Proper Restorative Material Selection, Digital Processes Allow Highly Esthetic Shade Match Combined with Layered Porcelain

Luke S. Kahng, CDT

Abstract: Today’s digital technologies are affording dentists and laboratory technicians more control over material choices for creating restorations and fabricating dental prostheses. Digital processes can potentially enable technicians to create ideal marginal areas and account for the thickness and support of layering porcelain over substructures in the design process. In this case report of a restoration of a single central incisor, a number of issues are addressed that are central to using the newest digital technology. As demonstrated, shade selection is a crucial early step in any restorative case preparation.

Technology today is giving dentists and technicians more and better control over the choices they have for creating restorations and fabricating dental prostheses. Perhaps the most common restorations associated with digital impression systems are zirconium crowns and fixed partial dentures (FPDs). The simultaneous data workflow of model manufacturing and substructure design and milling allows laboratories to have the substructure milled and ready for surface veneering or layering-over by the time the model is returned to the laboratory (generally within 3 days of the upload of the digital impression data). Digital processes have the potential to allow technicians to create ideal marginal areas and account for the thickness and support of layering porcelain over the substructure in the design process. The computer-designed substructures can then be milled from solid blocks of biocompatible material. The use of virtual imagery allows designs to meet certain specifications and conform to the surrounding dentition.

But what is the actual outcome of the workflow? What types of materials can be used with these systems? Are the teeth adjacent to the restoration natural dentition or porcelain restorations? If the surrounding dentition is natural, do the teeth have a high level of opacity or translucency? After the preparation, is the stump shade of the tooth too dark to use a zirconium material for the crown? These questions are central to using the latest technology and finding the best solution for the needs of the patient.

Fig 1. Clinician and technician used custom shade tabs to choose enamel and translucency. Fig 2. Sprued copings were milled with zirconium oxide milling block. Fig 3. Units were placed in the nesting stage.
Case Report
Shade selection is one of the first crucial steps in any restorative case preparation, as is demonstrated in this case of a 55-year-old man who sought consultation for restoration of a single central incisor, tooth No. 8. The patient showed interproximal staining, and the mesial corner was wider than the bilateral contact symmetry. Additional incisal one-third staining appeared as an intrinsic blemish, and a crack extended from the incisal edge up to the middle body one-third. An assessment of the patient’s surrounding dentition revealed that the opacity of the adjacent teeth was about 50% (as determined by amount of dentin). The tooth was prepared with enough room to accommodate the thickness of zirconium, making this a good material choice for both strength and esthetics. (The amount of reduction required depends on the case. If the dentin is of adequate color, then 0.8 mm to 1 mm reduction is needed; a dark stump [e.g., dark brown, grey, black, etc], on the other hand, would necessitate 1.5 mm to 2 mm reduction, especially if adjacent teeth are highly translucent.) The opacity was checked against a custom shade tab (Figure 1) and displayed variations of depth in chroma; the highest opacity was at the gingival one-third, the lowest was at the middle one-third, and the incisal one-third had a blue translucency. Due to enamel
wear, the dentin and enamel had the appearance of two different colors in the incisal aspect compared to the body shade of the tooth.

An intraoral scan (TRIOS®, 3Shape, www.3shapedental.com) was taken, and the stereolithography (STL) data file was transmitted to the laboratory, where a printed design was created on an epoxy model poured up by the lab. The substructure was milled from a zirconium oxide milling block (Armann Girrbach, www.armannGirrbach.com) (Figure 2), and the units were then placed in the nesting stage after the sprued copings were removed (Figure 3).

Placed in a sintering color bath of shade A1, the copings appeared nearly 30% larger in size before sintering (Figure 4). They were then placed in the sintering furnace (Figure 5), where they took on a warmer appearance after coloring was applied. Because of the worn enamel, the patient’s surrounding dentition showed the darkness of the intrinsic dentin hue, which was close to an A4 range in the cervical collar and would not have appeared lifelike if a clear layered porcelain overlay was used to represent the translucency. Using A4 to shade the core would have created a more grayish effect rather than the desired translucency. With the shade selection of A1 for the coping, the brightness of the intrinsic reflection through the darker layered dentin allowed the powdered translucent modifiers to produce a lifelike appearance.

Next, the frame modifier was applied, and an overlay of GC Initial™ ZR enamel E-58 (GC America, www.gcamerica.com) and white translucent modifier, TM-02, was applied to the incisal edge and along the distal contact to the gingival one-third aspect. Additionally, areas of hypocalcification were added using beige internal stain along the mesial corner and 2 mm to 3 mm along the incisal edge and again on the distal corner (Figure 6).

The restoration was fired at 810°C, and then, to achieve additional characterization, Initial dentin in shade A4 was layered over the full crown while leaving the middle incisal two-third aspect without dentin (Figure 7 and Figure 8). That is, the technician built “full contour” and cut back the middle incisal two-third to prepare for the enamel, because, as previously indicated, opacity of the adjacent teeth was about 50%. The mamelons were added using Initial INside sand shade IN-44, creating visual separation between the lobes (Figure 9). To recreate the translucent mottling over the facial surface, the Initial enamel opal in white EOP-2, shown in blue (Figure 10), was added to the distal mamelon and the middle of the incisal edge. Represented in light green (Figure 10), the addition of lighter shaded enamel, Initial E-57, was brushed along the mesial lobe from the incisal edge to the middle one-third aspect. The IN-44, shown in red beneath the white enamel opal, EOP-2, was brushed along the distal

Fig 10. Characterization of anatomy and color were built with enamel and opalescence. Fig 11. After completed characterization, the color was defined. Fig 12. The fired restoration maintained high definition. Fig 13. Mesial shape and contact were assessed. Fig 14. Texture and emergence profile were viewed. Fig 15. Mirror image of restoration showed color and translucency. Fig 16. Gingival margin to incisal proportion was assessed at the try-in. Fig 17. Speech analysis provided more information, revealing the need for further, minor interproximal contouring. Fig 18. Enamel intensity comparison showed harmony.
middle two-thirds (Figure 10). The restoration was layered with white enamel opal, EOP-2, over the full cervical one-third and along the middle-body mesial aspect; the IN-44 showed through from beneath and was brushed along the mesial contact, extending from the lower cervical one-third and ending just before the incisal edge before being fired (Figure 11). Once fired, the restoration reflected the light in the cervical aspect and showed the translucency layered throughout the mesial and incisal aspects (Figure 12).

The restoration was placed back onto the model and assessed after cutting the mesial contact contour (Figure 13). The morphology was marked, defining the lobe direction and matching the emergence profile with the adjacent teeth (Figure 14). The mirror image showed the incisal and mesial aspects’ color and translucency (Figure 15).

When the patient presented for the try-in, the restoration was assessed for proper gingival-to-incisal contour, proportion, and fit (Figure 16). It was determined when the patient was evaluated while sounding out words and vowels that the lobe direction and distal spacing of the restoration needed minor additional interproximal contouring (Figure 17). The edge-to-edge view was compared for proper enamel intensity. The lip resting over the tooth showed the blend and harmony of the body and incisal color of the restoration with the natural dentition (Figure 18).

Discussion and Conclusion
For the clinician, proper communication with the dental laboratory is essential when determining material choices for creating restorations and fabricating dental prostheses. Choosing the correct enamel shade for a single tooth match from a shade guide may not always provide the most lifelike restorative outcome. When the shade is selected after tooth preparation, the dehydrated dentin can also produce a restoration that fails to resemble the natural dentition. The best shade selection method begins with a good photograph of the tooth before preparation while it is fully hydrated and there are no distracting reflections in the image.

With a 1-mm to 1.5-mm minimum room allowance for the thickness of porcelain, for an anterior restoration the dentist and technician are able to choose from restorative materials that include pressable ceramic, lithium disilicate, or zirconium oxide. With the added benefit of digital technology to achieve accuracy and allow the design of esthetics in advance, a technician who understands format and contour—along with reflection, value, and color—can deliver the highest quality esthetics for virtually any restorative fabrication.

ABOUT THE AUTHOR
Luke Kahng, CDT
Owner/Founder, LSK121 Oral Prosthetics, Naperville, Illinois

REFERENCES