentures, only 19.05% of students were uncertain. In the group of students who had never done the treatment, 61.90% of students understood the procedure for determining the color of ceramic-metal bridge dentures, only 38.10% of students were uncertain about the procedure for determining the color of metal-ceramic bridge dentures.

The color of dentures produced by the Industrial Service Unit, Faculty of Dentistry University of North Sumatera had no color difference with the shade guide, as 4R 1.5 color difference value was the least different values when compared to the shade guide and the 4L 2.5 color difference value was a color group which was the most different from the shade guide, but did not pass the standard that has been determined.

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