

# How Clinicians Can Facilitate Predictable Outcomes with Shade Selection for Indirect Restorations

LUKE S. KAHNG, CDT

**ABSTRACT:** Difficulties with custom shade matching occur whether prescribing single- or multiple-unit restorations. Despite subjective factors that could contribute to shade discrepancies between what the patient/clinician expect and what the technician delivers, the use of a checklist that outlines what to do and provide during the communication and restoration prescription process can help ensure predictable outcomes when treatment planning indirect restorations. This article provides a step-by-step to-do list for clinicians to facilitate the custom shade matching process.

## INTRODUCTION

When the dental technician is given a work slip that says, “Tough shade; you’ll need to see the patient for a custom color,” most often the struggle results from a single anterior tooth, but sometimes it can occur with multiple units, too. The difficulty can be that the technician’s perception of the requested color is different from what the patient and clinician see. Without a strategy for color matching, everyone involved can become frustrated and discouraged when the shade of the restoration does not look as intended. The truth is that custom shade taking is an art, and there is always something new to learn.

This article examines a number of factors that may hinder the selection of a proper color match. Subjective faults can range from differences in color perceptions to ocular fatigue. However, with a practical plan and goal from the outset, as well as a checklist to follow, the custom shade matching process for indirect restorations can be simplified and the results more successful. In the same manner that we plan for quality control by using standards for double-checking our work, we can give ourselves a method to double check the custom shading process. The following outlines a to-do list to help ensure accurate custom shade matching.

## 1. Select Surface and Texture

Technicians must make sure that the surface texture will match after they apply natural glaze to the finished restoration. A young person’s teeth tend to look coarse (Figures 1 and 2), while an older patient’s surface texture may be considered “medium.” However, an older patient may also present with a glossy “before” surface texture that should also be replicated in the final restoration (Figures 5 and 6). Therefore, it would be helpful if clinicians provide their laboratory technicians with their description of teeth’s surface texture.



**FIGURE 1** Preoperative view of fractured tooth No. 9. Tooth No. 8 demonstrates heavy texture.



**FIGURE 2** Postoperative view of tooth No. 9 restored using a zirconia framework<sup>a</sup> with an initial porcelain layer on top<sup>b</sup>. Note that the heavy texture matches the preoperative condition of tooth No. 9.

## 2. Determine the Value

Technicians must understand clear and enamel dentin segmentation. When technicians build up the dentin and then cut it back, the technique they use is very important. If they cut back too much, they will need to replace it with enamel (clear) in order to create low value. If they do not cut back, they will produce a restoration with high value due to the dentin color. When submitting your custom prescription, be sure to indicate what the value of the shade is.

The value of a color is defined by the amount of white light that is absorbed or reflected. A tooth high in value is bright and vital in appearance. A low value tooth is gray and will appear less vital. Value is the only dimension of color that may exist alone (Figures 7 through 9).

## 3. Determine Hue

Hue is the intensity of a color (eg, red, blue, green), but white, gray, and black do not possess any hue. Chroma is the amount of saturation or strength of a hue. For example, a certain red and a

<sup>a</sup> Zirconium Oxide Ceramic, Etkon USA, Arlington, TX

<sup>b</sup> GC America, Inc., Alsip, IL



**FIGURE 3** Preoperative view of the crown preparation for tooth No. 8. Note the medium texture on tooth No. 9.



**FIGURE 4** The crown completed for tooth No. 8 matches the medium texture of tooth No. 9.



**FIGURE 5** Preoperative view of the left lateral implant. Adjacent teeth demonstrate a glossy texture.



**FIGURE 6** The lateral crown matches the glossy texture of the adjacent central and canine.

certain pink may have the same hue. However, the red may have a stronger saturation of hue and, therefore, a higher chroma. The pink is really a diluted red and has a low chroma.

So, what color is the tooth? Technicians must learn to utilize enamels effectively in order to correctly cover the restoration's surface. Does it need stain? This may help to define the hue. When providing your custom shade description, be sure to determine the hue and any related characteristics.

#### 4. Identify Where the Tooth is Translucent or Transparent

Divide the tooth into seven segments to determine where it's translucent or transparent, as well as by how much (Figures 10 through 12). A shade mapping guide will facilitate this process and help you chart the colors and determine areas of translucency and transparency. Be sure to share this with your technician, in addition to why you think the translucencies exist.

If technicians check the dentin and color on the inside of the tooth, they may find that it changes the translucency. This leads to overlaying color on the inside of the restoration. Technicians must understand the porcelain powders they are using and what roles they will play in the "look" of a restoration, something that becomes easier with experience.

#### 5. Document the Stump Shade

Always check the stump shade, especially with a complex case, in order to ensure the best material selection (Figures 13 and 14). A dark stump shade color will result in show-through and alter the appearance of the final restorative shade. The use of one universal shade tab is preferable over a different shade tab for every type of material. Technicians can then be certain that the same translucency modifier, enamel effects, enamel opals, enamel occlusion colors, and/or cervical translucencies will work for all types of restorations. You can document the stump shade in writing and also photographically.



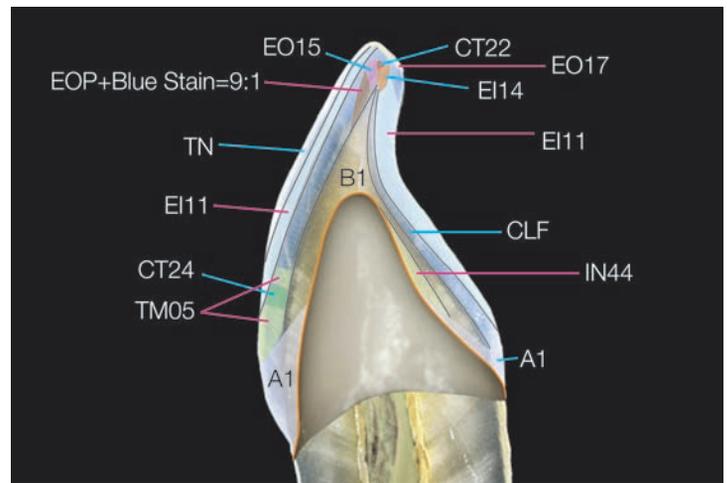
**FIGURE 7** A color tab from the manufacturer's porcelain is used to check the tooth's hue.



**FIGURE 8** An enamel opal tab is used to determine the incisal and value.



**FIGURE 9** The final restoration from Figures 7 and 8 is placed, demonstrating that the hue, value, and chroma are matched perfectly.



**FIGURE 10** View of a shade mapping completed by the technician. This will facilitate the application of porcelain where higher translucency is necessary.



**FIGURE 11** View of the preparation of tooth No. 8. The adjacent teeth demonstrate high translucency.



**FIGURE 12** The completed crown not only matches the shade, but also the translucency of the shade.



**FIGURE 13** A stump shade is taken of the preparation for use in fabricating the veneer restoration for tooth No. 9.



**FIGURE 14** The restoration for tooth No. 8 is a crown and for No. 9, a veneer. The veneer was fabricated to block out the underlying stump shade, yet still perfectly match the crown shade.



**FIGURE 15** Teeth Nos. 8 and 9 presented with old porcelain-fused-to-metal (PFM) crowns.



**FIGURE 16** All-ceramic crowns are compared to PFM crowns to demonstrate the same high esthetics that are now possible.

### 6. Observe and Communicate Symmetry Reflection/Tooth Morphology Characteristics

Surveying natural teeth reveals information about symmetry and answers questions about emergence profile from the gingival level. Are the teeth concave or convex? Which areas show reflection?

The finished restorations must demonstrate the same symmetry reflection as the teeth they border. Therefore, clinicians and technicians must always study the adjacent teeth. The cast model is the beginning of this process and shows the direction in which technicians should go. Natural teeth have at least 10 to 12 colors; their restorations will sometimes require as many as 18. If technicians do not recognize the tooth's frame design, they may add too many porcelain layers, resulting in a restoration that appears too lustrous due to porcelain shrinkage during the baking process.

### 7. Suggest Your Selected and/or Preferred Restorative Material

There is a multitude of indirect restorative material choices available today, and clinicians are encouraged to discuss the benefits and limitations of each with their laboratory technicians. For the purposes of determining custom shades, it's important to recognize how each material's optical properties may affect the desired esthetic outcomes. Pressed ceramics have made all-ceramic, metal-free restorations popular (Figures 15 through 17). However, it is possible to produce an esthetic result with the placement of a restoration fabricated using a non-oxide metal (Figure 18).

An initial material component of pressed ceramics was leucite, which has been used in veneers and crowns based on its translucent quality. Today, for crowns and bridges, these pressed ceramics



**FIGURE 17** Teeth Nos. 8 and 9 were restored with all-ceramic crowns to replace the previous PFM restorations.



**FIGURE 18** Here, however, new PFM crowns are used to restore the teeth.

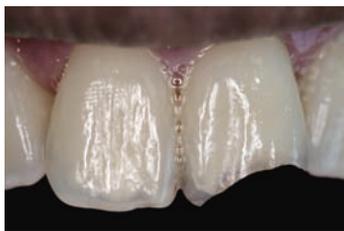
have been enhanced by the stronger lithium disilicate component, although it is not as translucent.

Alternatively, zirconia is another metal-free material available from many manufacturers that is beneficial because it can be used in a variety of computer aided design/computer aided machining (CAD/CAM) systems. With strength rivaling metal, zirconia appears very low in translucency and demonstrates higher opacity. Before zirconia there was alumina and it, too, was low in translucency, with only moderate opacity.

In the area of metal-ceramics, a composite gold material<sup>d</sup> that doesn't oxidize—according to the manufacturer—demonstrates a warm gold color that enhances the appearance of porcelain. Because it is a non-oxidizing metal, it produces no oxide show-through commonly observed with oxidizing metals.

### 8. Note any Mamelons or Craze Lines

Each patient may present with unique tooth characteristics that can affect the manner in which shades are perceived. Therefore, it's important for clinicians to note any mamelons or craze lines that are perceived to potentially influence the appearance of the tooth color (Figures 19 through 21).



**FIGURE 19** Teeth show high detail of mamelons and craze lines.



**FIGURE 20** An indirect composite resin material<sup>c</sup> was selected to repair tooth No. 9, including the application of high details.



**FIGURE 21** View of the indirect composite restoration<sup>c</sup> following cementation. Note that the mamelons and craze lines match tooth No. 8.

<sup>c</sup> Tescera™, Bisco, Inc., Schaumburg, IL

<sup>d</sup> Captek™, Precious Chemicals Company, Inc., Altamonte Springs, FL

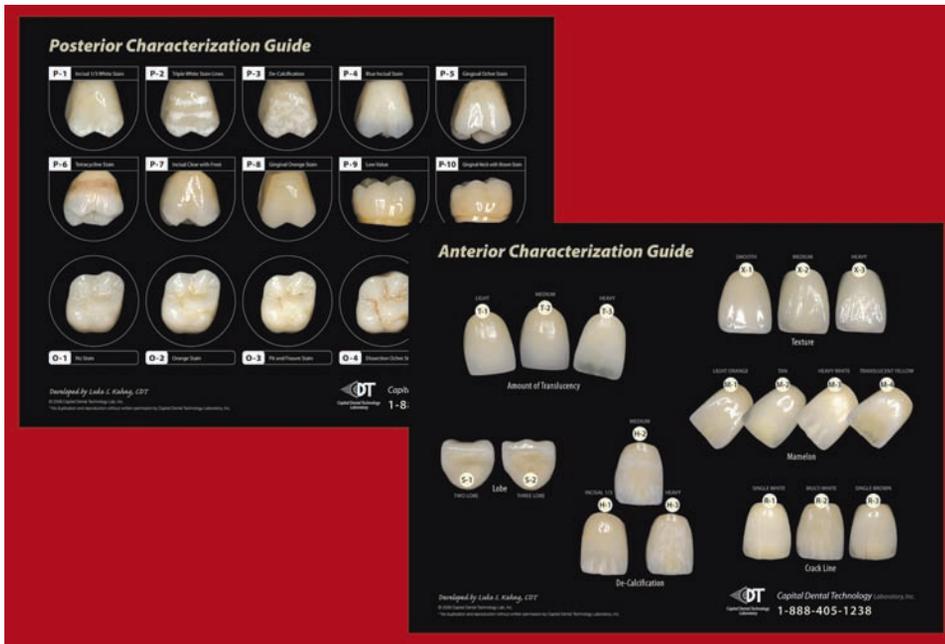


FIGURE 22 View of the author's characterization guide that can be used to facilitate communication from the doctor to the laboratory.



FIGURE 23 View of the author's smile selection book for use as a doctor/patient communication tool.

## 9. Take Photographs

The camera—either a digital or instant polaroid model—has become important to dentists and technicians because it allows evaluation of tooth color, craze lines, stains, surface texture, and luster. Multiple pictures should be taken at different angles and under different lighting conditions to facilitate the best matching results. Provide these images to the laboratory so that the technician can develop a true sense of what the patient's teeth look like. Computers have also become valuable communication tools. If clinicians take photographs with an intraoral camera, they can be sent immediately to another location via the internet. The film development step is eliminated, which translates into a savings of time and money.

However, digital photography and computers do not solve all of the problems of shade selection. Photographs need to be taken with shade tabs in the picture, preferably held at 90° to the tooth

(ie, perpendicular) for best results so that there will be no reflection. The shade tab provides a definite guide to the shade and color changes from different computer monitors and printers, since one office monitor may show a completely different color than another. The same can be said of printers. A laser printer is different from an inkjet printer, but a color difference can be observed among various laser printers, also.

## 10. Communicate

Communication among the clinician, technician, and patient facilitates the best outcome. Additionally, the use of my anterior/posterior characterization guide (Figure 22) provides a common ground for the clinician and patient during conversations about anticipated restorative outcomes. Finally, it may also be helpful to provide the patient with my smile selection book for use in making choices about his or her final smile appearance and/or shade (Figure 23).

## MATCHING COMPOSITE RESINS

Composites have changed dramatically in recent years in terms of their physical and mechanical properties. An indirect composite<sup>c</sup> can be a material of choice to create a life-like and durable esthetic restoration. The colors presented by the different composite manufacturers give dental technicians the ability to apply the similar layering techniques that are utilized in porcelain powder build-ups. A good technician can apply advanced layering techniques using composites to create a highly esthetic restoration.

## CONCLUSION

If dental professionals have different tools at their disposal—a photograph, a shade map, and a checklist—they can approach shade selection with confidence. You will feel better about the outcome of your work, and patients will feel secure that they're in good hands. The patient will sense that the clinician and the technician will meet their expectations.

Also, in this author's opinion, if the patient wants “best of the best” shade matching, one full day's appointment is recommended. This should include viewing the patient in different lighting situations, eating lunch together, and getting to know the patient's lifestyle and habits. The technician can make different understructures and the different copings can be prepared from all the different information. The different restorations can be tried in the patient's mouth, enabling a final decision about shade selection to be made at that time.

**ABOUT THE AUTHOR:** Luke S. Kahng, CDT, is the owner of Capital Dental Technology Laboratory, Inc., in Naperville, Illinois. He may be reached at [luke@lsk121.com](mailto:luke@lsk121.com).