ORIGINAL RESEARCH PAPER
Volume - 9 | Issue - 8 | August - 2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

SHADE SELECTION- 'A HINT FROM A TINT'- INSTRUMENTAL METHODS- A REVIEW.

Prosthodontics

Parvathi PSHL	Postgraduate Student, Department Of Prosthodontics, Lenora Institute Of Dental Sciences
Rao BL*	Professor & Hod, Department Of Prosthodontics, Lenora Institute Of Dental Sciences *Corresponding Author
G Sirisha	Senior lecturer, Department Of Prosthodontics, Lenora Institute Of Dental Sciences
Sruthi YSS	Postgraduate Student, Department Of Prosthodontics, Lenora Institute Of Dental Sciences
PK Monika	Postgraduate Student, Department Of Prosthodontics, Lenora Institute Of Dental Sciences
B Santhi	Postgraduate Student, Department Of Prosthodontics, Lenora Institute Of Dental Sciences

ABSTRACT

Shade determination for direct and indirect restorations has always been a challenge for the esthetic dentist. The kind of shade guide, individual ability to choose shades and conditions the choice is made under, all have influence on reliability and accuracy of the procedure. Therefore, it is necessary to introduce instrumental color determination in everyday work.

KEYWORDS

Tooth Color, Shade Guide, Technology, Colorimeter, Spectrophotometer.

INTRODUCTION:

In everyday life, a wide variety of colors are present, and these colors play very important roles. However, unlike length or weight, color is subjective; making it improbable that people would respond the same when asked to describe the same object. For example, if we say "red car" or "red apple" to people, they will imagine different shades of red because their color perception and past experiences will be different. This is the main issue with color, but advances in modern science and technology have helped solve this issue. With the introduction of color measurement instruments such as colorimeters and spectrophotometers, we are able to quantify color. These highly technically advanced instruments are able to assign numerical values to help quantify, control and define color.[1]

Today's shade-matching technologies have been developed in an effort to increase the success of color matching, communication, reproduction and verification in clinical dentistry, and, ultimately, to increase the efficiency of esthetic restorative work within any practice.[1] The aim of this paper is to provide a comprehensive review of the current state of shade-matching technologies and instrumentation.

Different types of technological shade systems are: RGB devices, spectrophotometers, colorimeters, digital cameras and imaging systems, spectroradiometers.

The Measurement system includes the spot measurement systems measuring small areas on the tooth surface (e.g. Shofu Shade Eye-NCC, Chroma meter system, Vita easy shade system) or complete tooth measurement systems that measures the entire tooth surface and provide a color map of the tooth in one image.

Search protocol:

Data collection process:

List of keywords: Tooth Color, Shade Guide, Technology, Colorimeter, Spectrophotometer.

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 1996 and December 2017, using the keywords. A total of 25 articles were found, out of these 6 were not related to present search and hence were excluded from the study. Finally, 18 articles found to be relevant (flow chart 1).

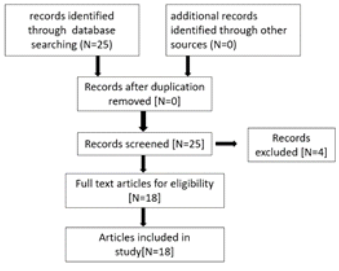
Search criteria:

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



Flowchart1: PRISMA flow chart for selection of articles.

RGB DEVICES:

Acquire RED, GREEN, BLUE image information to create a color image. They do not control key variables associated with accurate color determination.[2] ShadeScan™ measures shades over the entire tooth surface, then analyzes them and generate a shade match report. It likewise can generate a report to be used with any standard shade guide system. ShadeScan™ creates an image of the tooth with a translucency and characterization map, and then will generate a printed report.[3]

COLORIMETERS:

Colorimeters measure tristimulus values (CIE XYZ) by filtering the reflected light from an object into red, green and blue areas of the visible spectrum and typically convert these to CIELAB values (L*, A*, B*) that can compare the color parameters of different objects when analyzed mathematically.[4] Colorimeters can be of two types mainly the photoelectric tristimulus colorimeters (Microcolor) and silicon photodiode array (Orient Scientific Ltd). Microcolor colorimeter (a photoelectric tri-stimulus colorimeter) is a self-contained measuring system that requires no external power source while a silicon photodiode array requires both an external power

source and a standard light source.[2][3]

Some disadvantages of colorimeters have been described, including: colorimeters are designed to measure flat surfaces, teeth are often not flat and can have surface anomalies; teeth are translucent which can lead to light loss at the edge of the tooth sample being measured giving incorrect colour values, and inter-instrument agreement is relatively poor.[4] Because color filters are subject to aging and fading, the long-term accuracy of colorimeters may be adversely affected. Overall, they are thought to be more accurate than RGB devices but less accurate than spectrophotometers. The ShadeVision (X-Rite) [Fig:1] and ShadeEye NCC (Shofu Dental) [Fig:2] are examples of dental colorimeters.

Fig:1

Fig:2

SPECTROPHOTOMETERS:

Spectrophotometers measure the amount of light energy reflected from an object at 1–25 nm intervals along the visible spectrum and can convert the measured spectral reflectance to colour coordinates (CIEXYZ, CIELAB or CIELCH) and various tooth shade values. This can be a single shade or map subtle differences in shade across a tooth surface. There are various commercial spectrophotometers available for clinical applications, having different designs, software and output of data. However, care must be taken when using these devices, since studies have shown that the degree of matching repeatability can be influenced by the ambient illuminant and by the background that may be applied to teeth. Fogging of the optical lens can occur during in vivo measurement, which leads to inaccurate readings. As these devices are contact-measuring instruments, minor patient discomfort may occur since the head of some devices must be held stable against the gingival tissues. . Examples of dental spectrophotometers that are currently available include the following: The Easyshade Compact (VITA) [Fig:3], SpectroShade Micro (MHT Optic Research) [Fig:4], and the Shade Pilot (DeguDent GmbH) [Fig:5].

Fig:3

Fig:4

Fig:5

SPECTRORADIOMETERS:

Spectroradiometers measure radiometric quantities (irradiance, radiance) emitted or reflected from objects along the visible spectrum. Their colorimetric values are expressed by luminance and illuminance for radiance and irradiance units respectively and can be converted intocolour coordinates (CIEXYZ, CIELAB and CIECLH).[4] The main differences between spectrophotometers and spectroradiometers are that the latter ones do not have built-in light sources and they are noncontact measurement devices.

A spectroradiometer Minolta CS1000 (Konica Minolta, Inc., Japan) was used to measure colours of shade guide tabs in a study for developing a tooth whiteness index, as the device measured colours in a way that matched the settings of visual assessments. spectroradiometers are usually equipped with custom-built light sources, such as Xenon light sources with fiber optic cables, four 100-W bulb dedolights with filters. As the aperture of the device can be adjusted to be relatively small (1–2.5 mm), measurements have been made at different regions of a single incisor in vivo. The advantages of measuring tooth colour using spectroradiometers are mainly associated with their non-contact measurement approach.

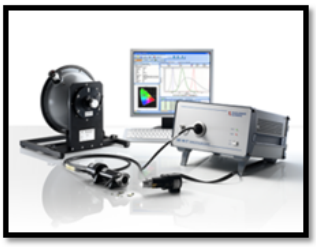


Fig:6

DIGITAL CAMERAS AND IMAGING SYSTEM:

Another non-contact colour measurement method is using digital imaging. Digital cameras record the scene onto a light-sensing material and output images represented by red, green and blue (RGB) values for each pixel. The advantages of this approach include non-contact measurement; ability to assess the whole tooth surface; systematic error due to translucency and surface curvature can be minimized; provides a permanent database of images that can be analysed and re-investigated at a later date; quick and simple training and operation, and not requiring a clinician. A typical dental imaging system for colour measurement consists of a digital camera and a light source. Commercial single-lens reflex (SLR)cameras when combined with the appropriate calibration protocols showed potential for use in dental colour measurement.

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 shades.[1] Similar to the software associated with color measuring devices, Clear Match contains the color database of industry-standard shade guides.

Fig:6

Limitations of Digital Shade Analysis:[6]

a. Accuracy of color measurement is affected by the phenomenon of edge loss.
b. Translucency mapping is inadequate with all of the systems.
c. Positioning of the probe or mouthpiece seems to be critical to the repeatability of the measurement.
d. None of the above instruments are sophisticated enough to function in a formulation mod: (i.e. specifying powders and layering to achieve the actual color designation of any tooth color or translucency distribution measured).
e. For this approach to be efficient the laboratory must have system as well.
f. A few models are available in the market, but are very expensive.

DISCUSSION:

There was literature available comparing the visual and instrumental methods and a number of reported studies compare the repeatability and accuracy of various instruments in vitro and in vivo. Paul et al., [7] showed that visual shade selection matched only 26.6% whereas spectrophotometric shade selection matched 83.3%. In a study done by Pusateri SK et al., the repeatability of a colorimeter for measuring shade tabs in vitro has been shown to be 99.0% with an accuracy of 92.6% and the repeatability of the SpectroShade (MHT Optic Research AG, Switzerland) and VITA Easyshade (VITA Zahnfabrik, Bad Sackingen, Germany) spectrophotometers for measuring shade

tabs in vitro has been shown to be 96.9% and 96.4% respectively, and their accuracy as 80.2% and 92.6% respectively.[8] In another clinical study measuring maxillary and mandibular teeth, both devices showed excellent repeatability with no significant differences between devices in CIELAB values.[9] Conventional contact measurements like spectrophotometers and colorimeters are subject to the edge-loss effect for translucent materials, where the illuminant light scatters inside of the material and travels to the edges, without reflecting back to the surface.[10] The edge-loss effect for a wide range of translucent dental materials[11] can be avoided by using non-contact colour measurement systems, such as spectroradiometers, which use external light sources and do not need to attach apertures onto the material surface.[12,13] The advantages of measuring tooth colour using spectroradiometers are mainly associated with their non-contact measurement approach. Some studies have showed that spectroradiometry-based colour measurement are closer to human colour perception of dental materials compared to other contact-measurement devices.[14,15] From studies comparing the performance between digital imaging and contact measurement methods, digital imaging was recommended as an alternative to colorimeters in dentistry when the proper object camera distance, camera settings and suitable illumination are used[16]. In a study with spectrophotometric and digital image measurement methods, it was found that both methods gave a comparable and an objective evaluation of bleaching efficiency [17]. Disadvantages of digital imaging are rarely reported in the literature. Metamerism could be a potential problem when different tooth colours under different lighting conditions look the same due to the metamerism phenomenon [18].

CONCLUSION:

Close shade matching of dental restorative materials with natural teeth is vital to producing restorations that are biomimetic. Most commonly used are shade guides but when Coupled with the advances in instrumental tooth colour measurement, such as spectrophotometers, colorimeters, spectroradiometers and digital imaging systems shade selection will be more accurate and help in prosthesis success and more patient acceptance.

REFERENCES:

1. Chu S J, Trushkowsky R D, Paravina R D. Dental color matching instruments and systems. Review of clinical and research aspects. J Dent 2010;38: 2–16.
2. Bhat V, Prasad DK, Sood S, Bhat A. Role of colors in prosthodontics: Application of color science in restorative dentistry. Indian J Dent Res 2011;22: 804-9
3. Mehta R, Kumar A, Goel M, Kumar V, Arora T, Pande S. shade selection: blending of conventional and digital methods - an updated review. J Oral Health Comm Dent 2014;8(2)109-112.
4. Joiner A, Luo W. Tooth colour and whiteness: A review. Journal of Dentistry 2017; 67: 3–10.
5. Ragain JC. A Review of Color Science in Dentistry: Shade Matching in the Contemporary Dental Practice. J Dent Oral Page Disord Ther 2016; 4(2): 1-5.
6. Smitha AJ, Savitha PN. Shade Matching in Aesthetic Dentistry – From Past to Recent Advances. J Dent Oral Care Med 2017; 3(1): 102.
7. S. Paul, A. Peter, N. Pietroben, C.H.F. Hammerle, Visual and spectrophotometric shade analysis of human teeth, J. Dent. Res. 2002; 81: 578–582.
8. S. Kim-Pusateri, J.D. Brewer, E.L. Davis, A.G. Wee, Reliability and accuracy of four dental shade-matching devices, J. Prosthet. Dent. 101 (2009) 193–199.
9. C. Llena, E. Lozano, J. Amenguai, L. Forner, Reliability of two-color selection devices in matching and measuring tooth color, J. Contemp. Dent Pract 2011;12: 19–23.
10. W.M. Johnston, N.S. Hesse, B.K. Davis, R.R. Seghi, Analysis of edge-losses in reflectance measurements of pigmented maxillofacial elastomer, J. Dent. Res. 75 (1996) 752–760.
11. B. Yu, J.S. Ahn, Y.K. Lee, Measurement of translucency of tooth enamel and dentin, Acta Odontol. Scand. 67 (2009) 57–64.
12. J.C. Kim, B. Yu, Y.K. Lee, Influence of surface layer removal of shade guide tabs on the measured color by spectrophotometer and spectroradiometers, J. Dent. 36 (2008) 1061–1067.
13. Y. Kim, H.H. Son, K. Yi, H.Y. Kim, J. Ahn, J. Chang, The color change in artificial white spot lesions measured using a spectroradiometer, Clin. Oral Investig. 17 (1) (2013) 139–146.
14. H.N. Lim, B. Yu, Y.K. Lee, Spectroradiometric and spectrophotometric translucency of ceramic materials, J. Prosthet. Dent. 104 (2010) 239–246.
15. H.N. Lim, B. Yu, J.I. Lim, Y.K. Lee, Correlations between spectroradiometric and spectrophotometric colors of all-ceramic materials, Dent. Mater. 26 (2010) 1052–1058.
16. A. Caglar, K. Yamanel, K. Gulsahi, B. Bagis, M. Ozcan. Could digital imaging be an alternative for digital colorimeters? Clin. Oral Investig. 14 (2010) 713–718.
17. C. Peskersoy, A. Tetik, V.O. Ozturk, N. Gokay, Spectrophotometric and computerized evaluation of tooth bleaching employing 10 different home-bleaching procedures: in-vitro study, Eur. J. Dent. 8 (2014) 538–545.
18. E. Cal, M. Sonugelen, P. Guneri, A. Kesercioglu, T. Kose, Application of a digital technique in evaluating the reliability of shade guides, J. Oral Rehabil. 31 (2004) 483–491.