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Restoring a Fractured Maxillary Central Incisor in the Whitened Dentition

Astute shade selection and a simplified polychromatic composite layering method are required for a natural-looking result.

By Robert D. Marus, DDS, AAACD

With the increasing quest for whiter teeth, dentists can expect to encounter the challenge of repairing fractured teeth[1,2] in a whitened dentition. Whitened enamel[3,4] is higher in value and more opalescent than unwhitened enamel, whereas the underlying dentin shade remains essentially unchanged by the whitening procedure; therefore, shade selection of the composite for the restoration of a fractured maxillary incisor that has been whitened calls for a different optical perspective.[5] Emulating the polychromatic variations[6-8] and visual properties of the whitened dentition requires astute visual observation and shade selection in order to render an undetectable and lifelike esthetic restoration. Current shade guides available today typically do not address the shade differential between dentin and enamel shades seen in a whitened tooth. The enamel-dentin shade layering system guides do not have a color scheme reflecting this greater shade discrepancy. With a whitened dentition, a simplified polychromatic composite layering method, which is mindful of the greater shade differential between enamel and dentin, is used to reproduce the optical properties that exist in the whitened tooth.

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Case Presentation

A 15-year-old boy presented to the author's office for treatment of a fracture of his right maxillary central incisor following an accident (Figure 1). Physical and radiographic examination revealed no root fracture or pulpal exposure. Photographs were taken and the patient was immediately scheduled for operative treatment of his fractured tooth. This patient of record had previously whitened his dentition, and had also completed orthodontic treatment approximately 1 year prior to presentation. The Venus Diamond composite system (Heraeus, www.heraeus-dental-us.com) was selected as the restorative material because of its unique opalescent incisal and chroma-rich opaque chromatic dentin shades. As a nanohybrid, non-BIS-GMA composite, in the author's opinion it also offered great strength and fracture resistance in this application.

Treatment Plan

At the operative visit, the shade of the tooth and the neighboring central incisor was taken and color mapping was performed before anesthetizing the patient. Shade evaluation was meticulously performed with the patient in a seated-upright position in fluorescent, daylight, and incandescent light sources. In this author's opinion, color metamerism is most pronounced in fluorescent light. It is the ultimate litmus test in shade selection. In modern society, patients spend a large part of their day in artificial lighting, namely traditional mercury-vapor fluorescent lighting. As compact fluorescent light (CFL) and light-emitting diode (LED) lighting technology slowly replace mercury-vapor fluorescent lighting, evaluation of metamerism under these new light sources should be performed.

The shade selection of a tooth is a complex process, created from factors such as lighting source and angle, opacity, translucency, light scattering, surface reflection and the viewer's eye, and the brain influencing the overall perception of tooth color.[9] Thus, understanding how these optical characteristics impact the final shade, in the case of the whitened dentition, gives insight into how layers of composite can be used to recreate that specific shade. When determining shade, a useful starting point is to consider value (brightness). In the whitened dentition, the value of the enamel is usually very high, which corresponds to a Vita 3D Shade Guide number of 1. This value can be translated into the traditional Vita Lumin Shade for use with a composite shade guide, because most composite systems use the Vita Lumin Shade guide. Chroma (intensity or saturation of color) and hue (wavelength or color) can then be determined using the composite shade guide.

Opalescence is the phenomenon in which a material appears to be of one color when light is reflected

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FIG. 1

FIG. 2

CASE PRESENTATION (1.) Fracture of the right maxillary central incisor. **(2.)** The composite mock-up.

from it and of another color when light is transmitted through it. In the author's experience, Venus Shade Guide's (Heraeus) unique incisal shades re-create the opalescence that occurs from whitening, making it extremely helpful in re-creating the whitened tooth.

The typical difference between the whitened and unwhitened dentition is that a whitened tooth is more opalescent and there is a greater shade differential between dentin and enamel. Therefore, when deciding on value, chroma, and hue, one must consider how a dentin shade ranging from A1 to A3 internally impacts through layering the final shade of the tooth. When observing a fractured tooth, some exposed dentin may be available for shade evaluation. If this is not the case, evaluating the cervical region of the tooth, where the enamel is very thin or not present because of gingival recession, will give the practitioner insight to the dentin shade present on the tooth to be restored. This author will frequently create a custom shade tab using an opalescent enamel layer over a dentin layer of composite, noting the layer thickness of enamel composite used.

Additionally, the shade must be taken quickly to prevent desiccation of the teeth, which will increase their value in a very short period of time. Any hypocalcification spots, frequently enhanced by the whitening procedure, should be noted and mapped.

Care was taken to evaluate the shade at the incisal third of the teeth, which is typically more gray in value due to its translucency. In this case, the incisal third of the tooth did not exhibit much translucency. Some white hypocalcification spots in this incisal third were noted. A composite mock-up (Figure 2) was performed without acid-etching, and the occlusion was then equilibrated in centric occlusion, lateral, and protrusive excursions.[10,11] For this mock-up, Venus Diamond composite shade B1 was placed on the fractured tooth using a gloved hand as a lingual guide. Once sculpted in position, it was cured and the excess was removed with a Sof-Lex™ coarse disc (3M ESPE, www.3mespe.com). A football-shaped diamond bur was used to adjust the occlusion and lingual contour. Refinement of the mock-up was performed by the addition of Venus® Diamond Flow flowable composite. Upon completion, a lingual matrix impression[12] was taken of this mock-up with bite registration material supported by a heat-softened piece of pink baseplate wax. This matrix was then put aside for later use. Local anesthetic was then administered on tooth No. 8, and treatment was initiated.

An irregular-shaped long bevel was placed both facially and lingually using a Brasseler 8856 fine-grit, round-end-taper, 30-µm bur (Brasseler USA, www.brasselerusa.com). All sharp line angles were smoothed. The tooth was then isolated with a stainless steel matrix band and all surfaces of the tooth were mechanically etched with the MicroEtcher II (Danville, www.danvillematerials.com) and acid-etched with Ultra-Etch® 35% phosphoric acid (Ultradent Products, www.ultradent.com) for 15 seconds and rinsed thoroughly. The use of mechanical etching is very effective in providing a meticulously clean surface prior to acid-etching and adhesive placement. This micro-etching allows the practitioner to sculpt composite onto the unbeveled facial surface of the tooth in order to blend the composite–tooth interface. A total-etch technique was employed on tooth No. 8, etching both dentin and enamel for 15 seconds. The etchant was rinsed with copious water spray; excess water was aspirated until the dentin surface was moist. An adhesive, iBOND® Total Etch, (Heraeus) was applied for 30 seconds, lightly dried, and then light-cured for 20 seconds.

The lingual matrix was replaced and the first layer of Venus Diamond OBC (opaque bleach chromatic) dentin shade was condensed firmly into the matrix. Composite was condensed into the lingual bevel of the tooth while the matrix was held firmly against the tooth to create an eggshell-thin layer of composite (Figure 3). Because of its plastic matrix, obtaining sufficient opacity with composite is typically more difficult than it is with stacked porcelain. However, with the availability of these new chromatic dentin shades, no additional opaquer is needed in a Class IV restorative application. Curing from the facial aspect was performed for 30 seconds and the matrix was removed. Then, the thin eggshell-like layer of composite was cured again from the lingual aspect for 30 seconds.

The dentin layer was constructed from the same Venus Diamond OBC dentin shade and the dentinal mamelon detail was sculpted (Figure 4). The interproximal and incisal areas were left partially vacant in keeping with natural dentin anatomy, and the composite was cured for 30 seconds. This dentin shade of composite was placed on only one third of the long bevel of the facial surface in order to conceal the internal margin. The enamel body shade Venus Diamond B1 was then placed covering the facial long bevel and partially filling in the interproximal and incisal areas while leaving room for a final layer of the incisal shade (Figure 5). This enamel layer was cured for 30 seconds. Venus Diamond YO (yellow opalescent) was placed, covering all remaining surfaces and thus simulating whitened enamel (Figure 6). Prior to curing, facial texture was created, and some indentations were placed in the area of the incisal third to mimic the topography of the neighboring teeth. This layer was then cured for 30 seconds. A brush with Venus Diamond Flow base liner was used to fill in the indentations, which replicated the hypocalcification spots seen on the adjacent central incisor. The final restoration was cured facially, lingually, and incisally, each for 30 seconds.

Finishing and Polishing

Occlusion in centric, lateral, and protrusive excursions was evaluated and adjusted. Because most of the facial contours were finished during the uncured composite placement, minimal finishing was performed using only medium and fine SofLex discs. Incisal edge adjustment was performed with the patient seated in the upright position for a face-to-face perspective. Polishing was accomplished with both pink and green Venus® Supra polishing cups (Figure 7).

Conclusion

Cosmetic dentistry has created unique patient expectations and demand for highly lifelike results.[13] Restoration of a maxillary anterior fractured tooth in a whitened dentition can be a challenge for clinicians, because a greater than usual shade discrepancy exists between the whitened opalescent enamel and the unchanged dentin. Shade matching and color mapping are critical optical skills required by the clinician to achieve a natural-looking esthetic result. Optical dissection of the tooth will empower clinicians with the skill to detect differences in hue, value, and translucency. Incremental layering with a whiter,


FIG. 3


FIG. 4


FIG. 5

CASE PRESENTATION (3.) An eggshell-thin layer of composite was applied. **(4.)** Dentin shade of composite and dentinal mamelon detail. **(5.)** The enamel body shade was placed covering the facial long bevel.

FIG. 6

FIG. 7

CASE PRESENTATION (6.) Yellow opalescent shade was placed, covering all remaining surfaces to simulate whitened enamel. **(7.)** The finished restoration.

more opalescent enamel composite—along with a classic dentin composite—will create the desired effect when restoring the whitened tooth.

Disclosure

Dr. Marus is a paid consultant for Heraeus.

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