LAB talk

*Laboratory perspectives from the inside out.*

# The Contrast-Zone Color System: A Porcelain or Composite Layering System to Achieve the Illusion of a Natural Tooth

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*This article will focus on* how to use shade information to layer a restoration to achieve the illusion of a natural tooth. For information on obtaining shade information, please refer to a previous article.[1] This technique works for ceramics in the laboratory as well as direct veneering of composites in the dental office. Called "the contrast-zone color system," this technique is based on the clear observation of natural teeth and the polychromatic effect or different color zones exhibited.

Understanding the zones of color that exist in natural teeth and the ability to duplicate the color zones is critical to the process of making a ceramic or composite restoration that creates the illusion of a tooth. The authors have spent considerable time studying the color and translucency patterns of natural teeth. There is a general pattern of color that exists in teeth, and this pattern can be used in the layering of ceramics or composites to create restorations that can be indistinguishable from their natural counterparts.

As discussed in a previous article,[1] the authors primarily use the Vita 3D Master® shade system (Vident, Brea, CA) for tooth shade analysis (Figure 1). Whichever shade system is used, it is important to understand that a shade guide is essentially an average (or blending) of all of the shade nuances of a tooth. It is intended to "guide" the observer into a shade or color range as a base starting place. It is not intended to be the complete source of information for shade, particularly with individual anterior teeth. It is extremely important to obtain the correct base shade[1] because if the starting point is wrong (eg, the base should have been a 1m1 or A1 and the observer choose 3m1 or C3), the final ceramic will never be the correct shade regardless of the nuances or contrasts placed in the porcelain. The shade guide has basically the same shade gingivally/incisally with one shade of dentin and one shade of enamel. In contrast, the natural tooth is polychromatic (ie, different colors and translucencies) gingivally/incisally (Figure 2). If averaged, those zones of color would give the correctly chosen shade. The eye sees contrasts very well; if the intratooth contrasts are duplicated within the porcelain build-up once the restoration is placed, it will fool the eye. But if the intratooth contrasts are not respected, then this will be perceived as a shade guide or denture tooth and look fake.

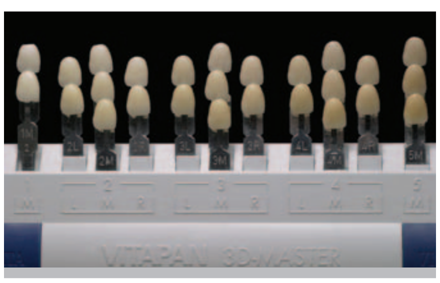



**Figure 1** The Vita 3D Master® shade guide.

**Figure 2** Image of the closest match shade guide next to a natural tooth. This clearly demonstrates that the shade guide is an average of the color zones in a natural tooth.


**Figure 3** Image of a natural tooth that shows the 3 basic zones of color.

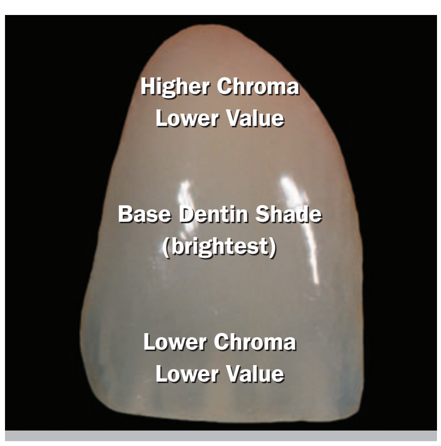



**Figure 4** Image of the same natural tooth, which shows the natural color contrasts that exist within the tooth.

## THE CONTRAST-ZONE COLOR SYSTEM

Within a tooth there are color contrasts mostly in value, translucency, and chroma. There are a minimum of 3 color zones gingivally/incisally that can be discerned in evaluating natural teeth. There are also 2 interproximal zones, but they are less important than the 3 facial zones (Figure 3). There are infinite variations and gradations of color in a tooth. The goal is not to re-create these many variations. Instead, the goal is to create the illusion of a tooth and fool the observer as simply and efficiently as possible. As a general pattern there is a "base shade" in a tooth that the eye is drawn to that we relate to the shade guide. This is in the center or middle third of the tooth and, in most situations, it is the brightest area of the tooth. The second zone, "the gingival zone," is usually higher in chroma and lower in value. The third zone, "the incisal zone," is generally lower in value, higher in translucency, and overall lower in chroma (Figure 4). Often, higher opacity and high chroma effects (called mamilon effects) exist in the incisal third, but the overall dentin and enamel color effect may be lower in value and chroma. The amount of contrast created in a tooth is specific to the patient. Generally, if creating multiple teeth, only mild contrasts should be inserted, but the contrasts should be there. Even single tooth restorations that may initially appear monochromatic, when darkened, will clearly show the different value zones (Figures 5A and 5B). The mamilon effects need to be mimicked to create the illusion of nature and the only means to communicate these effects is with high quality photography (Figure 6). Current digital photography has advanced to the point of an almost film quality effect. The authors use and recommend the Canon EOS 20D digital camera with the Canon Macro Twin Lite MT-24EX flash (Canon USA, Lake Success, NY) (Figure 7).

## THE COLOR-CONTRAST ZONE LAYERING SYSTEM

The porcelain building technique (called the skeleton build-up technique[2]) is used as the basis for teaching at the University of California, Los Angeles, Master Dental Ceramist Residency Program. It is so named to create the image of a structure that is built from the skeleton outward one layer at a time. The layers are individually completed before veneering the enamel surface (skin), thus allowing maximum control of both shape and shade. Just as our human form is distinct because of the different morphology of our skeletal systems, the 3-dimensional expression of shade and shape in a porcelain crown requires the exact placement of the internal dentin layers (skeleton) to support the surface enamel layer (skin). This technique focuses primarily with the systematic control of the exact thickness and 3-dimensional placement of opacious dentin, enamel, and translucent layers. (For a more complete discussion of the technique, a full-color PDF file can be downloaded at www.oralfacialarts.com.)

To create the illusion of a tooth, a minimum of 3 facial color contrast zones need to be created. Using the base shade information that was taken from the patient, 3 different color contrasts of either porcelain or composite are placed gingivally/incisally. For example, the chosen base shade may be 1M1. Three different dentin shades would then be chosen to create the polychromicity of natural teeth. For the gingival third, the chroma modifiers that come with most systems are added (generally 33% to 50%) to the base shade dentin. As an alternative, a higher chroma dentin than the base shade could be chosen. This creates the higher chroma and lower value zone to be placed in the gingival third. To match a single central incisor, the chroma chosen is based on the evaluation of the digital color images (with the shade guides in the image to show the chroma levels relative to the tooth). The shade chosen for the incisal third is a lower value and lower in chroma dentin. Mixing translucent enamel with the base shade dentin will also lower the value and chroma making it more translucent. Because the other 2 zones were darkened slightly, the middle zone (base shade area) needs to be lightened slightly to compensate so that the average of the 3 zones still comes closest to the chosen shade. The easiest way to do this is add 50% of the next brightest dentin to the base shade dentin. These 3 masses are built into the 3 zones as shown (Figure 8) and then fired or polymerized (Figure 9).

The next layer to be built is the lingual/incisal edge (the incisal frame). The authors have found that a medium translucent material should be placed on the lingual/incisal edge. When working with a porcelain mixture, the normal enamel shade with about 50% translucent powder works best (Figures 10A and 10B). For composites, a medium translucent material is best in this region. Incisal or mamilon effects are placed next (Figure 11). In natural teeth, these effects form a feather or slight streaky pattern, with no inverted cones or fingers as taught in many techniques. The final layer to be placed is the enamel (or skin). A slight contrast is also created with this layer as with the base dentin layer. In the gingival third, a slightly chromatized translucent material is used to simulate the chroma that is seen in this region. The remainder of the skin layer is accomplished with an opal enamel. (Figure 12). This is then fired or polymerized, contoured, glazed, and polished (Figure 13). Figure 14 shows a finished case following this concept.

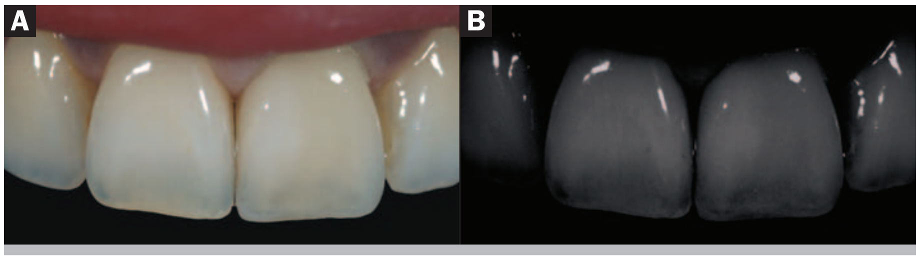



**Figure 5A** Image of a single spinell restoration on tooth No. 9, which appears monochromatic and similar to the adjacent natural tooth. **B** The same image turned to black and white and darkened, which clearly shows the different value zones in the gingival/incisal areas.

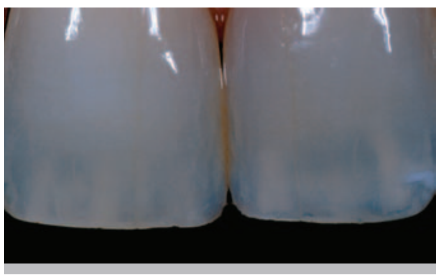


**Figure 6** Close-up of the incisal half of the central incisors showing multiple streaks of color called mamilons.

**Figure 7** The Canon EOS 20D camera with the the Macro Twin Life MT-24EX flash.

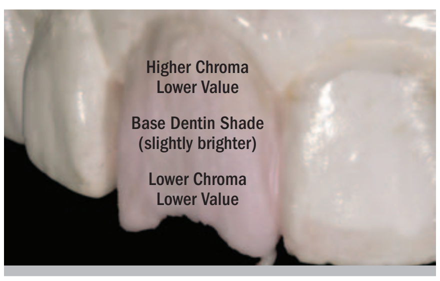
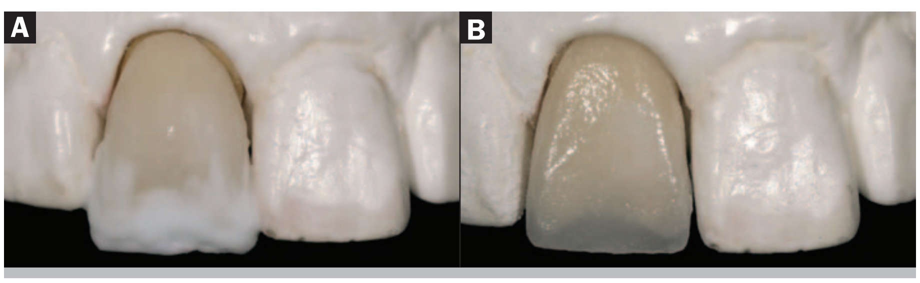



**Figure 8** Base dentin of the 3 different color zones built to contour.

**Figure 9** The fired base dentin.




**Figures 10A and B** The built up and fired incisal frame.

**Figure 11** The fired incisal effects.

**Figure 12** The built-up skin layer (translucent layer).

**Figure 13** The contoured, glazed, and polished central incisor.

**Figure 14** Postoperative view of the spinell VM7 crown on tooth No. 8.

## CONCLUSION

A system, namely the zone-color contrast system, of evaluating natural tooth polychromisites and then re-creating these in the final restoration has been presented. The observed color contrasts are then used by the ceramist or dentist to develop color zones within the restoration that, when finished, helps to create the illusion of a natural tooth. The system works for both ceramics and composites.

## REFERENCES

1. McLaren EA, Chang YY. The 3D Communication of shade: Visual shade taking and the use of computerized shade-taking technology. *Inside Dentistry.* 2006;2(1):92-93.
2. McLaren EA. The skeleton buildup technique: a systematic approach to the three-dimensional control of shade and shape. *Pract Periodontics Aesthet Dent.* 1998; 10(5):587-587.