RESEARCH ARTICLE

RELIABILITY OF TWO DIFFERENT COMMERCIALLY AVAILABLE SHADE GUIDES FOR THE SHADE SELECTION OF MAXILLARY CENTRAL INCISORS

1,*Bhagyashree S. Dange, 2Vikas Vartak and 3Ajay Mootha

1Post Graduate student, Dept. of Prosthodontics, Yashwantrao Chavan Dental College, Ahmednagar, Maharashtra
2Professor and Head, Dept. of Prosthodontics, Yashwantrao Chavan Dental College, Ahmednagar, Maharashtra
3Professor, Dept. of Prosthodontics, YashwantraoChavan Dental College, Ahmednagar, Maharashtra

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ABSTRACT

Background: Esthetic and Cosmetic dentistry is gaining attention of both common man and dental professionals in 21st century. An important aspect of this branch is selection of proper dental shade. **Aim/Objctives:** To evaluate the reliability of two commonly commercially available shade guides for the shade selection of maxillary central incisors in the local population of Ahmednagar, Maharashtra. **Material and methods:** A single examiner evaluated shades of maxillary central incisors in 200 subjects using Vita Classic and Vita3D Master shade guides. All the samples belonged in the age group of 19 to 25 years. **Results:** Variations in the shades of maxillary central incisors were examined related to gender and age using two different shade guides. In relation to Vita Classic shade guide, out of 16 shades, only 6 shades were recorded in our study sample. Total of 76 samples could not be matched using this shade guide. On the other hand, with Vita 3D Master shade guide, all but two samples could be correctly matched. Out of these 26 shades, only 10 shades were recorded in our study sample. **Conclusion:** Within the limitations of this study, it was concluded that there is a need of special shade guide which enumerates all the colour spectrum of the local population. There is need to improve communication between dentist and dental technicians using newly available softwares and spectro-colourimeters for proper shade duplication in dental laboratory.

INTRODUCTION

Shade selection is an important procedure in prosthodontics (Ana Todorovi *et al.*, 2013). If properly executed, it provides patients with an esthetic restoration that matches the shade of their existing dentition. Natural teeth are known to possess different shades in their surfaces (Azad *et al.*, 2012). The colour of natural teeth is influenced by many factors. Among them age, gender, light, severity of wearing diseases are considered to be crucial (Azad *et al.*, 2012). Colour has been related more to art than science, as a result of which colour measurement is difficult (Sumanth *et al.*, 2015). The first commercial shade guide for measuring colour ceramic systems was proposed by VITAZahnfabrik in 1956. Lemire and Burk (Rohit *et al.*, 2017). concluded in 1974, that the natural teeth had wider colour space than the shade guide. In 1988, Goodkind and Loupe (Lemire and Burk, 1975).

*Corresponding author: Bhagyashree Dange,
Post graduate student, Dept. of Prosthodontics, Yashwantrao Chavan Dental College, Ahmednagar, Maharashtra.

Reported that all the shades of natural teeth should be included in shade guide. In 1990, Miller *et al*. (1988) stated that the shade guide tabs, restoration material and thickness should be similar. In 2000, Hasegawa *et al*. (1993) reported that significant factor which contributes to the dissatisfaction of clinicians, technicians and patients is the limited spectrum of commercially available shade guide. To test the significance of these findings in local population, a study was designed to evaluate the colour space of the maxillary central incisors of the local population of Ahmednagar, Maharashtra using two different shade guides. The objective of this study was to evaluate reliability and practical limitations of commercially available shade guides for local Indian population.

MATERIALS AND METHODS

This study was conducted to evaluate the reliability of two different commercially available shade guides for selection of shade in maxillary central incisors in local population of Ahmednagar, Maharashtra. Approval was obtained from the Institutional Ethical Committee for the study protocol. According to designed protocol, all the patients between the

age group of 19 to 25 years who reported to the OPD of Department of Prosthodontics were examined. All these samples had natural, vital maxillary anterior teeth with normal tooth contours and structures.Samples with smoking or tobacco chewing habits, non-vital anterior teeth, restoration or caries in anterior teeth were excluded from the study. Subjects undergoing orthodontic treatment, having intrinsic or extrinsic stains, wearing artificial make up, suffering from systemic disease which can affect colour of gingiva and not willing to give written informed consent were also excluded from the study. The study sample size consisted of 200 samples which were selected through randomised sampling technique.Informed consent was obtained from all the participants. The observer was checked for colour blindness using Ishihara test (Akira Hasegawa *et al*., 2000) and no colour vision deficiencies were found. Study was conducted over a period of 2 months.

Determination of Shade of Teeth: A single examiner evaluated the shades of maxillary right central incisor in natural daylight with grey wall as background. All the subjects were examined during 12 noon to 2 pm.The subject to be examined was asked to seat upright with the mouth at the observer's elbow level. All subjects were asked to rinse the mouth with normal tap water prior to shade evaluation (Azad *et al*., 2012). The subjects were viewed at eye level so that the most sensitive part of observer's retina is used.The approximate distance between observer and the subject was 10 inches (BhanuRekha *et al*., 2016). For tooth shade determination, middle third site of the tooth was used because it is the best representative of tooth shade (Akira Hasegawa *et al*., 2000). The incisal site is not ideal because it is translucent and is affected by its background.The cervical site is not selected because its colour is modified by scattered light from the gingiva. A shade was selected within 5 seconds to avoid fatigue of the eyes.Gazing at a blue drape in between each shade evaluation allowed the eyes to rest (BhanuRekha *et al*., 2016). If an exact shade match is not possible, no shade was selected (Fig.1).

The VITA Classic shade guide: In this shade guide, shade tabs are divided into four groups (A,B,C,D) based on hue. Within the groups, tabs are arranged with increasing chroma-more the chroma, higher is the number. A1, A2, A3, A3.5, and A4 are similar in hue, as are the B, C, and D shades (Fig.2).

- Group A consists of five tabs (A1, A2, A3, A3.5, A4) (reddish-brownish)
- Groups B consists of four tabs (B1, B2, B3, B4) (reddish-yellowish)
- Group C consists of four tabs (C1, C2, C3, C4) (greyish shades) and
- Group D consists of three tabs (D2, D3, D4) (reddish-grey).

This shade guide enumerates total of 16 shades. While using this shade guide in the study, in the first step, the examiner chose hue followed by chroma and then value from the available tabs. In case of low chroma, accurate determination of given hue is problematic. Therefore, manufacturer recommends the region with highest chroma (i.e. cervical region of canines) to be used for initial hue selection.

The VITA 3D Master shade guide: Manufacturer of this shade guide claims that it covers the entire tooth colour space. A total of 26 different shades are represented in this guide. The

shade tabs are grouped in six lightness levels, each of which has chroma and hue variations in evenly spaced steps. In terms of lightness, the shade tabs are grouped in four CIELAB units. In terms of hue and chroma, they are grouped in two CIELAB units. Because of evenly distributed shades, intermediate shades can be formulated using different porcelain powder portions (Fig.3).

- Groups 1 consists of two tabs (1M1, 1M2)
- Groups 2 of seven tabs (2R1.5, 2R2.5, 2M1, 2M2, 2M3, 2L1.5, 2L2.5)
- Group 3 of seven tabs (3R1.5, 3R2.5, 3M1, 3M2, 3M3, 3L1.5, 3L2.5)
- Group 4 of seven tabs (4R1.5, 4R2.5, 4M1,4M2, 4M3,4L1.5,4L2.5)
- Group 5 of three tabs (5M1, 5M2, 5M3)

While using this shade guide in the study, the examiner first selected the value (1, 2, 3, 4 or 5), starting from the darkest group. Next, chroma was selected from the same value group in the middle (M) column. Lastly, hue was selected by determining whether the natural tooth was more reddish (R-column) or more yellowish (L-column) than the shade sample.

RESULTS

Variations in shades of permanent maxillary central incisors were determined in relation to gender and age.This study included 200 patients, all of which were in the age of 19 to 25 years (mean=20.77 years). The study group comprised of 80 males and 120 females. (Fig.4) Results were analyzed by Chi-square test. The P value was found to be <0.001.

VITA Classic shade guide: The results of this shade guide showed that out of 16 shades, only 6 shades were recorded in the study sample.The most commonly recorded shade was B2 (38 in females & 23 in males) (Fig. 5). The shades that were not recorded at all included A3, A3.5, A4, B4, C1, C2, C4, D2, D3 and D4. Total of 70 samples could not be matched using this shade guide (40 females & 30 males) (Fig.6). The reason for this was that the examiner had limited options once appropriate hue was selected. The examiner states that if correct hue was selected, in the same group, appropriate chroma or value was not available.

VITA 3D Master shade guide: The results of this shade guide showed that, out of the 26 shades, only 10 shades were recorded in the study sample. The shades that were not recorded at all included3R1.5, 3R2.5, 3M1, 3M2, 3M3, 3L2.5, 4R1.5, 4R2.5, 4M1,4M2, 4M3,4L1.5,4L2.5, 5M1, 5M2, 5M3.The most common chroma in females was M1 (42 samples).The most common chroma in males were M1 and M2 (26 samples each).The most commonly recorded chroma/hue was M1 (34%) (Fig.7). The most commonly recorded value was 2 (53%). In comparison to females, males had higher values (i.e. darker teeth). The most common value in females was 1 (65 samples).The most common value in males was 2 (52 samples) (Fig. 8).

DISCUSSION

Measurement of colour is a complex process, as it involves analysing the interaction between the object and light source. (Bhanu Rekha *et al*., 2016).

Fig. 1. Determination of shade

Fig. 2. Vita Classic shade guide

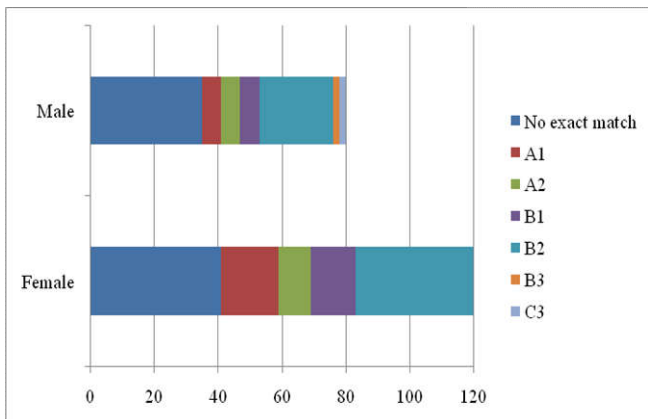**Fig. 3. Vita 3D Master shade guide**

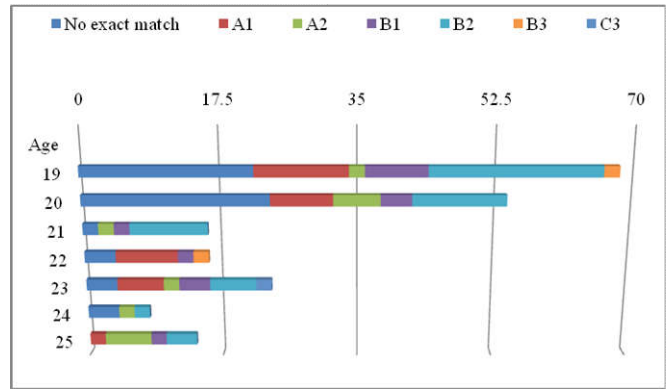**Fig.4. Vita classic shade guide and Gender distribution**

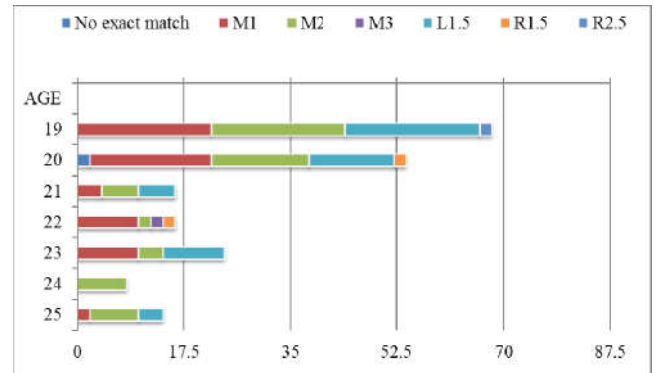**Fig. 5. Vita classic shade guide and Age distribution**

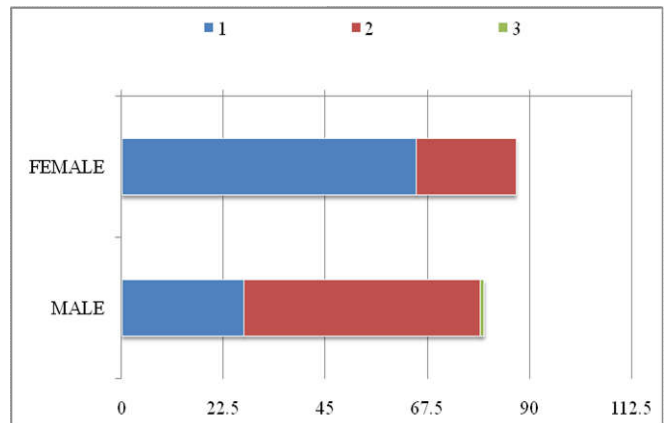**Fig. 6. Vita 3D Master Chroma and Age distribution**

Fig.7. Vita 3D Master Value and Gender distribution

Due to its complex nature, precise measurement of colour requires the understanding of the three dimensional (3D) nature of colour (Rosenstiel, 2016). Munsell colour system is widely used in dentistry (Akira Hasegawa *et al*., 2000). The 3 attributes of colour in this system are called hue, chroma and value. *Hue* is defined as the particular variety of colour. The shorter the wavelength, the closer the hue is to the violet portion of the spectrum; the longer the wavelength, the closer it is to red portion (BhanuRekha *et al*., 2016). *Chroma/saturation* is defined as the intensity of the hue. Intensity of chroma of a particular hue is more intense on the outer rim than near the hub of wheel (BhanuRekha *et al*., 2016). *Value* is defined as relative lightness and darkness of a colour or the brightness of an object. It is a direct consequence of amount of light energy the object reflects or transmits (BhanuRekha *et al*., 2016). When considering the shades of teeth in relation to gender, we found that males exhibited darker shades than females of the same age group.

This finding was supported by studies conducted by Esan *et al.* and Guo*et al.* (Esan *et al.*, 2006). Their studies have found that gender was significantly associated with tooth shades, in that men were more likely to present with darker tooth shades, whereas women of the same age group were more likely to show lighter tooth shades. In spite of commercial availability of various shade guides, VITA Classic shade guide is most commonly used by dentists. Ease of use and extensive laboratory support for this shade guide has made it very popular. However, this study suggests that, in the local population, the colour space covered by this shade guide is not enough to meet the high esthetic demands of both the dentists and patients alike. In our study, total of 70 samples (i.e. 35%) could not be matched using VITA Classis shade guide. VITA Classis shade guide includes less colour space in terms of value when compared with the natural tooth. This finding was in accordance with results of a study conducted by Hasegawa in 2000 (Miller, 1993). The VITA 3D Master shade guide was developed to overcome the disadvantages of the VITA Classical shade guide.

It was found to have broader color range, better color distribution and smaller coverage error when compared to other shade guides (Paravina *et al.*, 2002). In-spite of this, VITA 3D master shade guide, is less popular and least used by dentists as professionals feel it is time consuming and difficult to use in clinical practice. This shade guide, could mimic the natural colour space of local population to a better extent (i.e. only 2 samples could not be matched exactly). This could be because this shade guide contains more evenly distributed 26 shade tabs offering various options during shade selection. This finding was in agreement with a spectroradiometric study conducted by FundaBayindir *et al.* (2007) in 2007 which showed thatthe use of the VITA 3D Master shade guide system alone is as effective as using a combination of VITA 3D Master, VITALumin, and Chromascop shade guide systems. They also concluded that The VITA 3D Master shade guide system provides a high potential for a good visual shade match compared to the VITALumin or Chromascop shade guide systems. As Wee AG correctly stated that, even with the most careful and meticulous practice of selection of shade in clinical situation, some conceptual errors will always exist, because dental color standards are schematic representations of tooth color space, and the number of the shade tabs is limited (Wee, 2006) Currently used shade guides have obvious inadequacies. Therefore, straightforward and specific written instructions, shade diagrams, casts, and clinical photographs should be used to communicate and produce consistently acceptable esthetic results as recommended by Paravina RD (Paravina *et al.*, 2002).

Limitations of the present study are

The size of the sample i.e. the selected population is small. Therefore, a study on a larger population is required to derive more conclusive results.

- In this study, VITA Classic and VITA 3D Master shade guides were used because of their ease in availability and as they are most commonly used by dental professionals and technicians. However, newer shade selection systems like spectro-colourimeter or digital softwares must also be considered for the purpose of shade selection.

- There is further scope for this study, to include a larger population with different age groups and define a colour space that would cover the entire spectrum, also utilize the newer advances to provide highly precise shade guide to cater for today's esthetic demands.

Conclusion

To achieve an esthetic restoration, it is necessary to understand the process in which the colour and translucency of fixed restorations are planned and obtained so as to replicate colour and contours of its adjacent teeth. Errors, especially in colour replication process, are source of frustration for dentists and may lead to dissatisfaction for patient (BhanuRekha *et al.*, 2016). The proper shade selection is important because it helps in masking the artificial teeth in relation to natural teeth. The VITA Classic is the most commonly used shade guide. Out of 16 shades enumerated, only 6 shades were recorded in study. Total of 70 samples could not be exactly matched with this shade guide. This suggests that there is a definite deficiency in the colour space of VITA Classic shade guide. Therefore, findings of this study suggest that the professionals can practice use of VITA 3D Master shade guide as replacement.Only 2 samples could not be accurately matched using this shade guide. Hence, it is observed that VITA 3D Master shade guide could mimic the colour space of local population to a much better extent. Currently VITA 3D master is not used in popularity as dentists feel it is difficult to use. Within the limitations of this study, it can be concluded that, with proper education right at undergraduate level and thorough practice, these problems can be managed.

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