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Original Research Article

Comparative Evaluation of Hue Value Chroma using Cross Polarised Photography

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ABSTRACT

Introduction: Digital photographs offer a wide range of colour options. They aid in increasing communication between a dentist and a technician by making the morphology, colour, and texture of the teeth easier to visualise. A polarising filter reduces reflections and glare while boosting colour saturation in an image. The aim of the study was to analyse images with and without polarised photography.

Methodology: A total of 125 images of shade guidelines were collected for this study, 5 each shade tab for 5 shades (A1 to A4). We looked at the following shade guidance systems: VITA Classical (VITA Zahnfabrik) (control), IPS e. max Ceram (Ivoclar Vivadent) were photographed with a Canon EOS 60D digital camera and a 100-mm Canon Macro Lens. Ambient light, exposure (1/125, f16), ISO (100), flash (ETTL), distance, focusing (1:1), and backdrop were all standardized in the photographs. The Adobe RGB colour system was utilised since it covers nearly half of the Lab colour space.

Results: Mean and standard deviation values of images with and without cross polarised photography were compared. Hue, value, chroma of the images were assessed showing no statistical difference among the images with and without cross polarised photography.

Conclusion: Compared to visual and digital photographic approaches for choosing shades, the application of polarising filters had negligible effect on shade choice. When routinely practised, shade matching can improve a clinician's ability to choose the appropriate shade. Thus, knowledge and training may help someone become better at shade matching.

Keywords: Hue, value, chroma, cross polarised photography, Camera, Ring flash, Micro lens.

INTRODUCTION

Patients have become more aware of the need for aesthetically attractive restorations. As a result, it is a dentist's job to produce restorations that blend in nicely with the natural dentition. Selection of appropriate shade for the prosthesis can be a challenging process. Factors such as shade matching conditions (lighting), education and training, various shade matching tools and knowledge of colour science influence the final dental prosthesis.[1,2]

One of the most common methods for choosing shades is through visually, however it is highly subjective and inconsistent. Fatigue, ageing, colour defective vision, medications and experience may influence the colour perception of an individual. Variation seen during natural daylight can influence the shade matching.[3,4]

Instrumental methods of shade selection include the use of spectrophotometer, colourimeter and photography. The use of these devices involves huge investments resulting in fewer dentists opting for them. Digital photographs provide an array of colours to choose from. They help in visualising the morphology, colour and texture of the teeth thus improving the communication between a dentist and a technician.[5,6]

Images produced via photography can be analysed using appropriate software. This provides the value of colours from the whole or part of such images. The tooth shade can be analysed objectively and transmitted via internet to the technician thus giving more information about the restoration to be fabricated. Polarising filter eliminates glare and reflection seen in an image while increasing colour saturation. It enhances the translucency and allows us to better visualise the real polychromatic nature of teeth.[7,8]

With aesthetic restoration procedures, shade matching, for which the visual analogue technique is typically used, may provide problems. A clinical study indicated that ceramic restorations had a colour mismatch of between 44% and 63% due to factors including the color-measuring technology used. The development of shade-matching technologies, which incorporate colour matching, enhanced communication, and the duplication of dental characteristics, aims to increase success.

Digital cameras, spectrophotometers, and colorimeters have all been developed as tools for overcoming the difficulties of objectivity in colour registration. For clear communication with the dental laboratory technician and successful collaboration on a successful restoration procedure, a cross-polarization filter on digital images offers the most objective information regarding tooth colour, texture. [9,10] For improved perceptibility and acceptance, a mix of visual and instrumental procedures has been suggested. Increased expenditures and the requirement for training are, however, downsides.

Determining tooth colour and communicating that information to the dental laboratory technician are both made simple and reliable by digital imaging.[11] According to some research, using a cross-polarized light filter can improve accuracy by reducing ambient brightness and specular reflection from teeth or saliva. The aim of this study is to compare and analyse hue, value, and chroma using cross-polarized photography.

MATERIALS & METHODS

A sum of 125 photographs were taken of shade guides-totally five shades (A1 to A4). The ring flash (MT-14 Ring Flash, Canon USA), a 100-mm Canon Macro Lens, and a Canon EOS 60D digital camera were used. The ambient light, exposure (1/125, f16), ISO (100), flash (ETTL), distance, focusing (1:1), and background of the photos were all standardized. Since Adobe RGB covers about 50% of the Lab colour space, it was chosen. (sRGB and Adobe RGB are the two-colour spaces that digital cameras can be set in. Adobe RGB was chosen because of its wider spectrum, even if this improvement is largely seen in the cyan-green tones. To ensure uniform flash intensity, photos were taken at 1-minute intervals.

To reduce specular reflections, which could distort the image and result in faulty analysis, a cross-polarizing filter (Polar Eyes, Bioemulation) was used. After all of the pictures were taken, raw images were processed with Adobe Photoshop CC software for shadow analysis. Results were obtained using the hue, saturation, and brightness (HSB) model. This is the colour model utilised for data analysis since it is identical to the Munsell colour system (hue, chroma, and value), which is commonly used in dentistry.[12,13] The HSB colour model was used to construct the traditional shade guides. In this paradigm, any colour is represented by three digits. The first integer, which has a value ranging from 0 to 360 degrees, is the colour. A distinct colour stands in for each degree. Red is the first colour to appear at 0 or 360 degrees, then yellow at 120 degrees, green at 180 degrees, blue at 240 degrees, and so on until violet is seen. The entire range of colours is represented in this model.

It starts with the colour. The second value is the saturation. It represents the quantity or, more specifically, the proportion of colour. Its value ranges from 0 to 100, with 100 representing full colour and 0 representing no colour.[14] The brightness is the next one. The addition of white will boost the brightness of a colour, while the presence of black reduces it. [15]In terms of brightness, White is represented by 0 and black by 100. The colour is brighter and darker depending on how near to 0 or 100 this value is. A univariate analysis of variance with a P value of.05. was used to statistically analyse the HSB data for all tabs and hues. We looked at the hue, chroma, and value of each shade tab individually.

STATISTICAL ANALYSIS

Pearson's correlation coefficient analysis which is a measure of linear correlation between two sets of data was applied in this study.

RESULT

Figure 1a shows a picture taken through a cross-polarizing filter, while Figure 1b shows the same picture taken without one. Since there are no specular reflections in Fig. 1b, internal tooth features can be examined more precisely and directly. In this case, for any of the three factors that were evaluated, none of the VITA-coded shade tabs matched the actual VITA Classical shade tab.

When analysing the A2 shade, hue measurements showed no discernible difference (P =.05) between any VITA-coded shade tab and the VITA Classical shade tab. For the remaining hues, there was no comparable equivalency (P =.05). Any VITA-coded shade tab's shades A1, A3, and A3.5 showed a statistical difference (P =.05) in hue from the VITA Classical shade tab. Comparability between shade tabs was only evident in the A4 shade tab (P =.05). (Table 1). All A1 and A3 VITA-coded shade tabs differed statistically from the VITA Classical shade tab in terms of chroma evaluation, while the A2 VITA Classical shade tab differed considerably from Initial, the A3.5 from d.SIGN, and the A4 from others.

(Pearson's alpha =.05)

Table 1: Showing average mean values for Hue, Value, Chroma

Shade	Hue	Value	Chroma
A1	50.00(0.00)	64.50(0.46)	21.56(0.52)
A2	50.00(0.00)	64.80(0.46)	21.66(0.52)
A3	48.40(0.00)	66.58(0.46)	32.56(0.52)
A3.5	46.00(0.08)	62.50(0.24)	38.56(0.64)
A4	44.00(0.00)	58.60(0.46)	39.04(0.52)

Figure 1: Photograph of the same case with and without Colour compatibility

A. Showing with Colour compatibility

B. Showing without Colour compatibility

DISCUSSION

Shade matching is a preliminary phase in conservative dentistry, and physicians and dental technicians face challenges in colour selection and reproduction. Colour matching across multiple shade guidelines has proven to be a tough process with inconsistent outcomes.[16,17] The null hypothesis was disproved when it was found that all VITA-coded shade guides showed variations in hue, chroma, and value when compared to the VITA Classical control. The use of colorimeters, spectrophotometers, digital cameras, and a combination of these tools has advanced shade matching.[18,19]. Despite the fact that they were designed to analyse colour properties on flat surfaces and that their small aperture sizes can cause significant light edge loss, colorimeters and spectrophotometers are incredibly helpful for selecting shades. Tools for measuring and controlling tooth colour are available. On the other hand, fluctuations in data reading could result from changes in probe angulation.[20] Despite the current results that multiple commercially available shade guides provide unmatched shade information, these tools continue to be the most popular, quick, and economical method for choosing a shade and are acknowledged as the gold standard for judging tooth colour visually.[21,22]

Because of its stability, flexibility, and ease of colour matching, the Munsell colour system was chosen. The quality of colour is used to describe hue in this approach. The A2 shade was found to be homogeneous across all tabs in this investigation. VITA Classical was found to have lesser values for A1, A3, and A3.5, while A4 was identical to other tabs but had low values as well. The remaining hues, with the exception of A2, corresponded to distinct colour families amongst shade guidelines, making it difficult for technicians to get optimal outcomes.[23]

Differences between the visual shading method and the spectrophotometer can be explained because the colours in the guide do not match the colours of genuine teeth.[24] This study indicated that just a third of the selections were shared across the spectrophotometer and the visual analogue approach, which is consistent with other investigations. In over half of the cases, the spectrophotometer produced better results than the visual technique.

The quantity of grey leads to variable values of brightness and darkness determines the value of a colour. [25,26]VITA Classical shade values in this study showed a lot of variation when compared to various shade tabs. In contrast to showing values in the middle of the other shades for A3-A4. VITA showed the brightest values for A2, indicating that it was neither the brightest nor the darkest. Future studies will be required to determine whether the statistical variations observed in this study are related to changes in the final prosthesis that are apparent to the naked eye. The demographic data that was selected for the study had an imbalance between younger and older adults, which is one of its limitations. Further evaluation is advised because it appears that digital photography using a polarising filter and analytical software is acceptable for determining colour.

CONCLUSION

The shade selection technique used in digital photography was the most precise of the three. It enhances clinician-technician communication and can be applied to get the best possible aesthetic outcomes. Contrary to digital photographic shade selection and visual shade selection methods, the employment of polarising filters has no effect on shade selection. When routinely practised, shade matching can improve a clinician's ability to choose the appropriate shade. Consequently, education and training can help someone become better at matching colours.

Declaration by Authors

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