Treating Discolored Anterior Teeth: Ingot Selection and Cementation Protocol for Lithium Disilicate Restorations

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Treating Discolored Anterior Teeth: 
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INTRODUCTION
Restoration of the maxillary central incisors, especially when one is severely discolored, can be one of the most difficult challenges a clinician faces. The need to create visual harmony between the 2 maxillary centrals often dictates a more invasive approach than would otherwise be necessary.

Historically, the only option available was to crown both centrals, even when the nondiscolored tooth was not in need of a full-coverage restoration. With the advent of materials that allow bonding to glass ceramics, preparation of the nondiscolored tooth can be done more conservatively. The pairing of an opacious PFM or all-ceramic metal oxide crown on the discolored tooth, with a feldspathic porcelain veneer on the other central, has been a common solution to this problem.

While this approach was less invasive than what was previously employed, use of 2 dissimilar materials on the central incisors can result in an optical disharmony. The case illustrated in Figure 1 demonstrates such a situation. There is a difference in color saturation (chroma) and brightness (value) between the PFM crown on tooth No. 8 and the feldspathic porcelain veneer on tooth No. 9. Although both restorations are VITA shade A2, their appearances differ due to the variation in light reflected by the underlying structures.

Though there are many all-ceramic material choices available, favorable physical and aesthetic properties make glass-based lithium disilicate an excellent material for anterior restorations.1-3 This material currently has more options available for shade as well as light transmittance (translucency/opacity) than any other available ceramic system. There are currently 47 ingot selections available for the e.max Press system (Ivoclar Vivadent).4 The selection of an appropriately opacious ingot will allow for the masking of a discolored tooth and can achieve optical uniformity between multiple teeth of varying colorations.

The following case will demonstrate proper ingot selection, based on the desired final shade and preparation design, as
well as the details of an adhesive cementation protocol. Advantages of bonding glass ceramics using resin cements include additional optical flexibility for the clinician and the demonstrated reliability of their high bond strengths. However, additional considerations related to cement selection must be weighed by the judicious clinician, and will be discussed in conjunction with this case as well.

**CASE REPORT**

**Findings**

A 46-year-old female with a noncontributory medical history presented with a chief complaint of, “I don’t like the look of my front teeth.” Examination revealed either fractured or failing restorations of teeth Nos. 7, 9, and 10. Tooth No. 8 had a ceram-o-metal crown with an open facial margin as well as an incisal edge extending 1.0 to 1.5 mm beyond that of No. 9 (Figure 2).

Periodontal evaluation revealed probing depths of 1.0 to 3.0 mm, with minimal bleeding upon probing. Additionally, the gingival zeniths of the central incisors were noted to be 1.0 to 2.0 mm apical to those of the lateral incisors.

**Clinical Protocol**

The PFM crown on tooth No. 8 was removed. A dark stump, with an intact cast metal post, was noted. Prior restorations and any decay were removed from teeth Nos. 7, 9, and 10. These teeth were then prepared for veneers or three quarter crowns, with no preparation of their lingual surfaces. Final impressions were taken with a vinyl polysiloxane impression material (Aquasil [DENTSPLY Caulk]). Figure 3 shows the final preparations. A detailed prescription, along with preoperative and shade photos, were sent to the dental laboratory.

Figure 4 demonstrates a grayscale photograph provided to communicate the brightness (value) of the desired restorations to the laboratory team, as well as of the prepared teeth. The use of black and white photography has been shown to be a reliable way to accurately match tooth shades that is especially valuable when evaluating and matching value. The teeth were then temporized with a bis-acryl provisional material (Integrity [DENTSPLY Caulk]).

A medium opacity (MO) ingot was used to fabricate all of the restorations. To create a polychromatic appearance to optimize aesthetics, the ceramist cut back the incisal edges (Figure 5), then microlayered them using...
a fluoroapatite ceramic (e.max Ceram [Ivoclar Vivadent]). The final lithium disilicate restorations were then hydrofluoric acid etched (per manufacturer’s directions) on their intaglio surfaces to optimize the cement-to-ceramic adhesive bond strength (Figure 6).

On the day of cementation, the restorations were tried in with both opaque and transparent try-in pastes (Multilink Automix Try-in Paste [Ivoclar Vivadent]) to observe the effects that the different cements would have on the appearance of the restorations. No influence from either paste was noted, and no “show through” of the body of tooth No. 8 was evident, indicating that the dark stump and metal post had been satisfactorily masked. The teeth were then cleaned with medium-grit plain pumice. The try-in paste was cleaned off the restorations, and then they were placed in an ultrasonic with distilled water, as per the protocol of Martins et al. The restorations were dried, and a thin layer of universal primer (Monobond Plus [Ivoclar Vivadent]) was painted onto the intaglio surfaces (Figure 7), allowed to set for 60 seconds, then air-dried.

Restorations Nos. 7, 9, and 10 were primed for cementation via preparation with a self-etch, self-cure, bonding agent (Multilink A and B [Ivoclar Vivadent]); this was done before dual-cure resin cement (Multilink Automix Adhesive Cement [Ivoclar Vivadent]) was used to adhesively lute the restorations. Tooth No. 8 received a slightly altered protocol. Only the remaining tooth structure was prepared with the Multilink A and B (Figure 8), then a layer of the universal primer (Monobond Plus) was coated on the metal post (allowed to set for 60 seconds, and then air-dried) (Figure 9). Finally, the crowns were filled with the dual-cure resin cement (Multilink Universal Adhesive Cement) and seated into place (Figure 10).

Figure 11 demonstrates the immediate postoperative view. Figure 12 is a grayscale photo of the final result 10 days later, demon-
stratizing not only improved papillary fill, but also a uniform value among all the restorations.

**DISCUSSION**

Selection of the restorative material, application of various principles in tooth preparation, and cement selection and application, all enabled a good result in the case shown here. Attention to the color and transmittance of the restorative material resulted in a consistent appearance across all of the treated teeth, despite the significant differences of the underlying tooth structure.

The thinner and/or more translucent a restoration is, the greater the impact the cement shade can have on the final result. Conversely, cement color becomes less critical with a decreased ability to influence the shade/value outcome as the thickness and opacity of the restoration increases.

In the case shown here, dual-cure resin cement was selected due to the opacity of the restorations. However, this seemingly straightforward decision can be complicated somewhat by additional factors. For example, an inverse correlation exists between the opacity of an indirect restoration and the degree of conversion and polymerization of light-cure resin cement. The clinician can take advantage of this by using dual-cure resin cements under opaque restorations as was done in this case. However, this needs to be balanced with complications commonly seen with dual- or self-cure cements, including lower initial bond strength and the potential for post-cementation yellowing throughout time. This latter complication was not a salient factor in this case, because of the selection of a suitably opacious ingot.

One compromise required in this case involved selection of an opacious ingot for the restorations, even though 3 of the 4 restored teeth had stumps that were close to the final shade. Had tooth No. 8 not been severely discolored, a more translucent ingot could have been chosen. This would have resulted in a better optical interaction between the restoration and the underlying tooth structure, but the consistent appearance across all of the teeth would have been sacrificed. In this case, the advantage of a more opaque (MO) ingot was that it offered sufficient opacity to block out the dark stump of No. 8; at the same time, less aggressive preparations of teeth Nos. 7, 9, and 10 were required. The uniform final result achieved here would have been impossible with a less opaque ingot.

Although unrelated to material selection, another aesthetic compromise in this case requires discussion. As mentioned previously, the gingival zeniths of the central incisors were noted to be 1.0 to 2.0 mm apical to those of the lateral incisors. This created the appearance of shorter central incisors relative to the laterals, with a minimal interproximal papilla. In this case, this could have been corrected via osseous crown lengthening. The patient opted to forego this procedure as her low lip-line masked the discrepancy. To compensate, a long contact was created in the final restorations.

It is evident that the range of opacities available in today’s restorative materials, combined with the proper products for adhesive cementation, will yield a satisfactory aesthetic result in many cases while allowing less aggressive tooth preparation. In cases involving the restoration of more than one adjacent tooth, many combinations of indirect materials could block the varying underlying stump shades. However, the differing optical properties inherent in the dissimilar materials could cause inconsistencies in the overall final appearance. Selection of a suitably opacious material for all involved teeth allows the clinician to achieve a more ideal optical match.

**CLOSING COMMENTS**

Many options now exist that enable clinicians to go beyond the traditional emphasis placed on tooth shade, final restoration shade, and cement color. The ability to control the translucency or opacity of the material enables more control over the final aesthetic outcome. This increased control allows achievement of a more ideal aesthetic result in a compromised dentition. This case involving the maxillary central incisors, where bilateral symmetry is of paramount importance, provides a good illustration of the more complicated decision-making process that must now be performed.
REFERENCES
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POST EXAMINATION QUESTIONS

1. With the advent of the materials that allow bonding to glass ceramics, preparation of the nondiscolored tooth could be done more conservatively.
   a. True    b. False

2. Though there are many all-ceramic material choices available, favorable characteristics make zirconium oxide the only choice for anterior restorations.
   a. True    b. False

3. The selection of an appropriately opacious lithium disilicate ingot will allow for the masking of a discolored tooth and achieve optical uniformity between multiple teeth of varying colorations.
   a. True    b. False

4. Advantages of bonding glass ceramics using conventional cements, such as glass ionomers, include additional optical flexibility for the clinician and the demonstrated reliability of their high bond strengths.
   a. True    b. False

5. The use of black and white photography has been shown to be a reliable way to accurately match tooth shade that is especially effective when evaluating and matching value.
   a. True    b. False

6. In this case, after the try-in paste was cleaned off the restorations, they were placed in an ultrasonic with distilled water, as per the protocol of Martins et al.
   a. True    b. False

7. Cement color becomes more critical as the thickness and opacity of the restoration increases.
   a. True    b. False

8. An inverse correlation exists between the opacity of an indirect restoration and the degree of conversion and polymerization of light-cure resin cement.
   a. True    b. False
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Please check the correct box for each question below.

1. a. True  b. False
2. a. True  b. False
3. a. True  b. False
4. a. True  b. False
5. a. True  b. False
6. a. True  b. False
7. a. True  b. False
8. a. True  b. False

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