

Original Article

The use of digital imaging along with conventional shade guide for colour matching and communication in restorative dentistry

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ABSTRACT

Accurate mimicking of human tooth colour for restorative purposes is since long an enigma to both the dentist and Lab technician.

The purpose of the study is to determine validity of combination of digital photography and conventional method of shade selection using shade guide for accuracy in matching colour of human tooth over only conventional method of shade selection. 30 volunteer are selected randomly from dental students studying in dental college. These are grouped under 2 of 15 each. First group to be used for shade selection by 5 different operator plus digital photography and second group to be used for shade matching by conventional shade guide only by same 5 operators. Shade selection to be done under controlled illumination and time period. All digital images to be analysed on computer screen to help technician make an accurate observation. Technician asked to match tooth colour on standard metal framework for both groups. Prepared PFM crown to be evaluated clinically for accuracy of shade matching and validity of combination method over conventional method of shade selection.

Aim-To determine validity of combination of digital photography and conventional method of shade selection for accuracy in matching colour of human tooth over a conventional method of shade selection using shade guide. **Objectives-** 1)To Select a shade of human natural teeth with the help of shade guide viz. Vitapan classical by five different operator. 2)To digitally evaluate shade of teeth whose shades have been selected by operators. 3)To Communicate with lab technician about mimicking of shade. 4) To verify shade matching clinically.

Introduction

Clark¹ said, "Color, like form, has three dimensions, but they are not in general use. Many of us have not been taught their names, nor the scales of their measurement. In other words, we as dentists are not educationally equipped to approach a color problem. "Thus an accurate mimicking of human tooth colour for restorative purposes is since long an enigma to both the dentist and Lab technician. Culpeppe²

pointed out the inconsistencies among individual dentists in matching natural tooth shades and the inability of some dentists to duplicate their own shade selections reliably from one time to another. Due to individual perception and subjective nature of the art of a shade selection by dentist as well as human error in shade replication by lab technician, often gives an unsatisfactory result

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Various techniques and recent advances like colorimeter and spectrophotometer are being used to avoid error in shade matching. E. Cal et al³ compared different methods of shade selection and concluded that color measurements obtained with digital analysis method were in accordance with those of spectrophotometric evaluations, with respect to a* and b* values. This finding may require further assessment of digital method's capability in determining the color changes in aesthetic dentistry, and would provide a more practical and consistent method to determine the color in dental clinics and to transmit this information to dental laboratories.

Since objective method of shade selection using spectrophotometer poses an issue of affordability to general practitioner, this paper aims to give a simple cost effective way to match shade of human tooth with reduced chances of error.

Purpose of the study is to determine validity of combination of digital photography and conventional method of shade selection using shade guide over conventional method of shade selection

Materials and methodology

Materials-A Shade guide (Vitapan classical)

Digital camera [The Nikon D70s digital SLR camera (Japan)]

Standardized metal frameworks

Ceramics with different shades

Methodology

The Study was conducted at Dept of Prosthodontics, Crown and Bridges and Implantology, Late Shri Yashwanrao Chavan Memorial Medical & Rural Development Foundation's Dental College and Hospital, Ahmednagar.

Total 24 volunteers were selected from dental students with age group 18-25years old. The Subjects

were randomly divided in two groups of 12 participants each. The Tooth selected for shade matching purpose was Maxillary right central incisor. Teeth which are sound, non-carious, without any staining or acquired and developmental defect were selected for the study. Teeth to be excluded were non vital teeth, discolored teeth, extrinsic and intrinsic staining of teeth, developmental defect like enamel hypoplasia, amelogenesis imperfecta, dentinogenesis imperfecta etc.

Shade selection was done in controlled clinical environment like controlled illumination of natural daylight at specific time period of the day.

Group 1- Shade selection was done using shade guide (Vitapan classical) by five different operators. Photographs were taken of concerned teeth along with selected shade tab using a digital camera. Photographs were analyzed on computer screen.

Specification of camera used- The Nikon D70s digital SLR camera (Japan) was set on manual mode (M) program, and used with a 105 mm macro lens at 1:1 magnification. The shutter speed was set at 125 second with the aperture of F20.

Group II- act as control group. Shade selection was done using shade guide (Vitapan classical) by five different operators. No Digital photography was done with this group.

Lab technician was asked to replicate teeth color on a standardized metal framework of both groups. Shades of the Samples with group 1 were matched with help of selected shade and digital photograph whereas sample with group II were matched only with selected shade.

Prepared PFM crown were evaluated clinically for accuracy of shade matching and validity of

combination method over conventional method of shade selection.

Result

Results were analysed by applying proper statistical test

| | Group I | Group II | Total |
|-----------|-----------|-----------|-------|
| Matched | 8 7.50 | 5 5.50 | 13 |
| Unmatched | 4 4.50 | 7 6.50 | 11 |
| total | 12 | 12 | 24 |

$$\text{Chi-Sq} = 0.833 + 0.833 + 1.389 + 1.389 = 4.444$$

$$\text{DF} = 1, \text{P-Value} = 0.035$$

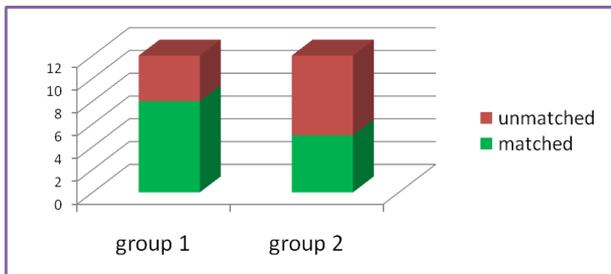


Figure- graphical representation of data shows higher frequency of accurate shade matching within group 1 i.e. shade matching with help of shade guide and digital imaging

Discussion

The visual shade selection varies, depending on the clinician's color perception and experience, ambient light condition, background of the tooth, and the shade guide used.

Communication with a dental laboratory is another problem. The technician does not usually see the patient and has to work on dentist's written prescription as based on the shade guide used.

Spectrophotometric method is objective and appears to be more accurate; however, the quantitative spectrophotometric evaluation is limited to reading one point at a time. Additionally, there is a lack of standardization, high costs, and relatively low performance, with respect to agreements of the computer-aided devices⁴

Photographic images make it possible to evaluate several points, which can aid in determining the true shade of a tooth. Clear Match (Smart Technology, Hood River, OR) is a software system that uses high-resolution digital images and compares shades over the entire tooth with known reference shades⁴. Digital photographs are an important adjunct to the laboratory technician and together with the shade or "color map" should be sufficient communication material to construct an acceptable restoration. Clinicians and technicians are frequently located in different areas. A digital camera permits the transfer of images from the clinician to the technician. The best way to reference shade information is by using shade tabs to communicate shade. Camera and light settings and image format must be kept constant at all times for consistent shade color communication.

Shade matching that is based on digital imaging is convenient and less expensive than the use of spectrophotometers or colorimeters, and may provide the entire spectrum of color space for natural teeth. Color communication is best performed using reference photography with reference shade tabs from current shade guide systems obtained using digital camera⁵



Figure 1) Vitaspan classical shade guide



Figure 2) Nikon SLR Digital Camera



Figure 3) Study Environment with natural daylight illumination and Digital camera with adjusted settings fixed on a tripod



Figure 4) Conventional Shade selection by one of the operator



Figure 5) Digital Photography with shade tab



Figure 6) Shade Matching by technician using digital photograph and communicated shade

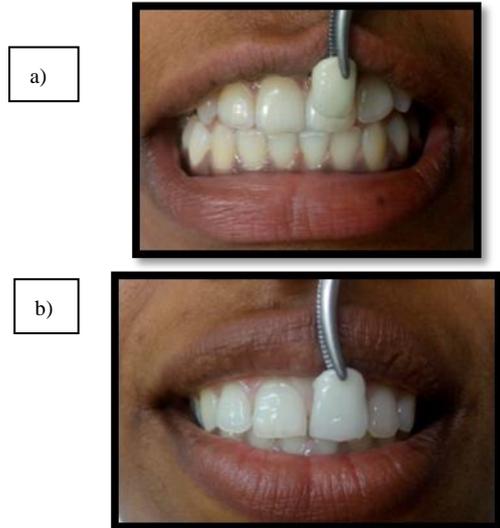


Figure 7) Evaluation of prepared crown for shade matching in both groups; a) Group 1, b) Group 2

Additionally, digital imaging is recognized as an objective and efficient tool for communication with a dental laboratory. However, the validity of the method has yet to be proven.

Limitation of this study-

Subjective variation due to individual color perception.

Variability in illumination quality.

Conclusion

The comparison between visual and instrumental findings is a very attractive topic as it reveals pros and cons of both methods. Visual color matching is subjective and influenced by variety of factors. However, this method is not inferior and should not be underrated. Actually, the all “objective” color measuring instruments have been developed based on the visual response of the “standard observer” and they are good only if they match that response. Therefore, the answer whether to use visual or instrumental method for color matching in dentistry is: whenever if possible, use both, as they complement each other and can lead towards predictable esthetic outcome. Thus within the limitations of this study, tooth color matching using the digital photography method was found to be valid with the use of the Vitapan Classical shade guide. This digital technology could provide an alternative accurate as well as cost effective method of tooth color matching by enhancing communication with the laboratory personnel.

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