Journal of Coastal Life Medicine
www.jclmm.com
ISSN: 2309-5288(Print)/2309-6152(Online)
Volume 10 No.1 (2022), Page No. 226 – 236
Article History: Received: 02 January 2022, Revised: 10 February 2022, Accepted: 21 February 2022, Publication: 31 March 2022

Effect of Aging of Shade Guide and Its Influence on Shade Selection- an in Vitro Study

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Volume 10 No.1 (2022), Page No. 226 – 236
Article History: Received: 02 January 2022, Revised: 10 February 2022, Accepted: 21 February 2022, Publication: 31 March 2022

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ABSTRACT

BACKGROUND

The selection of the most appropriate colour is generally determined visually by matching commercially available shade guides to the existing dentition. However, colour determination and obtaining an appropriate match continues to be a challenge for the clinician. The colour stability of the shade guide over time is a critical factor that may influence shade selection. Evidence is lacking with respect to how the exposure of different light sources and contact of disinfectant and contact of saliva in the mouth and various other materials that come in contact in the dental clinic affects the colour stability of the shade guide.

AIM

The purpose of this study was to determine the effect of ageing of shade guide based on manufacturing date on the colour stability of Vita classical shade guide by comparing it with Spectrophotometer.

MATERIALS AND METHODS

The study was performed in a university setting where it has the advantages of a controlled environment. Approval for the study was given by the institutional scientific review board of Saveetha dental college, SIMATS, Chennai. The study was conducted over a month period and shade tabs were collected from different clinics and departments. The Vitapan Classical Shade Guide was selected for use in this study from 5 different shade guides based on the manufacturer's date and usage in different clinics in order to include all basic hues and a wide range of saturations and values. The 5 shade guides were first evaluated visually for any perceptible or noticeable colour differences among tabs within the same shade group and each shade guide is compared to spectrophotometer based on manufacturing date and compared it to a brand new shade guide and (ΔE) were calculated for each shade tab from the spectrophotometer. One Way Anova and Tukey HSD Post hoc test was performed and the p-value was determined to evaluate the significance of the variables. The

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activity between different groups by (ΔE) was evaluated and statistics were carried using SPSS Software version 23.0 by IBM India. The results were obtained in the form of tables and graphs.

RESULTS

ΔE values are decreased following the years as it is maximum in 2020 (5.33±1.77) for A2 and minimum as(2.30±0.72) in 2012 whereas for B1 it is (6.43±1.48) in 2020 and (1.60±0.65) in 2012 and for C1 it is (10.63±2.20) in 2020 and(5.66±2.0) in 2012 and mean difference among groups are statistically insignificant ($p>0.05$)followed by one way ANOVA

CONCLUSION

Within the limitations of this study, it was found that the age of shade tab from manufacturers date caused undesirable colour changes in the shade guide tabs and it is evident that changing of shade tabs in the clinic is necessary and should not be used for a long time as it may affect the shade selection. Manufacturers should print an expiry date on the shade tab and maintenance of shade guide protocol should be reviewed and manual should be provided along with the new package

INTRODUCTION

Colour matching is an important aspect of restorative dentistry. The selection of the most appropriate colour is generally determined visually by matching commercially available shade guides to the existing dentition. However, colour determination and obtaining an appropriate match continues to be a challenge for clinician [1]. Difficulties in accurate shade matching have been well documented time and again [2,3]. The increased patients demand to improve their dental esthetics, focuses on replicating natural symmetry and match to the existing natural dentition as closely as possible [4–6]. This has eventually led to the development of new tooth-coloured ceramic restorations; however, accurate colour matching of the restoration to the adjacent teeth and the subsequent dentist laboratory communication remains one of the most critical procedures in clinical dentistry .

Several factors influence the esthetic success of dental ceramic restorations [7], such as surface or substrate characteristics [8,9], marginal accuracy [10], ceramic thickness, [11]translucency, underlying cement, and proper shade selection [11,12]. According to the literature, an accurate colour match of a ceramic restoration with the surrounding teeth is still doubtful[13]. Therefore, many factors, such as eye exhaustion, viewing conditions, the experience of the operator, light source, background and available shade guides play a dominant role in colour determination [14–16]. Tooth colour can be determined using instrumental methods, such as spectrophotometer, spectroradiometer, colourimeter or visual method using commercially shade guides which are preferred by many clinicians[14–16]. It has been reported that the precision of shade selection can be reduced to approximately 48% when a shade guide is used[17].

The Vitapan classical shade guide (Vita Zahnfabrik, Bad Säckingen, Germany) is considered the gold standard and the most commonly used guide for shade selection in esthetic dentistry. [18]. Although the guide is made from acrylic resin, it is compatible with porcelain systems [19]. It contains 16 tabs and is divided into four groups based on hue formulated by the letters: A (reddish/brownish), B (reddish/yellowish), C (greyish), or D (reddish/grey). An exact letter group contains shade tabs with the same hue, and each hue group is further grouped by increasing chroma and decreasing value, formulated in numeric order, such as B1, B2, B3, and B4.(11)

The most commonly used method to evaluate the colour difference is the CIE L*a*b* colour measuring system, developed by the Commission Internationale de l'Eclairage (International Commission On Illumination) in 1978 [13,20]. The system defines the colour of an object within a three-dimensional colourspace which depends on the human colour perception according to three coordinates (L*, a*, and b*)[21]. The L*coordinate (y-axis) represents the lightness of an object with a range from 0 (absolute black) to 100 (absolute white) (increased L* value means a lighter shade), the a* coordinate (x-axis) represents the red (positive) or green (negative) chroma, and the b* coordinate(z-axis) represents the yellow (positive) or blue (negative) chroma [22,23].

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The colour stability of the shade guide over time is a critical factor that may influence shade selection. Most dental clinicians use a shade guide that remains in use throughout the practice service; however, exposure to ultraviolet light can cause changes in colour, especially if they are made of resin [24, 25].

Our research and knowledge have resulted in high-quality publications from our team [26–49] Evidence is lacking with respect to how the exposure of different light sources and contact of disinfectant and contact of saliva in the mouth and various other materials come in contact in the dental clinic affects the colour stability of the shade guide., The purpose of this study was to determine the effect of ageing of shade guide based on manufacturing date on the colour stability of Vita classical shade guide by comparing it with Spectrophotometer.

MATERIALS AND METHODS:

The study was performed under a university setting where it has the advantages of a controlled environment. Approval for study was given by the institutional scientific review board of Saveetha dental college, SIMATS. The study was conducted over a month period and shade tabs were taken from different clinics and departments

The Vitapan Classical Shade Guide was selected for use in this study because it is among the most widely used shade guides in dentistry. Shade tabs were selected from different 5 shade guides based on the manufacturers date and usage in different clinics in order to include all basic hues and a wide range of saturations and values. The 5 shade guides were first evaluated visually for any perceptible or noticeable colour differences among tabs within the same shade group and each shade guide is compared to spectrophotometer based on manufacturing date and compared it to a brand new shade guide and (ΔE) were calculated for each shade tab from the spectrophotometer.

STATISTICAL ANALYSIS :

Descriptive statistics were used to evaluate (ΔE) values of each shade tab. One Way Anova and Tukey HSD Post hoc test was performed and the p value was determined to evaluate the significance of the variables. The activity between different groups by (ΔE) was evaluated and statistics were carried using SPSS Software version 23.0 by IBM India. The results were obtained and tabulated in the form of tables and graphs.

RESULTS

The data were analyzed and tabulated. The value of ΔE for each shade(A2, B1, C1) in 3 different areas: incisal, middle and cervical as obtained from spectrophotometer (Table 1). The mean values of the ΔE in each shade (Table 2). Comparison of ΔE values in between groups was tabulated (Table 3).

This study shows that ΔE values are decreased following the years as it is maximum in 2020 (5.33±1.77) for A2 and minimum as(2.30±0.72) in 2012 whereas for B1 it is (6.43±1.48) in 2020 and (1.60±0.65) in 2012 and for C1 it is (10.63±2.20) in 2020 and(5.66±2.0) in 2012 and mean difference among groups are statistically insignificant ($p>0.05$), followed by ONE WAY ANOVA

DISCUSSION

Based on the above results it is seen that ΔE values are decreased as the age of shade guide increases and there is a change in ΔE values from incisal to cervical and ΔE values are statistically insignificant. Significant differences were found between the colour parameters for all shades, in terms of L*, a*, and b*coordinates.

The Vita classical shade guide was selected in this study because it is the commonly used guide in the dental field for many years [50]. The colour difference between two objects, which determines whether the changes in the overall shade can be detected by the human eye, can be obtained by comparing the differences between the exacting coordinate values for

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each object before and after it is subjected to meticulous conditions. Studies have revealed that ΔE of 2.29 was considered unacceptable as reported by 50% of the observers (25). Several studies have investigated how much of the colour change detected by a chromameter or colourimeter is perceptible to the human eye. It was reported that one unit of ΔE was detectable by 50% of human observers in controlled conditions [51], and colour differences between 2.0 and 3.7 units were visually detectable under clinical conditions [52]. It was also reported that ΔE greater than 2.75 units is clinically unacceptable [52,53],[54] whereas other investigators have reported that ΔE greater than 3.032 or 3.333 is clinically unacceptable.

The material of the shade guide plays an important role in colour stability. Some shade guide tabs are made of porcelain or resin. The industrial fabrication of the shade guide tabs may affect any colour change caused by sterilization or weathering conditions [55]. In the current study, all tested shade tabs showed a significant colour change based on manufacturing date; however, the change may either due to change the ceramic tab itself or it can be due to other accessory components which holds the ceramic tab to the metal arms which include some plastic material, so further studies should be conducted to determine the cause of colour difference.

Recommendations from the American Dental Association Council on Scientific Affairs for the disinfection of prosthetic materials include spray or immersion with an appropriate material. The incorrect application of the disinfectant may affect the physical and/or mechanical properties of the material undergoing the disinfection process [56,57]. Agents containing an organic solvent, such as alcohol, should be generally avoided, as they can cause degradation of some materials, such as plastics or resins[58].

For tooth shade determination, the middle site of the tooth was used. The middle site of the teeth is said to be the best representative of its colour because the incisal site is most often translucent and is affected by its background while the cervical colour is modified by scattered light from the gingiva[59].

Shade taking is a demanding exercise, with few standardized methods to allow transfer and interpretation from the dentist to the laboratory technician. Recent advancement in shade selection has been the development of technology-based shade guide systems; several systems are currently available. Therefore, both a subjective and objective approach to colour treatment planning is now available to the clinician. The subjective approach is the use of shade tabs that remains the most common practice but contains uncertainties because of the human factors surrounding the perception of colour. The objective approach is technology-based computer imaging and analysis which overcomes many of the human factors.It is important to consider that this aging for the shade tab from manufacturing date will negatively affect shade color selection and manufacturers should work to solve this problem either through indicating an expiration date on the shade guide or producing a new tab which can withstand aging.

Although the VITA classical shade guide is a popular shade guide in the dental clinic, few studies have been done on the effect of thermocycling on the other shade guides that are available on the market such as 3-D Master shade guide, or the Chromascop shade guide; thus, future investigations are required. Also, clinical studies are mandatory to better simulate intraoral conditions to validate the results of this study.

The development of new shade-matching systems may herald a major advance in clinical practice. Shade determination can be divided into the areas of analysis, communication (of information to the laboratory), interpretation, fabrication, and verification. Technology-based systems address analysis and communication quite well; interpretation and fabrication of restorations are still inherently subjective. In sum, efforts in the direction of objective evaluation of shade via unbiased technology-based information systems hold promise for the future.

Limitation of the current study include only Vita easy shade guides are taken in to consideration and there are different shade tabs in market which are used by different clinicians and there are so many Fake shade tabs circulating in market based on cost of shade tab

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CONFLICT OF INTEREST:

None

ACKNOWLEDGEMENT:

This research was done under the supervision of the Department of Research of Saveetha Dental College and Hospitals and White lab.We sincerely show our gratitude to white lab and the corresponding guides who provided insight and expertise that greatly assisted the research.

SOURCE OF FUNDING:

None

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Volume 10 No.1 (2022), Page No. 226 – 236
Article History: Received: 02 January 2022, Revised: 10 February 2022, Accepted: 21 February 2022, Publication: 31 March 2022

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Journal of Coastal Life Medicine
www.jclmm.com
ISSN: 2309-5288(Print)/2309-6152(Online)
Volume 10 No.1 (2022), Page No. 226 – 236
Article History: Received: 02 January 2022, Revised: 10 February 2022, Accepted: 21 February 2022, Publication: 31 March 2022

FIGURES:

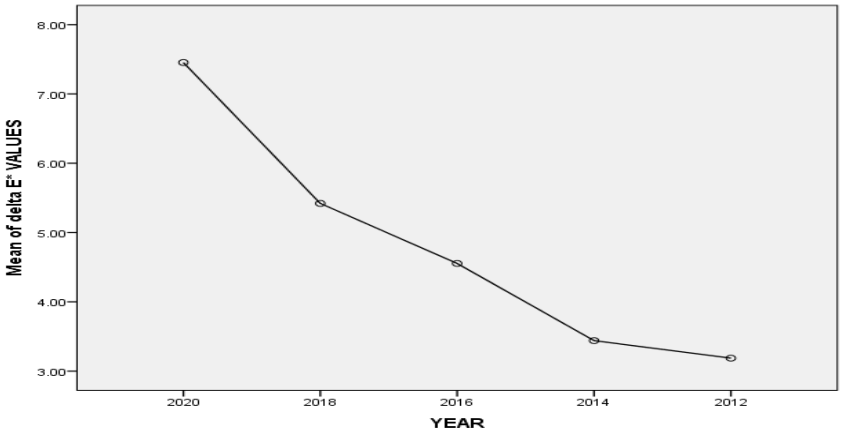

Fig 1:Figure showing the mean plot of different ΔE values following different years of manufacture of shade guide

Fig 2: Figure showing the Vita Easy Shade V ®(Vita Zahnfabrik, Bad Säckingen, Germany)

Fig 3: Figure showing the Vita Classical Shade ® guide(Vita Zahnfabrik, Bad Säckingen, Germany)

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TABLES:

TABLE 1:The value of ΔE for each shade(A2,B1,C1) in 3 different areas obtained from spectrophotometer

	VITA CLASSIC SHADES (ΔE VALUES)								
YEAR	A2			B1			C1		
	Incisal	Middle	Cervical	Incisal	Middle	Cervical	Incisal	Middle	Cervical
2020	6.9	5.7	3.4	7.7	6.8	4.8	12.9	10.5	8.5
2018	5.5	4.6	3.2	5.1	3.8	2.0	10.5	7.8	6.3
2016	5.0	4.3	3.1	3.6	2.7	2.5	8.3	6.5	5.0
2014	3.2	2.6	2.0	2.6	1.7	1.3	8.0	5.6	4.0
2012	3.1	2.1	1.7	2.3	1.5	1.0	7.8	5.4	3.8

TABLE 2 : MEAN VALUES OF ΔE VALUES OF ALL GROUPS IN EACH SHADE

	VITA CLASSIC SHADES (ΔE VALUES) MEAN± SD		
YEAR	A2	B1	C1
2020	5.33±1.77	6.43±1.48	10.63±2.20
2018	4.43±1.15	3.63±1.55	8.20±2.12
2016	4.13±0.96	2.93±0.58	6.60±1.65
2014	2.60±0.60	1.86±0.66	5.86±2.01
2012	2.30±0.72	1.60±0.65	5.66±2.01

TABLE 3 : COMPARISON OF ΔE VALUES IN BETWEEN GROUPS

	df	Mean Square	F	Sig
Between groups	4	8.953	1.684	0.229
Within groups	10	5.317		

*Statistically insignificant p>0.05 p-value was derived from one way ANOVA