RESEARCH ARTICLE

Interoperator Variability in Shade Selection using Two Shade Guides

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ABSTRACT

Statement of problem: Research shows that correct shade matching for porcelain restoration cannot be achieved accurately even after using visual shade guides because there is always a noted difference in the visual perception of operators.

Purpose: This study was conducted to compare the inter-operator variability in shade selection by visual techniques using VITA Toothguide 3D-Master and Vitapan classical shade guide and then to calculate the amount of percentage in variability in shade selection.

Materials and methods: Three prosthodontists selected the shade of upper right central incisor of 100 patients (age 20–30 years) in a standardized environment. Two shade guides were used—Vitapan classical shade guide and the VITA Toothguide 3D-Master (Vita Zahnfabrik) for shade selection. Each examiner was tested to eliminate color blindness. All teeth were polished before each shade selection, and the selection process was standardized for controlled lighting and procedures. The results were analyzed for repeatability using agreement analysis test, t-test (p = 0.05).

Results: According to the agreement analysis, there was about 14% of interperson variability seen in Vitapan classical shade guide and about 23% in VITA Toothguide 3D-Master.

Conclusion: Within the limitations of this study, the following result was drawn: VITA Toothguide 3D-Master showed higher interperson variability than Vitapan classical shade guide.

Keywords: Interoperator shade variability, Shade selection, Visual shade guides.

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INTRODUCTION

Restorative dentistry is a blend of art and science, and the key to its success lies in the functional and esthetic results.[1,3] Accurate shade matching is one of the most challenging aspects in dental restorations and esthetic dentistry. Due to greater variations in the natural tooth color, achieving an accurate shade match is a complex process and for this a thorough understanding of color, light, and related factors affecting it must be known.[1,2] Christopher, in his research in 2001, had stated that the difficulty in shade selection is that clinicians must interpret a multilayered structure of varying thicknesses, opacities, and optical surface characteristics. These aspects can affect the way the eye perceives color.[4] Also, the shade selection procedure depends on various factors including translucency, surface texture, metamerism, etc. Color matching with shade guides is considered subjective and difficult at the chair side because of variable viewer interpretations and environmental influences, such as fatigue of the human eye, aging, emotion, lighting conditions, level of experience, and physiological variables, such as color blindness.[3-6]

Therefore, in order to obtain a natural looking restoration, shade selection can be made using either visual assessment or instrumental color analysis.[2-5] However, the most popular and traditional method of shade selection in dentistry is through the use of visual selection with a prefabricated shade guide.[3-5]

Shade guides are the visual aids for the selection of the shade and are defined as the collection of shade tabs, organized by color (hue, chroma, and value) and used to match color of natural teeth. It is a very essential process for completion of a porcelain restoration and achieving acceptable esthetics.[7,8]

However, with different commercially available porcelain shade guides, correct shade selection is a demanding task even for experienced dental practitioners.[9] A noted difference in the visual shade matching of different clinicians can be observed as color matching depends on numerous variables like clinician's color perception, surrounding light source, type of shade guide, the background of the tooth, and experience of the clinician. According to a study conducted by Cuppler, there are inconsistencies among individual dentists in matching natural tooth shades and the inability of some dentists
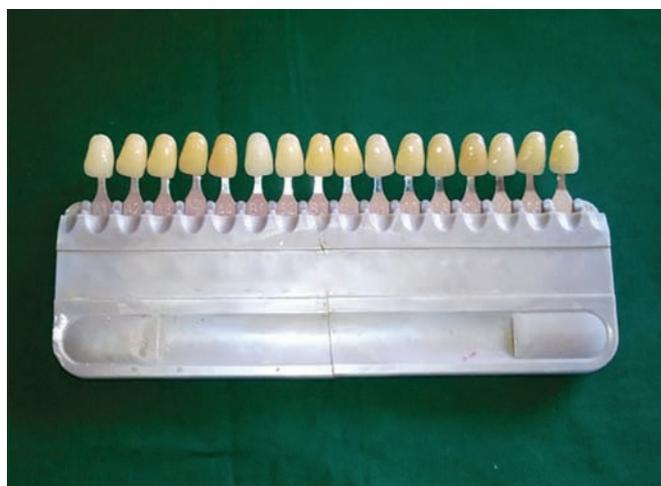
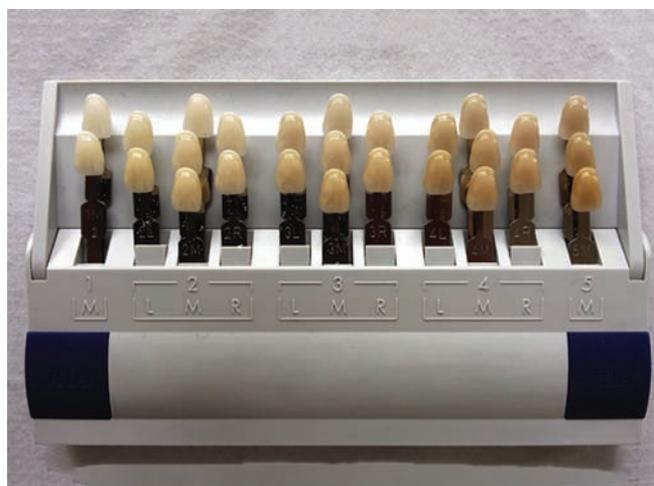**Fig. 1:** Vita lumen classical shade guide

Fig. 2: VITA Toothguide 3D-Master

to duplicate their own shade selections reliably from one occasion to another.[1,3,7]

Hence, a study was undertaken to compare the interoperator variability in shade matching by visual techniques using two most commonly used shade guides: Vitapan classical shade guide and the VITA Toothguide 3D-Master (Vita Zahnfabrik).[8,9]

MATERIALS AND METHODS

Shade guides used in this study are:
- Vitapan classical shade guide (Vita Lumin Vacuum, Germany) (Fig. 1).
- VITA Toothguide 3D-Master shade guide (Vita Zahn-fabrik, Bad Sackingen, Germany) (Fig. 2).

A total of 100 volunteers, irrespective of sex, were randomly selected as subjects for shade matching according to the inclusion criteria.

Patient inclusion criteria:
- Age: 20 to 30 years of age
- No sex predilection
- Nonsmokers
- Healthy maxillary right central incisor (no restoration and no bleaching)

Visual shade matching was performed using manual shade guides. Three operators participated in this study, not having any color deficiencies. All of them satisfied the criteria for visual shade matching for the study.

The clinical area used for shade selection was standardized accordingly for shade selection[10-12] (Fig. 3):
- Teeth to be matched were clean and moistened.
- Removal of bright colors from the field of view.
- Shade selection was done under different lighting conditions. Then the patient was taken to a window and the color was confirmed in natural daylight after initial selection under incandescent and fluorescent lightening.
- Tooth shade was mainly determined in daylight (from the northern direction).

Fig. 3: Clinical area

- Operatory wall was neutral in color.
- Brightly colored clothing of the patient was draped and lipstick was removed.
- View was at the patient eye level; all of these measures were taken to reduce the possibility of errors resulting from contrast.

Each subject was seated upright in the dental chair and the middle third portion of the maxillary right central incisor teeth to be matched was slightly moistened (Figs 4 and 5). Then, all the three operators selected the shade under natural daylight source for all the 100 subjects in the following manner:
- Shade selection using Vitapan classical shade guide[8] (Vita Lumin Vacuum, Germany), is a hue-based shade guide with increasing chroma within the groups (A–D):
  - After the subject is seated, the shade tab is placed under the lip adjacent to maxillary right central incisor with the same relative edge position.
  - Patient was viewed at the eye level of the operator, so that the most color-sensitive part of the retina is used.

Fig. 4: Shade selection

Fig. 5: Placement of shade tab

- – To establish a proper shade, operator stood 25 to 30 cm away.
- – The shade selection was done quickly and from different angles.
- – After each shade selection, eyes were relaxed by observing a neutral gray card between two trials.
- Shade selection by the VITA Toothguide 3D-Master shade guide[9] (Vita Zahnfabrik, Bad Sackingen, Germany): the similar procedure was followed by each operator for the VITA Toothguide 3D-Master, but since it is a value-based shade guide, shade selection can be done individually selecting each component of color, i.e., firstly by determining the value, secondly by selecting chroma (vertically) and then the hue of the tooth (horizontally).

The selected shade by each operator was tabulated and assessed for interperson variability. The shade matching was considered as an agreement when the operators selected the same shade and as a disagreement when their shade matching was different.

The percentage of variability in shade selection between the operators was calculated. Statistical analysis and agreement analysis were performed using a "t" test to reveal the interoperator variability in shade selection.

RESULTS

Interpretation was done by agreement analysis, where kappa statistics was used and the kappa value denoted the amount of interperson variability and the amount of agreement between the operators.
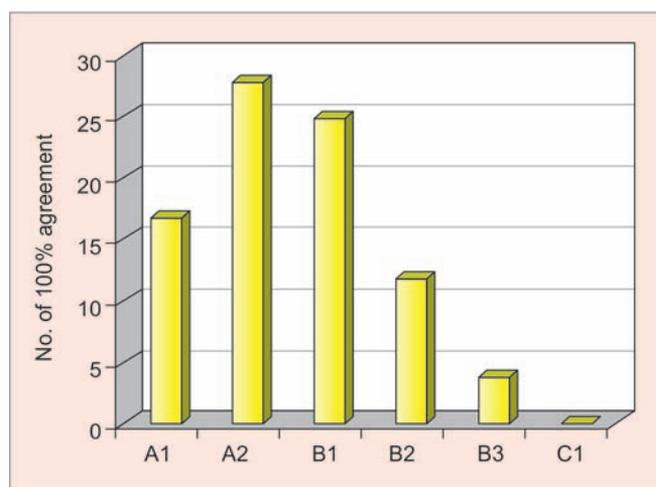
The interpretation provided a range of kappa values, i.e., the kappa value between 0 and 0.40 showed poor agreement, 0.41 to 0.75 showed good agreement, and the value greater than 0.75 showed excellent agreement. Higher the kappa value, the lesser is the interperson variability and more is the agreement between the opera-

tors. Similarly, lesser the value is, more is the interperson variability.

So, according to the agreement analysis, the kappa value for Vitapan classical shade guide was about 0.86 (Table 1 and Graph 1) and about 0.77 for the VITA Toothguide 3D-Master (Table 2 and Graph 2). Both the values indicated excellent agreement between the operators. However, a higher interperson variability of 23% was seen with VITA Toothguide 3D-Master than Vitapan classical shade guide.

Table 1: Agreement analysis of classical shade guide, kappa value is 0.86 and the interperson variability is 14%
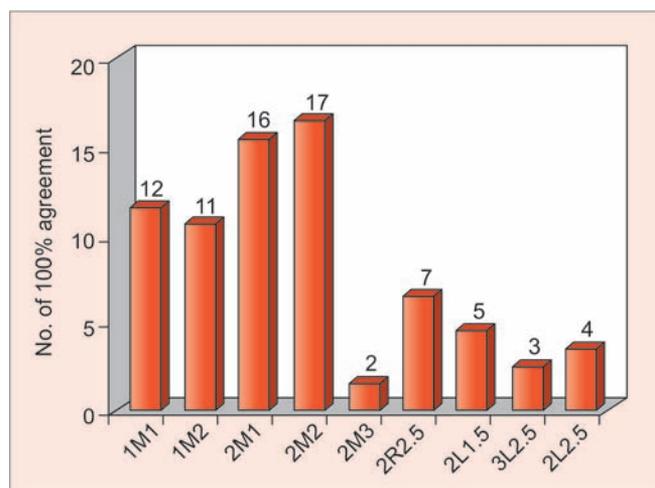
Shades of classical shade guide	Number of 100% agreement between the three operators
A1	17
A2	28
B1	25
B2	12
B3	4
C1	0
Variability	14

Graph 1: Agreement analysis of classical shade guide showing highest agreement with A2

Table 2: Agreement analysis of Toothguide 3D-Master, kappa value is 0.77 and interperson variability is 23%

Shades of VITA Toothguide 3D-Master	Number of 100% agreement between the operators
1M1	12
1M2	11
2M1	16
2M2	17
2M3	2
2R2.5	7
2L1.5	5
3L2.5	3
2L2.5	4
Variability	23

Graph 2: Agreement analysis of tooth guide 3D master, showing highest agreement with 2M1, 2M

Using Vita classical shade guide A2 and B1 seems to be showing very good agreement among the operators with both showing values of 28 and 25 followed by A1 with a value of 17. Overall, the total variability found was 14%. While in VITA Toothguide 3D-Master shade guide, 2M2 was the most agreed upon shade followed by 2M1 and the overall variability in this guide was 23%.

It (α = 0.05) revealed no significant difference. No significant difference was found in the interperson variability based upon the agreement analysis between the operators, as there was about 14% of interperson variability seen in the Vitapan classical shade guide and about 23% in VITA Toothguide 3D-Master. Thus, the variability in VITA Toothguide 3D-Master was higher than in the Vita classical shade guide.

DISCUSSION

In modern dentistry, great emphasis is being placed on esthetic restorations by patients and dentists.[1-3] For these tooth-colored restorations, an accurate and acceptable shade selection on the chairside and its accurate formulation in the laboratory still remain a demanding task even for the experienced clinicians and laboratory technicians.[11,13]

According to the glossary of prosthodontic terms, the term "shade selection" or "tooth color selection" is defined as the determination of the color and other attributes of appearance of an artificial tooth or set of teeth for a given individual.[14]

Successful color matching integrates a number of critical factors including individual's perception of color, the light source under which the shade is being selected, and surrounding environment. There are different methods of shade matching, either by visual aids or instrumental aids. The manual method of shade matching is the most common type of method being used by the dentist today. However, color matching by visual aids is complicated by individual differences in color perception and different abilities of color discrimination.[15,16]

Therefore, this study was aimed at checking the interperson variability in shade selection by visual techniques using VITA Toothguide 3D-Master with Vitapan classical shade guide and then to calculate the amount of percentage in variability in shade selection.

However, the null hypothesis was rejected since there was about 14% of interperson variability in the Vitapan classical shade guide among the operators and about 23% of interperson variability in VITA Toothguide 3D-Master.

This study shows higher variability with the 3D-master shade guide, which is in contrast to the study carried out by Jivanescu et al,[17] which shows higher agreement with Vita 3D-Master. However, the difference in the variability of two shade guides is not very noticeable.

Most of the studies are directed toward minimizing errors in visual color selection mainly using two instruments—colorimeters and spectrophotometers. Spectrophotometers have shown high repeatability.[18]

CONCLUSION

Within the limitations of this study, the following conclusions were drawn:
- VITA Toothguide 3D-Master shows higher variability in comparison with Vita lumen shade guide (23%).
- However, the difference in variability was not significant.

REFERENCES

1. Sikri VK. Color: implications in dentistry. J Conserv Dent 2010 Oct-Dec;13(4):249-255.
2. Corciolani, G. A study of dental color matching, color selection and color reproduction. Siena: University of Siena; 2009.
3. Paravina R, Stankovi D, Aleksov L, Mladenovi D, Risti K. Problems in standard shade matching and reproduction procedure in dentistry. UDC 1997 May;4(1):12-16.

4. Naik AV, Jurel SK, Pai RC. Interoperator variability in shade matching for restoration with two shade guides. IJCD 2011 Jan;2(1).

5. Saleski CG. Color, light and shade matching. J Prosthet Dent 1972 Mar;27(3):263-268.

6. Bayindir F, Kuo S, Johnston WM, Wee AG. Coverage error of three conceptually different shade guide systems to vital unrestored dentition. J Prosthet Dent 2007 Sep;98(3):175-185.

7. Culpepper WD. A comparative study of shade-matching procedures. J Prosthet Dent 1970 Aug;24(2):166-173.

8. Vitapan classical shade guide manual.

9. VITA Toothguide 3D-MASTER manual.

10. Christopher CK. Shade selection. Aust Dent Pract 2007 Sep-Oct;10:116-119.

11. Dagg H, O'Connell B, Claffey N, Byrne D, Gorman C. The influence of some different factors on the accuracy of shade selection. J Oral Rehabil 2004 Sep;31(9):900-904.

12. Capa N, Malkondu O, Kazazoglu E, Calikkocaoglu S. Evaluating factors that affect the shade matching ability of dentists, dental staff members and lay people. J Am Dent Assoc 2010 Jan;141(1):71-76.

13. Fondriest J. Shade matching in restorative dentistry: the science and strategies. Int J Periodontics Restorative Dent 2003 Oct;23(5):467-479.

14. The Academy of Prosthodontics. Glossary of prosthodontic terms. 8th ed.

15. Hall NR. Tooth colour selection: the application of colour science to dental colour matching. Aust Prosthodont J 1991 Feb;5:41-46.

16. Joiner A. Tooth colour: a review of the literature. J Dent 2004 Feb;32(Suppl 1):3-12.

17. Jivanescu A, Marcauteanu C, Pop D, Goguta L, Bratu D. Conventional versus spectrophotometric shade taking for the upper central incisor: a clinical comparative study. TMJ 2010 Nov;60(4):274-279.

18. Llena C, Lozano E, Amengual J, Forner L. Reliability of two color selection devices in matching and measuring tooth color. J Contemp Dent Pract 2011 Jan-Feb;12(1):19-23.