Ingot Selection for Predictable IPS e.max® Restorations

Using a Systematic Approach for Improved Esthetic Results

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Due to its ease of processing, versatility, and longevity, the IPS e.max® product (Ivoclar Vivadent, www.ivoclarvivadent.com) has become an extremely valuable restorative material for the dental laboratory industry. When manufacturing IPS e.max restorations, the selection of an ingot (or milling block) color in which to process the restoration is vital to the final esthetic outcome (**Figure 1**). This article will describe the author's systematic approach to improving the predictability of the esthetic outcomes of IPS e.max restorations manufactured in the modern dental laboratory. When color is measured using the Munsell Color System—which consists of hue (red, blue, yellow), value (brightness), and chroma (intensity of color)—it is often the value or brightness that determines whether or not the crown will be cemented. When using this three dimensional color system, any color could potentially present in a variety of values. For example, it is possible to have an A1 shade that is low value (grey/dull), A1 value, or high value (bright). However, value is not often considered when shades are communicated from the dental practice to the dental laboratory or even amongst the technicians responsible for creating the restoration. The simplest way to capture the value of the dentition is with a black and white image of the patient's teeth and a corresponding shade tab. A black and white image works extremely well in this regard as the hue and chroma are negated to show only shades of grey, therefore presenting an ideal representation of value. As the digital camera has become an essential tool for formulating treatment plans, engaging in meaningful patient communication, and communicating color and characterization between the dental practice and laboratory, it is also an ideal tool for value communication (**Figure 2 and Figure 3**). Most camera systems allow the user to take pictures in black and white with simple adjustments in the camera menu. A color image can also be adjusted to black and white in most image manipulation software packages. When working with a subtractive color system, such as stains and glazes, it is necessary to understand the inter-related changes in these 3 color variables. For example, if a dental technician were working to a prescribed A2 shade with an A3 body and A3.5 cervical, what would the final value of the restoration be? Also, how would color changes made to the restoration during the manufacturing process impact its value? As a rule of thumb, we can assume that by adding chroma to an A3 restoration in order to achieve A3.5 cervical, we have effectively lowered the value of the restoration. If also we assume that the A2 requested at the incisal/occlusal portion of the tooth resulted in a final value of at least the same brightness as A3 (or even a little brighter), it would not be unusual for these cases to look too grey when tried in the mouth, unless we gave careful consideration to our ingot selection (**Figure 4**). The author recommends three broad categories to consider when establishing

Figure 1

Figure 2

Figure 3

Figure 4

criteria critical to achieving an esthetic match—the patient, the tooth, and the restoration.

Figure 5

#1 The Patient

Patient-specific factors—such as how much of the tooth is shown, when the patient smiles and the patient's esthetic expectations—are always our first consideration (**Figure 5 through Figure 7**). If a patient smiles and shows less than half of his central incisor, the relative opacity of the core material is not as vital to the final result as it would be to a patient showing tissue above the gingival of the central incisors and tooth display to the second molar. The patient's expectations of the final result also have a significant impact. Sometimes, even though patients may not show a great deal of tooth in their smile, their expectation does not allow for any flexibility in the final result. For patients whose smiles show more of the restoration, or those with higher expectations of the final result, it is better to use ingots with a higher level of transparency in order to deliver the best esthetic results. As the transparency of the core material and the thickness of the restoration increases, a corresponding decrease in the overall value of the restoration will result. This will therefore require either an ingot with a greater relative opacity or one with higher brightness. Additionally, the influence of the stump color will become greater as the transparency of the ingot increases and the thickness of the restoration decreases, increasing the complexity of both selecting an appropriate ingot color and delivering a suitable esthetic result.

Figure 6

Figure 7

Figure 8

#2 The Tooth

When considering the tooth the restoration is being manufactured to replace, there are two discriminating factors for ingot selection: the color of the remaining tooth and the volume of tooth reduction. The stump (or abutment) color will have more of an impact when the restoration is manufactured thinner than 1mm, the tooth reduction is greater, and the color of the stump is darker than A4/C4 (**Figure 8 through Figure 10**). Therefore, LT ingots are ideal for restorations 1 mm or thicker when the abutment teeth are no darker than A4/C4. When considering HT ingots, if the difference between the prescribed final color and the stump color is more than two shades, the final result can be unpredictable. If the stump color is darker than A4/C4, it becomes more difficult to make a broad statement; however, in most situations the MO ingots will be suitable to mask the underlying tooth color (**Figure 11 and Figure 12**). This will require a thicker layer of veneering porcelain to create a natural looking esthetic result. For abutment teeth with metal posts and metal implant abutments, consider switching to porcelain-fused-to-metal restorations. For teeth prepared for full coverage restorations, LT ingots are preferred, as the volume of tooth reduction and relative opacity of the ingot are balanced to prevent a drop in value in the restoration. For partial coverage restorations 1.5 mm thick or less, the HT ingot will provide a balance between the transparency and thickness to prevent a lower value restoration. In situations where the teeth have been

Figure 9

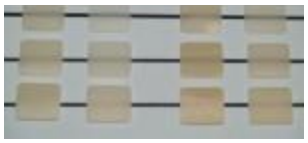

Figure 10

Figure 11

Figure 12

minimally prepared for enamel replacement, Opal 1 and 2 ingots are excellent choices (**Figure 13 and Figure 14**). While they do not have the ability to make significant color changes, they do have the transparency and opalescence of natural enamel, which can create incredibly vital looking restorations in thin sections.

Figure 13

Figure 14

#3 The Restoration

Ingot selection for a monolithic or layered restoration follows similar guidelines to those mentioned above, however the role of the stain and the layering porcelains is also important to consider. As layers of color are added to increase the chroma and transparent appearance of a monolithic and layered restoration, the value of the restoration will decrease. In a subtractive color system such as the one used in the author's laboratory, the combination of the three primary colors creates a complex grey color. A way to help prevent the restoration from greying out is to keep the colors from blending together when adding stains, particularly when replicating more highly characterized teeth. Therefore, as we add characterization and stain to achieve high esthetics, starting with a lighter ingot can lead to a more predictable result. Of course, the easiest way to predictably produce an esthetic restoration is by making only very slight modifications to an appropriately selected ingot. When fabricating a layered IPS e.max restoration, the value will most likely be influenced by the thickness of the veneered porcelain. While the ceramist works hard to blend the layered materials to re-create the natural vitality of the tooth, it is not uncommon to see the value drop after each firing is completed. The best way to improve predictability with layered restorations is to keep the veneering materials as thin as possible (**Figure 15 through Figure 17**). In order to minimize the thickness of the veneered layer and improve the esthetic predictability, the core is modified to create a layer of approximately 0.75 mm of the more transparent IPS e.max® Ceram (Ivoclar Vivadent). As with a monolithic restoration, the ingot color establishes the value. However, adding significant characterization will lower that value, and as such a brighter ingot should be considered.

Figure 13

Figure 16

Figure 17

Conclusion

The author has several recommendations for technicians looking to use the methods outlined in this article. Firstly, for patients with high esthetic demands, technicians should use the most transparent ingot possible. For full coverage restorations, an LT ingot is ideal, as long as the stump shade is lighter than an A4 or C4 and the restoration is thicker than 1 mm. Technicians should use the MO ingots for stump colors darker than A4/C4. When using HT ingots, partial coverage restorations thinner than 1.5 mm with a

stump shade within two tabs is ideal. For restorations thicker than 1.5 mm, technicians should use the LT ingots. For monolithic and layered restorations requiring significant characterization, technicians should start with an ingot at least a shade lighter than desired shade. When a technician is minimizing the thickness of the veneer layer, he or she must keep the core to support the brightness of the restoration. Technicians can use a black and white image with a shade tab to communicate the required value of the restoration in addition to other clinical pictures. If technicians heed these recommendations, they should be able to consistently create highly esthetic, highly predicable restorations for their patients.

About the Author

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