



SHADE SELECTION- 'A HINT FROM A TINT'- MANUAL METHODS- A REVIEW

Prosthodontics

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ABSTRACT

Aesthetic restorative efforts are defined and guided by some universal principles in forming beautiful smiles. Understanding the science of color and color perception in the ever-expanding field of esthetic restorative dentistry is crucial to success. Selection of the wrong shades can destroy the result of the prosthesis and thus requiring a thorough understanding and knowledge of the concept of shade selection.

KEYWORDS

Color, Shade Selection, Shade Matching, Dental Shade Guide

INTRODUCTION:

The interest in color research in dentistry has increased significantly over the past several decades. To match the color of restoration to natural teeth, we should be able to select, record, and communicate the correct shade. Shade selection requires dental professionals to understand the science of color, the shade and surface characteristics of teeth, and also various methods of shade selection to meet patient expectations.[1] The shade-matching tools that most dental practitioners use to identify and communicate color and shade information with others are called color reference standards or simply shade guides. Presently, dentists use shade guides for describing tooth shades, prepared teeth (dentin/stump guides), gingival tissues, and even human skin.[2] In the literature, many shade selection methods were described, which consists of manual as well as instrumental methods. Despite recent advancements, the majority of dental fraternity still using manual methods for selection of shade. Hence this review was undertaken to discuss various shade selection manual techniques and their drawbacks.

SEARCH PROTOCOL:

Data Collection Process:

Information Resource:

An electronic literature search was conducted through Medline via Pubmed, Wiley Online Library, Ebscohost, Science Direct, Scopus, Web of Science, as well as the Google Scholar for articles published between October 1990 and December 2017, using the keywords. A total of 20 articles were found, out of these 4 were not related to present search and hence were excluded from the study. Finally, 16 articles found to be relevant (flow chart 1).

Search Criteria:

Inclusion Criteria:

1. Articles published in the English language
2. Full-text articles
3. Articles with keywords like Aesthetic Hue, Chroma, Value, Shade selection, Shade matching, dental shade guide.

Exclusion Criteria:

1. Abstracts
2. Articles in other than the English language
3. Short studies

COLOR SCIENCE:

For effective esthetic restorations, an understanding of the nature of light and how the eye perceives and the brain interprets light as color is critical.

Nature Of Light:

Light is a part of electromagnetic waves. The electromagnetic

spectrum will have a visible and invisible spectrum. The white light that is seen by the human eye is called "visible" light (380 nm to 780 nm). Waves called radio, microwave, infrared, ultraviolet (UV), x-rays, and gamma rays are cannot be seen by the human eye, and therefore called the "invisible" spectrum(fig:1).[3]

FLOW CHART 1: PRISMA flowchart for selection of the articles

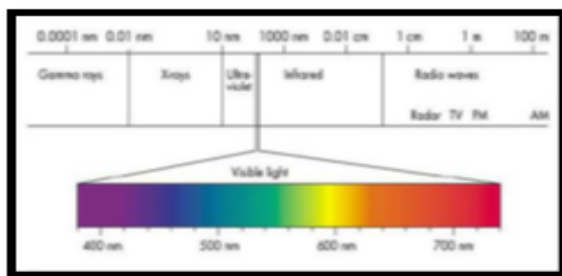
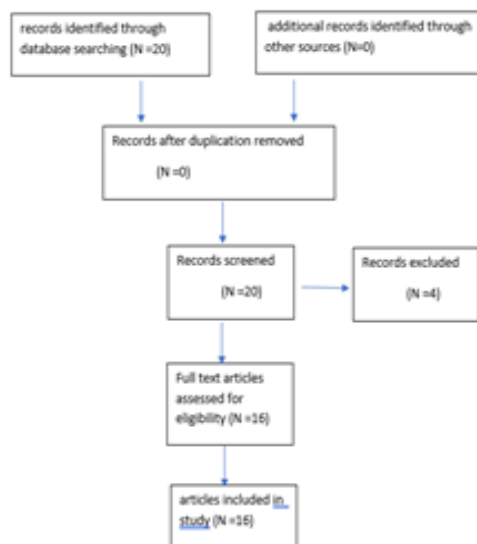


Fig:1

Color:

Color is a property of light. Objects have no color of their own; they just reflect a particular wavelength from the color spectrum. For example, a blue object absorbs all of the wavelengths, except for

blue. The remaining wavelengths enter our eyes, and this is what we see.[3]

Description Of Color:

The most popular method for describing color is the Munsell system. The three attributes of color in this system are called Hue, Chroma, and Value(Fig:2).[3]

Hue: It is defined as a particular variety of colors. The Hue of an object can be red, green, yellow, and so on.

Chroma: The intensity or saturation of a hue is called Chroma.

Value: The relative darkness or lightness of a color is called Value.

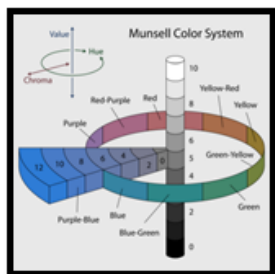


Fig:2

Metamerism:

Another aspect of lighting is the subject of metamerism. Two objects may appear to be identical colors under a certain kind of light, yet under another type of light, they may look totally different. This is called metamerism. The problem of metamerism can be avoided by selecting a shade and confirming it under different lighting conditions (e.g., natural daylight and fluorescent light).[3]

SHADE SELECTION METHODS:

We have two types of shade selection methods they are 1) Manual or visual methods and 2) automatic or instrumental.

The most frequently used technique in the shade matching of teeth to restorative materials is done manually and visually with dental shade guides. A shade guide serves to determine a tooth shade accurately. A shade guide, based on the three-dimensional Munsell Color Order System would be a boon to dentistry and the color matching of ceramo-metal restorations.[4]

Some are universal shade guides i.e they can be used for matching ceramic materials and composite resin materials with teeth.[5] However, it is usually beneficial to use a shade guide made of the corresponding restorative material. Examples of resin-made shade guides are Esthet-X (Dentsply/Caulk, Milford, DL, USA) Tetric Cream (Coltene/Whaledent, Cuyahoga Falls, OH, USA), Venus (Heraeus Kulzer, South Bend, ID, USA), and Vit-l-escence (Ultradent, South Jordan, UT, USA). The ceramic made shade guides include the Vita line of shade guides (Vita North America, Yorba Linda, CA, USA), Chromascop (Ivoclar Vivadent, Amherst, NY), and Vintage Halo (Shofu Dental, Menlo Park, CA).

- 1)Hyashi Shade Guide
- 2)Clark Shade Guide
- 3)Spectatone
- 4)Chromascop
- 5)Trubyte Bioform(Dentsply)
- 6)Vita Classical Shade Guide
- 7)Vita 3d Master Shade Guides
- 8)Visually Optimal Shade Guide
- 9)Dentin Shade Guide
- 10)Custom Shade Guide
- 11)Modified Shade Guide

Hyashi Shade Guides:

The guide, which has been published in Japan, uses fully controlled paper tabs to represent each equally spaced 125 locations in color space[6]. Although it is not a commercial guide, it is a concept that can serve as a guideline for future guides. This illustration is a representation of the five hues in the shade guide designed by

Hayashi and printed on paper. The illustrated Hayashi guide is based on the Munsell Color Order System with Hue steps of 1.25 intervals, Value steps of 0.5 intervals, and Chroma steps in unit intervals, as shown below:

- a. Five Hues—8.75 YR to 3.75 Y with 1.25 interval.
- b. Five Values for each Hue—6 to 8 with 0.5 intervals.
- c. Five Chromas for each Hue—I to 5 with unit interval.

Clark Shade Guide (tooth Color Indicator):

A similar guide was developed in porcelain by Clark 60 years ago[7]. There was 60 in the Clark guide. It contain 60 tab - 3 basic hue, 19 value, 6 chroma. According to him, "Value" is an important dimension to control

Spectatone:

This guide used 12 hues, but the shade guide had only every other hue represented.[6] The missing hues could be selected by interpolation. Once the closest hue was selected, the viewer had 36 value and chroma variations of this hue. Since there were 6 hues, a total of 256 selection tabs were available, and an additional 256 tabs could be created by interpolation. The system enabled the viewer to move about in the color space to every hue, value, and chroma needed to achieve the closest match to the tooth being replicated. Even though the initial consideration of 256 tabs seemed overwhelming, the guide was simpler and more effective than the illogically ordered systems having fewer tabs.

Chromascop Shade Guide (Ivoclar Vivadent)

This is also hue-based.[8] It has 20 possible shades in the following 5 hue groups: Group 100 = white, Group 200 = yellow, Group 300 = light brown, Group 400 = gray, and Group 500 = dark brown (Fig:3). Each hue group has 4 shade variations of increasing chroma (i.e., Group 100 = 110, 120, 130, and 140).



Fig:3

Trubyte Bioform Color Ordered Shade Guide (DENTSPLY Trubyte)

It has 24 shades that are based more directly on Munsell's work[8](Fig:4). Its shade tabs are broken down into the following 4 hues: reddish-brown, yellow, gray, and reddish-gray. The guide may be purchased in 2 different materials—plastic and porcelain—and 2 different versions—Style A, where all 24 tabs are ordered by value from lightest to darkest, and Style B, where the tabs are ordered first by hue and then lightest to darkest within the hue group.



Fig:4

The VITA Classical A1-D4 shade guide

(Vita North America, Yorba Linda, CA, USA)(Fig:5) was introduced to dentistry in 1956. [8] It is composed of sixteen tabs. The tabs are arranged into four groups (A-D) based on hue A = reddish-brown, B = reddish yellow, C = gray, and D = reddish gray with increasing chroma within each groups.

**Fig:5**

The VITA System 3-D MASTER Shade Guides. This system is composed of the VITA Linear guide 3-D MASTER, VITA tooth guide 3-D MASTER introduced in 1998.[8]

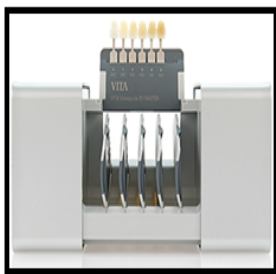
1)The VITA tooth guide 3-D MASTER® shade guides

It has 26 tabs that cover the following six value-based groups: zero, 1, 2, 3, 4, and 5. (Fig:6) Within each value group, and there are the following three hue variations: M = standard hue, L = yellow, and R = red. Each of the hue groups are further differentiated by 2 or 3 chroma variations.

**Fig:6**

2)The VITA Linear guide 3-D MASTER

It is organized in terms of lightness, chroma, and hue, and the shade can be determined in two steps (Fig:7). 26 natural and systematically arranged tooth shades; in addition, three shades for tooth whitening (VITA Bleached Shades). Clear organization of the shade samples in terms of lightness, chroma, and hue. Easy use is self-explanatory—the possibility of creating intermediate shades by mixing.

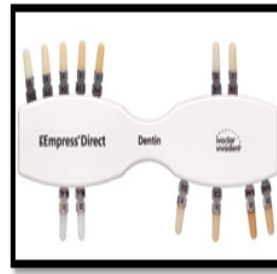
**Fig:7**

Visually Optimal Shade Guide:

This is an optimal shade guide with the use of a hierarchical technique [9]. The hierarchical clustering is a mathematical procedure for creating a sequence of partitions within a data set. In this approach, the similarity between all tooth samples in the population is computed. With the use of this hierarchical clustering approach, a series of shade guide was designed with varying number of tabs. The average error (Δe) between colors from each shade guide and the extracted teeth were computed. It was demonstrated that a hierarchical clustering could be used to design an optimal shade guide.

Dentin Shade Guides-

When using a translucent all-ceramic system for a crown or veneer, communicating the shade of the prepared dentin to the dental laboratory is helpful [6] (Fig:8). One system provides specially colored die materials that match the dentin shade guide and enable the technician to judge restoration esthetics.

**Fig:8**

Custom Shade Guide -

Unfortunately, certain teeth may be impossible to match commercial shade samples. [6] In addition, difficulties may be encountered in reproducing the shade guides in the final restorations. The extensive use of surface staining has severe drawbacks because the stains increase surface reflection and vent light from being transmitted through porcelain. One approach to this problem is to extend the concept of a commercial shade guide by making a custom shade guide. An almost infinite number of samples can be made by using different combinations of porcelain powders in varying distributions. However, the procedure is time-consuming and is generally confined to specialty practice.

The fabrication of a custom shade guide, especially one having an expanded shade range, can be very helpful. Although the fabrication of such a guide is time-consuming, it provides a more realistic representation of what is achievable. Unlike most shade guides, a custom guide is made of the same material as the final restoration, thus reducing metamerism. Miller has recommended the addition of red (pink) modifiers to supplement the conventional guide in this area of the color space where such guides are lacking. Fabrication of a custom guide should include a metal backing for metal-ceramic restorations and should be of realistic thickness, achievable with clinical restorations. Guides having varying textures and gloss may also be helpful.

Modified Shade Guide-

When a tooth closely approximates a specific shade selection tab but has characterizations or deviations, those variations may be defined and communicated using a shade guide with the glaze removed and a set of dental surface colorants ("stains"). [6] Air-borne particle abrading using aluminum oxide is recommended to remove the glaze, although this can be done using emery discs. The colorant may be applied and removed or modified until the proper effect is achieved. Once the guide closely resembles the tooth to be matched, it should be placed in a vial to avoid smearing and sent to the laboratory along with a description of the colorants used and the effects desired.

Drawbacks of Shade Guides [6]

- The inaccuracy in the name of the shade guides is less a problem than the guides themselves. They have historically been a weak link in an orderly approach to color matching in dentistry.
- The colors of shade guides, from a given manufacturer, vary from guide to guide.
- The porcelain for the guide is not necessarily the same as the porcelain used for the restoration.
- The guides do not duplicate the manner in which porcelain restorations must be constructed (thickness of opaque, the thickness of body and incisal porcelain, metal bonding, etc.).
- The colors of the guides are illogically arranged and do not cover the volume of the color space of the natural teeth.
- All standard shade tabs are thick (3-4.5mm) as compared to a crown (1-1.5mm), and are made of synthetic resin.
- Light is reflected and transmitted through a shade guide tab giving it translucency and vitality whereas, in the restoration, light is reflected and barely transmitted making it look dense and opaque.

Color Corrected Lights:

Color cannot be accurately perceived if a proper illumination of the viewing object is not achieved. Light intensity regulates the pupillary diameter, and thus, it controls the amount of light that will stimulate the retinal receptors. The standard illuminant for dentistry, D55, is defined as Washington, DC, June, noon to 1 p.m., with a

slight overcast, a color temperature of 5,500 K, and a color-rendering index of 90.[10] The illuminance at the tooth level should range from 1,000 lux to 1,500 lux. Since these ideal conditions are difficult to achieve in the dental offices, color-corrected lighting tubes are recommended to be used for overhead lamps. Handheld color-corrected shade-matching lamps are also available, and several studies reported better shade-matching performances when they were used.[11]

Eg: Rite lite(fig9), Smile lite(fig:10)



Fig:9



Fig:10

Recommendations For Shade Selection In Dental Operatory:

- Teeth to be matched must be clean.
- Remove bright colors from the field of view.
- Tooth shade should be determined in daylight or under standardized daylight lamps (not operation lamps).
- Operatory walls should be neutral in color.
- View at the patient eye level.
- Evaluate shade under multiple light sources.
- Make shade matching at the beginning of treatment before the teeth begin to dehydrate.
- Shade matching should be made quickly to avoid eye fatigue (5-7) seconds. The observer can look at a blue or gray card to rest the eyes.

DISCUSSION:

Tooth shade guides were first developed in the late 1920s in response to the acceptance of Munsell's color theory and the development of dental ceramics intended for artificial porcelain teeth and customized dental restorations. The individual shade tabs of those early guides were empirically developed, based on the availability and popularity of commercially available porcelain shades. The best-known and most popular guide worldwide is the VITA Classical Shade Guide. Lee YK et al., [12] observed some visually perceptible color differences in VITA Lumin shade guide tabs (VITA Zahnfabrik, Bad Sackingen, Germany) based on spectrophotometer (SP) color measurements when CIE standard illuminants were changed. A study research done by Park JH et al., [13] also revealed that perceptible color shifts were observed in Chromascop shade guide when different illuminants were used. According to Corciolani et al.,[14] the shade matching ability of the VITA 3D-Master Tooth Guide was found to be more reliable than that of the VITA Classical Shade Guide for Omega 900. Paravina RD et al., [15], revealed that the Vita Toothguide 3D-Master shade guide demonstrated lower ΔE (Mean color differences) values than the Vitapan Classical. As per Lee Y K et al.,[10] Perceptible shifts in the color of shade guide tabs under different ambient lighting conditions were confirmed and were influenced by the type of illuminant used. Öngül D et al. [16] did a study to evaluate the influence of 2 shade guides on the color match and to evaluate the relationship between color difference (ΔE) values and examiners' assessments of the color match in ceramic crowns. They found that

ceramic crowns fabricated with the Vita Toothguide 3D-Master shade guide resulted in a closer color match to the natural teeth than those of the Vitapan Classical guide. According to opinion of Wee A G et al., [17] the ambient light in the private dental clinics was not ideal for visual shade matching. Curd FM and his colleagues[18] reveals that Dental students' shade matching abilities were better with a light-correcting source than under natural light.

With the available literature vita 3D master shade guide results in more closer color to the natural tooth, but visual methods are influenced by a host of variables, such as age, experience, and degree of color deficiency of the individual choosing the shade, the shape and texture of the tooth being matched, and the type of lighting.[18]

CONCLUSION:

The blending of science and art is something the dental industry is primed for. Patients are demanding contemporary esthetic dentistry, which has prompted the industry to continuously raise the bar with regard to esthetic detail. Many factors can influence the perception of color; by taking advantage of today's shade-matching technology, the subjectivity of color assessment can be minimized, and accurate diagnosis of a restoration's shade is more easily communicated.

Each method has its own advantages and disadvantages, but they are easy to use and comparatively provide good results for shade selection.

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