INGOT SELECTION FOR AESTHETIC RESTORATIONS USING CONTEMPORARY PRESSED CERAMICS

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Accurate communication among the patient, clinician, and laboratory technician is critical to the development of a functional, aesthetic restoration. The use of pressed ceramic restorations has provided a durable, consistent alternative for full-coverage crowns, veneers, onlays, and short-span fixed partial dentures. This article discusses the importance of proper ingot selection in the fabrication of aesthetic restorations and in the realization of patients' expectations for smile design. Ceramic ingots are available in a variety of colors and opacities that provide the clinician and laboratory technician with the latitude to select an ingot that will ultimately ensure patient satisfaction.

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The first aspect of smile enhancement is the clinician's fundamental understanding of ceramic materials. While most patients will state that they are satisfied with the color, shape, and proportion of their smiles, trained clinicians can discern differences and add unique characterizations to a patient's restorations that will transform an average smile into a masterpiece.[1] Knowing that different porcelain systems behave differently, a thorough understanding of each restorative material is necessary in order to achieve consistent results. In this, pressed ceramics are generally well accepted and can be utilized in a variety of restorations.[2] The ability to fashion full-coverage crowns, veneers, onlays, and limited-span fixed partial dentures allows a consistency among teeth to be restored.

Pressed ceramic materials (IPS Empress, Ivoclar Vivadent, Amherst, NY) were introduced over 10 years ago in the US. Unlike traditional feldspathic porcelains that contain metal oxides to change the density of the materials, pressed ceramics are 40% filled with a leucite-reinforced glass, which provides the material with durability and strength.[3,4] The pressed materials are fabricated by the "lost wax" technique. As with a gold restoration, the restoration is waxed to full contour after the impression is poured, trimmed, and mounted, when it is then sprued and invested. Once the restoration is placed in a burnout oven, the pressed ceramic is melted and pushed into the investment. Care should be taken during removal of the restoration prior to its being desprued, layered, baked, and finished to create a final polished restoration. This technique provides the clinician with an all-ceramic unit that has natural fluorescent properties and the fit of gold.

Pressed ceramics were originally developed to be surface-stained, polished, and glazed. Enhanced aesthetics can be achieved in the anterior region using cutback and layered porcelain techniques.[5] Ceramic ingots (eg, IPS Empress, Ivoclar Vivadent, Amherst, NY) of varying color and opacity provide clinicians and

Figure 1. The most commonly prescribed ingots are generally within the TC1, 01, and T2 shade range (Empress, Ivoclar Vivadent, Amherst, NY).

Figure 2. Preoperative view demonstrates preexisting 20-year-old PFM crowns with metal collars.

Figure 3. A T2 ingot was utilized to rejuvenate the patient's smile and overall appearance.

Figure 4. Teeth exhibiting worn incisal edges and loss of canine guidance.

Figure 5. A stained TC1 ingot was used as the framework for the all-ceramic restorations, and anterior guidance was reestablished.

Figure 6. In addition to reviewing basic ingot shade, use of a shade guide will allow additional modifications during restoration fabrication.

Figure 7. Dark yellow chroma was evident upon presentation. The patient desired a brighter smile with improved shape and harmony.

Figure 8. An unstained TC1 ingot was selected to allow the natural dentin color to influence the final shade of the restoration.

Figure 9. The patient was unhappy with the shade and overall shape of the teeth.

laboratory technicians with the latitude to match a particular ingot selection to a patient's specific smile request. In the authors' experiences, three of the most commonly requested ingots are tooth-colored (TC1), opaque (O1), and translucent (T2) (Figure 1). When applied in accordance with an understanding of the underlying tooth structure (eg, enamel or dentin), each ingot will produce a different aesthetic result (Figures 2 and 3). Precise communication is, therefore, critical among the patient, clinician, and technician to ensure development of the desired result. Actual ingots can be used as a general guide during the initial consultation with patients to help them understand the final result prior to restoration fabrication.

Shade Considerations

While occlusal harmony remains the goal of the restorative team, the definitive result is of paramount importance to the patient (Figures 4 and 5). The clinician must determine what shape, contour, texture, and glaze the patient desires prior to the initiation of treatment. The definitive result is, however, largely influenced by the final shade of the restoration. The base shade can be determined using basic ingots, and a shade guide can then be incorporated for additional modifications (Figure 6). Utilizing a TC1 ingot provides the restoration with a natural, white smile. An O1 ingot results in a bright, white, "Hollywood" smile. Use of a T2 ingot will result in the development of an aesthetic, youthful appearance. While the degree of reduction is dictated by the type of restoration planned as well as the presence of sound tooth structure, depending on the type of ingot selected, the proper amount of tooth reduction is critical to obtain the desired final appearance (Figures 7 through 9). Proper reduction allows the correct penetration of light (Table). It is this light transmission that reflects off the dentin and refracts back through the pressed ceramic to develop the desired shade.[5,6]

General Principles

The pressed ceramic technique was created as a modification to traditional, time-consuming porcelain layering

Table

Reduction Chart for Ingot Specificity (ingot selection based on recommended preparation depths)

	TC1	O1	T2
Reduction Guide	Average 0.8 mm	Maximum > 1 mm	Minimum 0.5 mm to 0.6 mm

Figure 10. A stained O1 ingot was used to provide the desired shade, and increased length and contour were developed to provide proper anterior guidance.

Figure 11. Incisal view demonstrates the aesthetic texture, contour, translucency, and incisal edge relationship.

Figure 12. Preoperative view demonstrates short clinical crowns with a yellow appearance and loss of surface texture.

Figure 13. Postoperative view following restoration with all-ceramic crowns fabricated using an unstained TC1 ingot. Note the increase in value and surface texture.

modalities. The ability to wax a restoration to final shape mounted on a semi-adjustable articulator provides the clinician and technician with the ability to view the newly formed restoration prior to definitive fabrication. At this point, the ceramist can work out the function and guidance of the restoration (Figures 10 through 12). Any adjustments can be made while the restoration is modeled in wax. Since this technique is similar to that used for cast-gold restorations, laboratory technicians who have mastered gold can quickly adjust to this approach with a minimal learning curve. With fewer steps involved, there is less chance for system failure. Pressed ceramic restorations can be fabricated in varying manners (based on the technician's familiarity with each technique) but are generally classified as either stained or layered. When dealing with crowns in the posterior region, use of a staining technique will allow development of a natural-looking restoration.[7] The same concept applies for inlay and onlay restorations. Provided that accurate shades are obtained, definitive aesthetics can be developed in a predictable fashion. In critical aesthetic areas (ie, the maxillary anterior region), a cut-back and layered crown or veneer is often selected (Figures 13 through 15).[8,9] The creation of depth within that restoration will ultimately refract and reflect light, fluorescence, and opalescence to provide natural aesthetics within the restoration (Figures 16 through 18).[10]

Laboratory Fabrication

Traditional ceramic restorations were created using two techniques (Figures 19 through 22). The first was to create a dentin-shaped substructure in wax that was subsequently pressed, fitted, and contoured to desired dentin shape. Additional dentin ceramics were subsequently layered followed by the application of internal color effects. Layers of enamel, transparent, and opal ceramics were then layered over the entire restoration and fired. The restorations were subsequently contoured, glazed, and polished to achieve final luster. This technique was — and still is — used to create predictable, all-ceramic, full-coverage crown restorations.

Figure 14. Increased magnification was used to verify incisal translucency and surface texture and polish.

Figure 15. The patient's preoperative lateral incisor appeared widened and discolored. An improper tooth relationship was evident according to the Golden Proportion.

Figure 16. An unstained 01 ingot was selected with the proper tooth size relationship.

Figure 17. Magnified view demonstrates development of an incisal edge that follows the curvature of the lower lip.

The second technique involved waxing the restoration to full contour, paying particular attention to function and surface detail. These restorations were then pressed and fitted, occlusion was verified, and final surface detail was added. Once occlusion and tooth morphology of the full-contour glass-ceramic restorations were completed, surface stains were painted on the restoration to replicate natural tooth color. Although these restorations can be developed to provide a harmonious result in posterior restorations, they are not indicated for treatment of compromised aesthetics in the anterior region.

The Hybrid Technique

A technique was developed by Culp in 1993 to combine the aesthetic qualities of both aforementioned modalities. This technique has been used with much success by many laboratories for approximately 10 years. This technique requires the technician to wax to full contour and press the restoration from the neutral staining ingots (TC1, T2, and O1). The restoration is then reduced in the incisal area to create space for the addition of transparent ceramics (Figure 23). Once the restorations have been cut back, dentinal incisal lobes are created and accentuated with stains and internal modifiers. These characterizations are set with a lower furnace firing, and enamel transparent and opalescent powders are layered in the incisal third. Once the enamel porcelains are fired, the restoration is contoured to desired shape, and the appropriate dentin stain can then be applied to the surface to create the desired shade. By combining these two techniques, restorations that achieve accurate and predictable function and aesthetics can be created.

The Effect of the Underlying Dentin on the Definitive Restoration

The definitive value of the restoration is ultimately determined by the clinician's choice of cement. While most cements cannot alter the shade from an A2 to an A1, they can change the value and brightness of the restoration.[11] The final appearance can also be evaluated by the patient and clinician prior to definitive cementation using a try-in gel (eg, Variolink II Try-in Gel, Ivoclar

Figure 18. A black line was placed on several veneer preparations to demonstrate the opacity of various ingots.

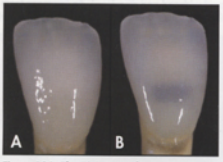

Figure 19A. The T2 ingot is the most translucent of the ingots. 19B. The black line demonstrates the effect of the underlying preparation on the definitive result.

Figure 20A. The TC1 ingot provides an amber appearance in the veneer. 20B. The black line preparation is virtually concealed by the opacity provided using a TC1 ingot.

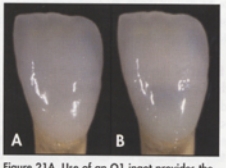

Figure 21A. Use of an O1 ingot provides the highest degree of opacity. 21B. The black line preparation is concealed and a bright, white appearance is provided.

Vivadent, Amherst, NY). If the patient feels that the restorations are too bright, a darker shade can be used to decrease the light transmitted and lower the value; conversely, a lighter shade of cement can increase the light absorption and brighten the final crown or veneer. By utilizing only the base and not mixing it with a dual-cure component, color stability will be ensured over prolonged periods. Due to tertiary amines, it is important not to place these variables in the anterior segment of the mouth. Cement selection should, therefore, address any variables (eg, flow, tackiness, set times) that may alter the definitive result.

Conclusion

Knowing the differences inherent in each ingot allows the clinician and technician to visualize a desired outcome before proceeding with a smile design. Choosing ingots—rather than simply denoting a desired shade—gives the clinician another avenue of fulfilling patients' desires for a new and dramatic change to their smiles and themselves. Accurate communication among the patient, clinician, and laboratory technician is critical to the development of a functional, aesthetic restoration. This article described the importance of ingot selection in the fabrication of aesthetic restorations. Selection of the appropriate ingots will provide the clinician and laboratory technician with the latitude to properly design restorations that ultimately ensure patient satisfaction.

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