

The 3D Communication of Shade: Visual Shade Taking and the Use of Computerized Shade-Taking Technology

Edward A. McLaren, DDS and Yi-Yuan Chang, MDC

Correctly evaluating tooth shade and properly communicating the information to the laboratory historically has been mere guesswork, in large part because of the lack of adequate shade matching systems available as well as a general lack of understanding of the color distribution that exists within a natural tooth. Personal observation by the authors through the evaluation of color from multiple natural tooth samples and compared to standard shade guides clearly demonstrates that the shade guides do not adequately cover natural tooth shades. What has been needed is the development of a shade-taking system that relies on color science, adequately covers natural tooth color space, is simple to use, and easily facilitates the transfer of information to the ceramist. This column will discuss the use of a relatively new shade-taking system that relies on color science that more adequately covers the color space of natural teeth. It also will cover the use new computerized technology that greatly facilitates the shade-taking process.

Vita (Vident™, Brea, California) introduced the Vitapan® 3D-Master™ Shade Guide for evaluating tooth shade. The system was developed to take into account the full range of natural tooth shades within the 3 dimensions of color space: hue, chroma, and value. The system is arranged around choosing the value first, "which is the most important optical parameter" (Figure 1), choosing the chroma level second, and choosing the specific hue last. The shade guide has 26 different shades and 3 bleached shades for a total of 29 shades. At first glance, the system with all of its options can be very intimidating. The authors have found a significant simplification of the 3D master guide that works well for them. When using the guide, remove all of the "L" and "R" shades (Figure 2), leaving only the "M" hues. This reduces the guide down to 14 shades plus the 0-value shades (bleached) for a total of 17. This is only 1 more than the

old Vita shade guide that many dentists still use.

The first step in the shade evaluation process is to choose the value. Very few crowns are accepted if the value is incorrect, while even moderate inaccuracies in chroma and hue may go unnoticed. There are 5 value levels that are exactly equally spaced 5 ΔE s apart within the color space (6 if you add the bleached shade). ΔE is a mathematical measurement of the distance between 2 points in color space; the human eye can only differentiate points that are greater than 2 ΔE s apart. The procedure of choosing the value is best done by a process of elimination; the closest value is chosen and recorded on a specially devised prescription pad (Figure 3). If it is determined that the tooth to be matched is between 2 value levels, for example between value level 2 and 3, this would then be recorded as value 2.5. The ceramist would then equally mix value level porcelains 2 and 3, which would give a result that is halfway between value 2 and 3 in the final restoration. Because the value is the most important optical parameter, the author has found it extremely beneficial to use black and white digital photography to help determine the value (Figure 4). The authors use a Canon 20D camera with a 100-mm macro lens (Canon USA, Inc, Lake Success, NY), and the MT 24-Ex Canon flash with a Novoflex bracket (Photomed, Sherman Oaks, California) to take the digital images (Figure 5). When taking the image, place 2 shade guides in the images: the one that was the closest visual match and then the next closest value. For example, the evaluator feels that the value level 2 was the closest match but the natural tooth was slightly brighter. The evaluator would hold value level 2 and value level 1 against the tooth and take the image. It is important to hold the shade guides in the same vertical plane as the natural tooth because if the guide is held closer to the light source it will erroneously appear higher

Edward A. McLaren, DDS

Director, Center for Esthetic Dentistry
Founder and Director, UCLA Master
Dental Ceramist Program
Adjunct Associate Professor



Yi-Yuan Chang, MDC

Master Dental Ceramist
Full-Time Faculty, UCLA Master
Dental Ceramist Residency Program
School of Dentistry
University of California at Los Angeles
Los Angeles, California

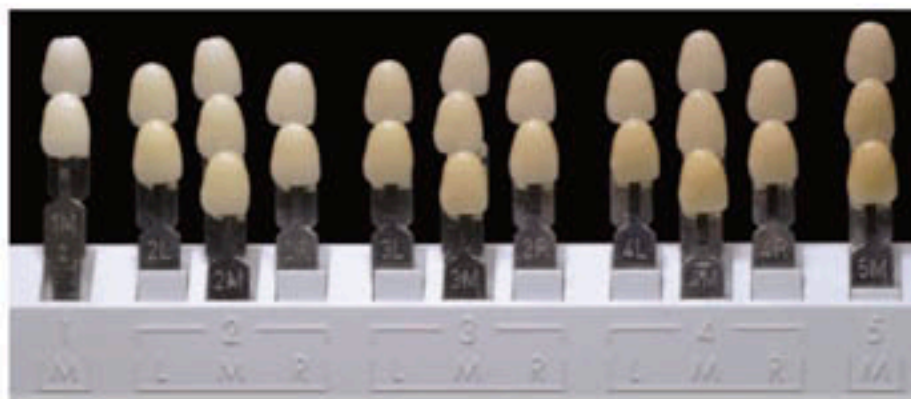


Figure 1 The Vitapan 3D Master Shade Guide.



Figure 2 The 3D Master Shade Guide with only the "M" hues included.



Figure 3 An example of documenting the 2 closest value matches.



Figure 4 Black and white image of the 2 closest value matches.



Figure 5 The Canon 20D camera with the Novoflex bracket and the Canon MT 24EX flash.

in value. The digital images are transferred to the ceramist along with the shade prescription giving more complete information to facilitate the correct shade match of the restoration to the tooth.

The next step is to determine the level of chroma, of which there are 3 within the “M” hue range (Figure 6). The simplest way to accomplish this step is for the evaluator to judge whether the level appears to be low chroma (level 1), medium chroma (level 2), or high chroma (level 3). Again, this is best accomplished by process of elimination, recording the closest match or noting if it is between 2 chroma levels. The chroma levels are all exactly equidistant from each other within the color space. Changing the levels of chroma has historically created problems with altering the value but this system allows the clinicians to alter the chroma and hue without altering the value. So the chroma can be increased or decreased and the hue can be changed without changing the value (Figures 7A and 7B). This feature alone significantly helps in matching restorations to teeth. After choosing the 2 closest chromas, a color digital image is taken to show the ceramist the level of chroma of the natural teeth relative to the shade guide. It is best to take these images in RAW file format because if there are any exposure problems they can be easily corrected in this format.

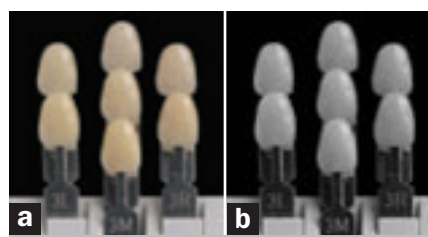
The last step in the process, as recommended by the manufacturer, is to choose the specific hue (Figure 8). The authors have found this to be unnecessary if the process described previously—choosing the value and chroma documented with photography—is followed. Spectrophotometric analysis of natural teeth has shown that natural teeth exist in a very small hue range but if the user wants to record the hue, there are 3 specific hues: the orange-ish middle hue (“M” hues); a yellower hue (“L” hues), and a redder hue (“R” hues). The L and R hues are equidistant in color space from the M hue. The observ-

er would first evaluate the M hue relative to the tooth and decide if it matches or if it is redder or yellower, and then record the chosen hue. The reason the authors have found this step unnecessary is it is easy to see from the photograph if the natural tooth shade is redder or yellower than the M hue. Thus, the shade-matching process becomes easy and very systematic and based on color science. Specific characteristics (ie, crack lines or decalcifications) can be recorded by a drawing and also is seen in the high-quality digital image. Figures 9A and 9B demonstrate a case of all-ceramic crowns using VM9 porcelain (Vident, Brea, CA) and Lava™ copings (3M ESPE, St. Paul MN) using the 3D master shade system, and also a no-preparation veneer that was done on tooth No. 10.

An important tool in our armamentarium today is a shade-taking computer. There are several computerized shade-taking devices available. The authors have several systems at UCLA that they use on an ongoing basis for both daily work and for research. They believe from experience that a device should be simple to use and can give an accurate base shade. The Vita EasyShade® (Vident, Brea, California) (Figure 10) in the authors’ tests has shown to provide as or even more accurate base shade than the average visual shade taken by a group of dentists. This system will give base tooth shade and 3 zones (eg, gingival, middle, and incisal) of shade if desired. The X-Rite ShadeVision™ System (X-Rite, Inc, Grandville, MI) also yields good results and will give a shade map of the tooth. Ideally, the computer is used to get the base shade only and then compared with the visually derived shade information that has been documented with digital photography. For both authors, who are master ceramists, correct base shade supplemented with high-quality photography has shown to be the best information for matching porcelain restorations to natural teeth.



Figure 6 An example of documenting the 2 closest chromas.



Figures 7A and 7B The 3-value group of the 3D Master Shade Guide showing that the different chromas and different hues all have the same value.



Figure 8 Image of shade tab 2L1.5 and 2R1.5 demonstrating that if the value and chroma are the same but the hue is different, it is very difficult to perceive subtle hue differences.



Figures 9A and 9B Preoperative and post-operative views of Vita VM9 porcelain and Lava crowns on teeth Nos. 8 and 9. On tooth No. 10 there is a porcelain veneer made with VM9 porcelain in which no tooth preparation was done.

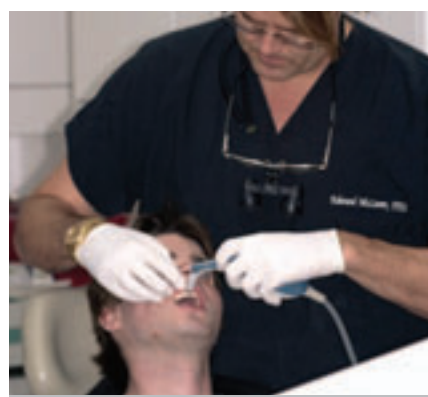


Figure 10 Demonstration of the use of the Vita Easyshade.