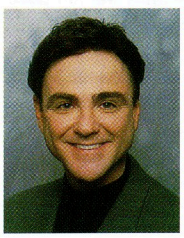
Enhanced Resilience and Esthetics in a Class IV Restoration

Abstract: *The purpose of this article is to give the reader a better understanding of the complex restorative challenge in achieving true harmonization of the primary parameters in esthetics (ie, color, shape, and texture) represented by the replacement of a single anterior tooth. The case presented demonstrates the restoration of a Class IV fracture taking esthetic consideration of the anatomic variations of the adjacent teeth to produce a direct composite resin in harmony with the surrounding dentition. The basic procedure includes tooth preparation, development of the body layer, internal characterization with tints, development of the artificial enamel layers, shaping and contouring, and polishing. In understanding the total morphology of a tooth and using natural teeth as the basis for morphological thinking, the clinician possesses the knowledge to create restorations with a more natural appearance. Use of a recently developed optimized-particle composite and this morphological thinking allowed the author to achieve a restoration in harmony with the surrounding dentition. Continuing technological breakthroughs allow the clinician to implement and maximize new products to attain more predictable and esthetic results as demonstrated by this methodological protocol of incremental application of composite resins and modifiers to transform the Class IV fracture into a final restoration that mimics nature.*

In colonial times, homes were constructed of logs, mud, and grass. New inventions brought the use of stronger and more urbane resources such as stone, concrete, steel, fiberglass, and plastics. Builders used products that provided not only strength and durability, but also esthetically pleasing results for homeowners. Following the same timeline for dentistry, some colonists wore wooden teeth. New technology introduced the use of silver amalgams, gold crowns, microfills, and hybrids. The dental community, like that of the builder, continually strives to enhance products that provide a pleasing smile while possessing endurance and resilience.

The buzzword of modern technology is "user friendly." Improvements in adhesive bonding and composite bonding systems (such as Point 4™ and OptiBond™ Solo Plus[a], ESTHET•X™ and Prime & Bond NT™,[b], 3M™ Z250 and Single Bond[c], Vitalescence™ and PQ1™,[d], and Tetric Ceram™ and EXCiTE®,[e]) in general have produced single-component adhesives, "no-bottle" adhesives, and the syringe-delivery system, which has the potential to deliver greater bond strength

[a] Kerr® Corporation, Orange, CA 92867
[b] Dentsply®/Caulk®, Milford, DE 19963
[c] 3M Dental Products, St. Paul, MN 55144
[d] Ultradent Products, Inc, South Jordan, UT 84095
[e] Ivoclar Vivadent, Amherst, NY 14228



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Learning Objectives:

After reading this article, the reader should be able to:

- describe how to prepare, restore, and finish a Class IV restoration using a small-particle composite.
- discuss tooth morphology and focus on the relationship between the expanse and direction of ridges and grooves and the anatomic variation of adjacent teeth in a Class IV restoration.
- explore the use of a new small-particle composite to enhance resilience and esthetics in the anterior dentition.

Figures 1A and 1B—Preoperative facial views show a horizontal fracture.

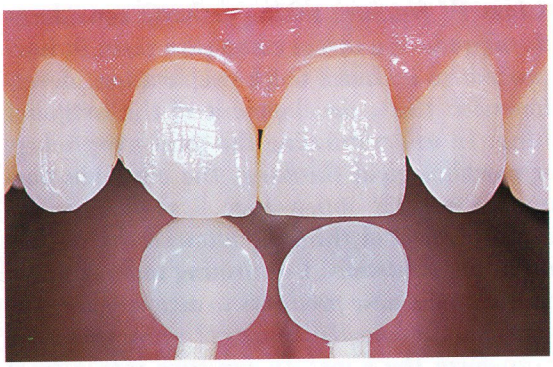


Figure 2—Shade selection with custom-fabricated shade tabs.

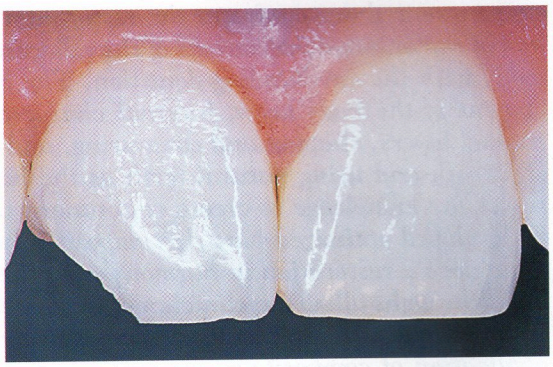


Figure 3A—A chamfer 0.3 mm in depth was placed 2 mm long around the entire margin.

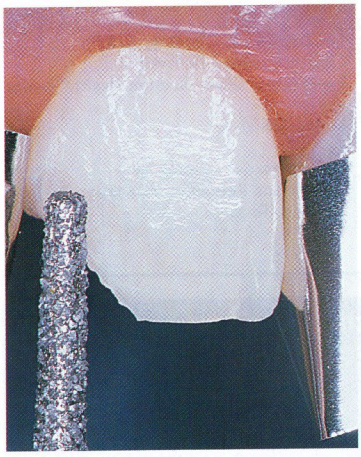


Figure 3B—A "scalloped" bevel was placed on the chamfer with a long tapered diamond.

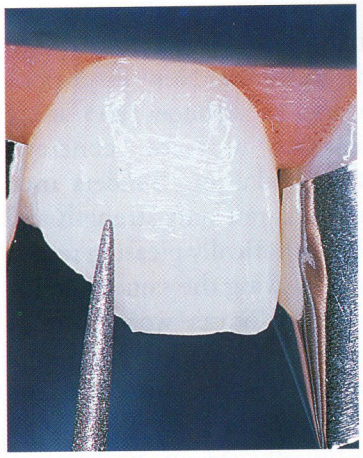


Figure 3C—A bevel was placed at the chamfer margin.

and eliminate sensitivity and microleakage. Even with such advances, the clinician must choose between the hybrid, the microfill, or a combination of both for ameliorating restorations.

The single anterior tooth replacement represents a complex restorative challenge for the clinician whether he or she is using composite restorative resins or porcelain systems. The challenge includes achieving true harmonization of the primary parameters in esthetics (ie, color, shape, and texture).[1,2] Designing porcelain restorations relies on the quality of the stone models, photographs, and narrative description the clinician provides for the dental laboratory technician. Direct restorative resin reconstruction relies on the quality of the clinician's esthetic observations as well as his or her ability to blend the restoration within the confines of the patient's mouth, adjusting hue, chroma, and value to match the adjacent dentition. The proximate environment dictates the appearance of any restoration.[3] This case presentation demonstrates the restoration of a Class IV fracture, taking into consideration the esthetic and

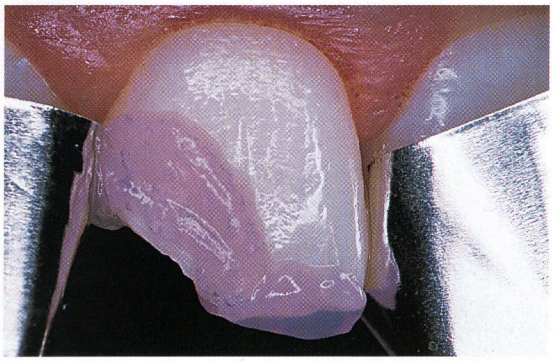


Figure 4—The preparation was etched for 15 seconds with 37.5% phosphoric acid.

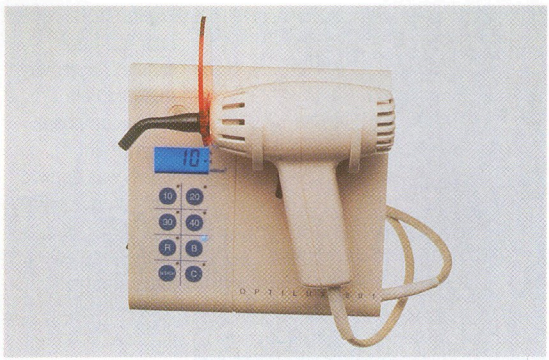


Figure 6—The Optilux™ 501 curing unit delivers high output across a broad bandwidth. Its versatility allows the clinician to cure any composite in either a Conventional, Ramp, or Boost mode. There is also a setting for Bleaching.

anatomic variations of the adjacent teeth to produce a direct composite resin that would be in harmony with the surrounding dentition. Although stratification techniques are still necessary, by understanding the dimensions of color, the properties of composite resins, and the morphology of the tooth, the clinician will attain more predictable and esthetic results. This article describes a methodological approach for preparing, restoring, and finishing a Class IV restoration with a recently developed optimized particle composite with suggested improved mechanical and physical properties.

Preoperative Considerations

A 27-year-old woman presented with an oblique fracture that resulted from a traumatic blow to the maxillary right central incisor (Figures 1A and 1B). In fractures of young teeth, the clinician must assess clinically and radiographically the extent of trauma and pulpal injury. A finding of acute pathology would require altering the treatment plan, using all necessary actions for resolution. At this

Figure 5—A single-component adhesive (OptiBond™ Solo Plus) was applied with an applicator for 20 seconds.

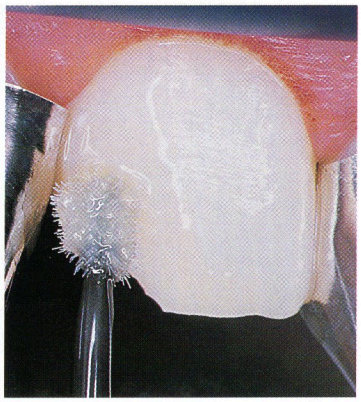


Figure 7—The artificial dentin body of A-1 shade composite resin (Point 4) was applied and contoured with a long-bladed composite instrument and smoothed out with an artist's brush to form the dentin lobes.

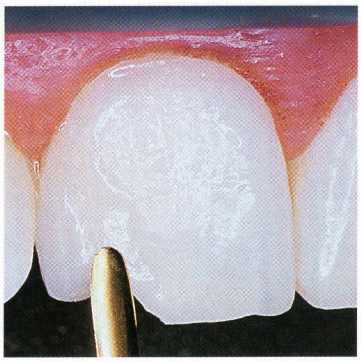
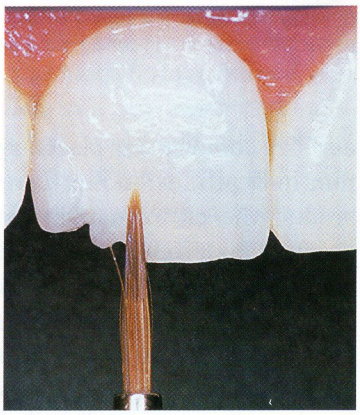


Figure 8—A diluted white tint was placed along the interface to disguise the fracture line.

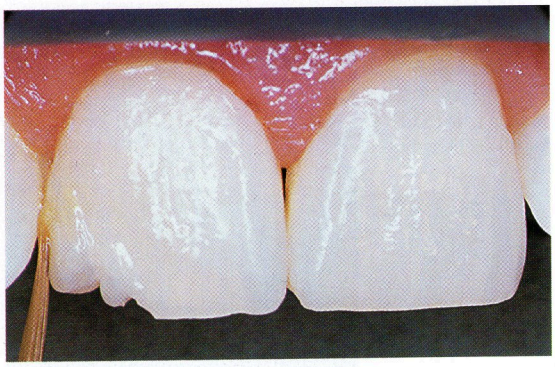


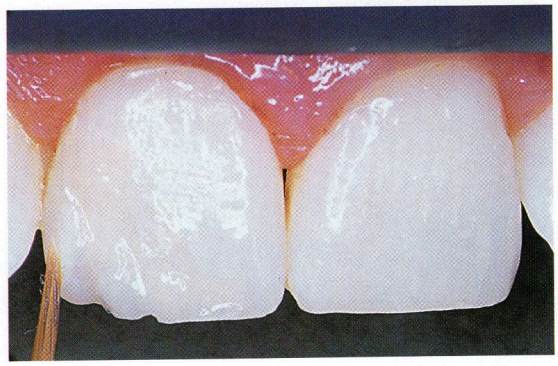
appointment, a previsualized mock-up was performed with a selection of the composite restorative materials, modifiers were selected, and their orientation was charted so they could be applied at the restorative stage. The shade selection was performed at this visit to prevent an elevated value or selecting an improper shade after tooth dehydration (Figure 2).

Clinical Procedure

Preparation

After administering anesthesia, rubber-dam isolation was accomplished using a modified technique to create an elongated hole that allowed placement of the dam over the retain-





Figures 9A and 9B—A diluted yellow tint was applied in a thin wash vertically at the distofacial line angle and highlighted with a white modifier.

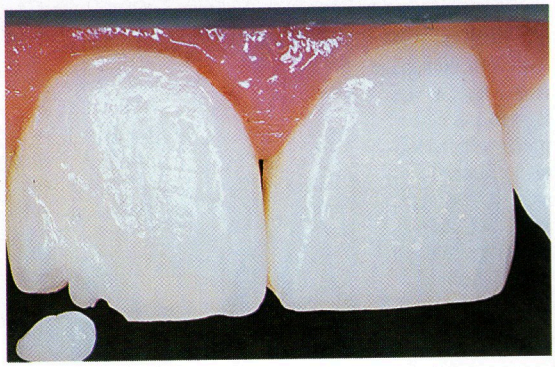


Figure 9C—The first enamel layer of B-1 shade composite resin (Point 4) was applied and contoured with a long-bladed composite instrument and smoothed with a sable brush.

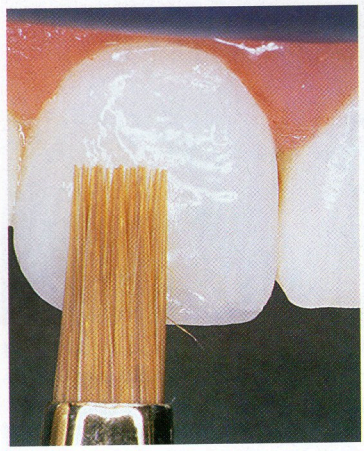


Figure 10—The final "artificial enamel" layer was restored with T-1 shade composite resin (Point 4), which was applied and contoured with a long-bladed composite instrument and smoothed with a sable brush.

ers.[4,5] A chamfer was placed approximately 0.3 mm in depth, extending 2 mm to 3 mm long around the entire margin (Figure 3A). This preparation provides a greater fracture resistance by allowing a larger volume of composite resin to be placed at the restoration margin.[6] A "scalloped" bevel was placed with a long tapered BluWhite™,[a] diamond (FG777C) to break up the straight chamfer line (Figure 3B).

Direct restorative resin reconstruction relies on the quality of the clinician's esthetic observations.

If the blend in color at the interface of the bulk of composite resin and the natural tooth is not harmonious, a bevel placed at the chamfer margin will help the clinician improve the transition (Figure 3C). Also, to improve microleakage at this interface, the gingival margin is beveled 0.5 mm because it is on enamel[7] (Figures 3A through 3C). The lingual aspect of the chamfer was extended 2 mm onto the lingual surface, but not onto the occlusal contact area. The margin should not end on the occlusal contact area unless relocating it to a contact-free area would require excessive reduction of healthy tooth structure. The preparation was completed with a finishing disk and polished with rubber cups that contained a premixed slurry of pumice and 2% chlorhexidine (Consepsis Scrub®,[d]).

Development of the Restoration

The preparation was rinsed and lightly air-dried, and a soft metal strip was placed interproximally to isolate the prepared tooth. The "total etch" technique was used to minimize the potential of microleakage and enhance bond strength to dentin and enamel.[8-10] The preparation was etched for 15 seconds with 37.5% phosphoric acid (Gel Etchant[a]), rinsed for 5 seconds, and gently air-dried for 5 seconds. The etch should extend several millimeters beyond the bevels, and the adjacent teeth should be protected from the conditioner with a soft metal strip (Figure 4). A single-component adhesive (OptiBond™ Solo Plus[a]) was

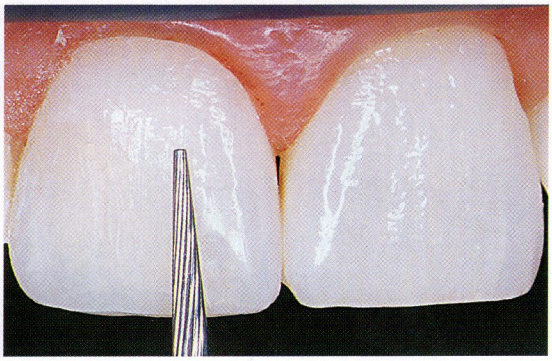


Figure 11—Facial contouring was initiated with 12- and 30-fluted needle-shaped burs.

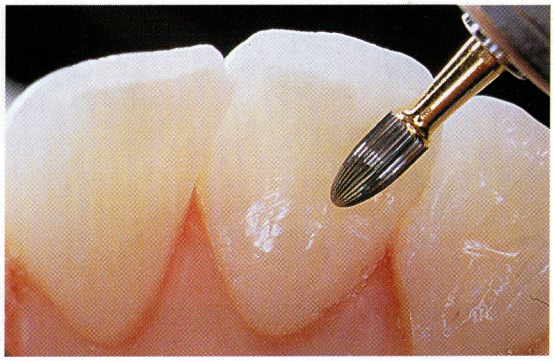
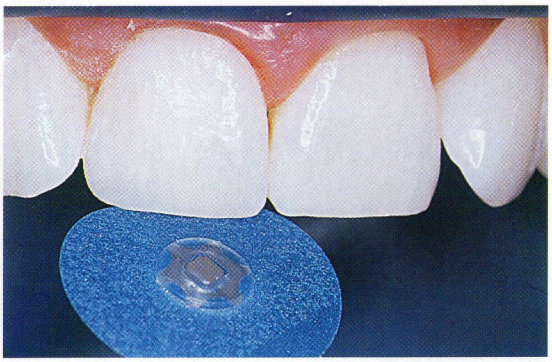
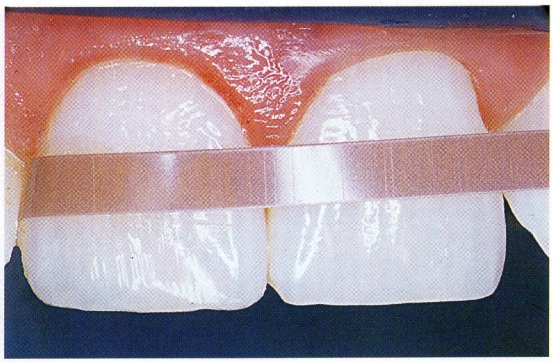


Figure 12—The lingual surfaces were contoured with 12- and 30-fluted football-shaped burs.





Figures 13A and 13B—Finishing the proximal, facial, and incisal angles was performed with aluminum oxide disks and finishing strips.

applied with a disposable applicator[a] for 15 seconds with continuous motion and was lightly air-dried for 3 seconds (Figure 5). The adhesive was light-cured for 20 seconds.

The first layer—the artificial dentin body—of A-1 shade composite resin (Point 4[a]) was applied and contoured with a long-bladed composite instrument and smoothed out with an artist's sable brush. This step is crucial because surface irregularities could interfere with placement of tints for internal characterization. This composite layer was polymerized with a curing unit (Optilux 501[a], Figure 6) for 10 seconds, which allowed placement of subsequent increments without deforming the underlying composite layer. This process was repeated with a second layer of A-1 shade composite to form the dentin lobes (Figure 7). To prevent overbuilding of the "artificial dentin" layer, it is important to monitor the composite placement from the incisal aspect so adequate space is provided for the final "artificial enamel" layer. Although this composite resin exhibits opaque characteristics, a very small amount of diluted white tint (Kolor+Plus™,[a]) was placed along the interface to disguise the fracture line (Figure 8). To emphasize the tooth form, a diluted yellow tint was applied in a thin wash vertically at the distofacial line angle and highlighted with a white modifier (Figures 9A and 9B). This technique uses color variation to create a three-dimensional effect in the restoration.

The artificial enamel was created in two composite layers to impart an esthetic hue variation and to instill a more realistic depth of color. This layer represents the principal determinant of the value of the restored tooth and is selected to correspond to the contralateral teeth. The first enamel layer of B-1 shade composite resin (Point 4) was applied with a long-bladed composite instrument (Figure 9C) and then smoothed with a sable brush. Surface irregularities were carefully eliminated, and the increment was polymerized with a curing unit (Optilux 501) in the Boost mode for 10 seconds. The final enamel layer was restored with a clear translucency, T-1 shade composite (Point 4), contoured with a long-bladed composite instrument, and smoothed with a sable brush (Figure 10). This composite layer was polymerized with the same curing unit in the Boost mode from the facial and the lingual aspects for 10 seconds.

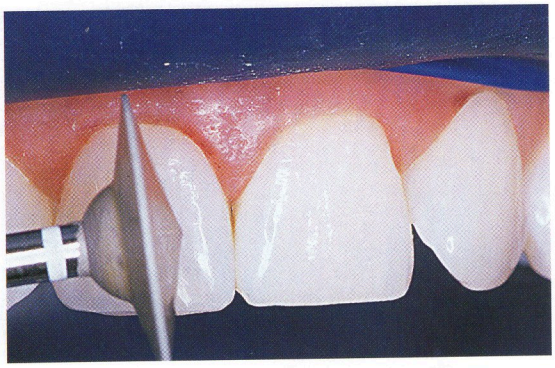


Figure 14—Surface texture was created with a knife-edge wheel.

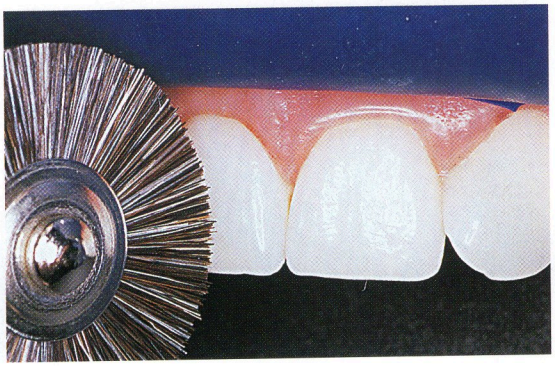


Figure 15—Polishing was completed with a soft goat-hair brush.

Figures 16A through 16C—The completed restoration was harmoniously integrated with the surrounding dentition.

The Final Restorative Phase

The final restorative phase is accompanied by contouring and finishing the restoration, which is critical for enhancing the esthetics and longevity of the restored teeth.[11,12] Proper surface texture of composite restorations is relatively difficult to achieve, demanding intensive training, meticulous attention to technique, and very close observation of the surrounding natural teeth.[13] In this case, particular attention was given not only to the relationship between the expanse and direction of the ridges and grooves and the anatomic variations of the teeth that were adjacent to the restoration, but also to the light refraction and surface reflection resulting from microstructure of the tooth surface.[14] To reproduce the shape, color, and gloss of the natural dentition[15] while enhancing the esthetics and longevity of the restoration, the following protocol was implemented.[11,12]

To replicate natural form and texture, the initial contouring was performed with a series of finishing burs.[16] The facial contouring was initiated with 12- and 30-fluted needle-shaped burs (BluWhite diamonds and carbides, Nos. 7714 and 9714[a]), closely observing the tooth-resin interface and using a dry protocol (Figure 11). The lingual surfaces were contoured with 12- and 30-fluted football-shaped burs (BluWhite diamonds and carbides, Nos. 7406 and 9406) (Figure 12). Finishing the proximal, facial, and incisal angles was performed with aluminum oxide disks and finishing strips (Figures 13A and 13B). These were used sequentially according to grit and ranged from coarse to extra fine.

For characterization, finishing burs, diamonds, and rubber wheels and points were used to create indentations, lobes, and ridges. To re-create the surface texture of the contralateral central incisor, a knife-edge wheel (KN7 Ceramiste Silicone Points[f]) was used vertically

Figure 17—Postoperative facial view of the restored maxillary right central incisor revealing the anatomy and surface texture.

Figure 18—Postoperative facial view of the final restoration.

in an intermittent staccato motion (Figure 14). The horizontal grooves, an important anatomic detail, were created with the sharp edge of a diamond bur, making the grooves deeper on the cervical and shallower on the incisal side.[13] To impart a high luster while maintaining the existing texture and surface anatomy, composite paste was used to polish the restoration with a soft, white goat-hair brush (Vivere™,g) (Figure 15). After the polishing was completed, the restoration was polymerized for an additional 60 seconds. Harmonious integration with the surrounding dentition was achieved by developing tooth anatomy and surface texture that contribute to light and shade reflectance (Figures 16A through 16C).[3,17]

Conclusion

Understanding the total morphology of a tooth and using natural teeth as the basis for morphological thinking, the clinician can create restorations with a more natural appearance (Figure 17).[13] Unfortunately, the desire to create can be limited by the clinician's level of knowledge as well as the products he or she is able to use for restorations. Continuing technological breakthroughs allow clinicians to not only comprehend the "building blocks" of the ideal composite restoration, but also to implement and maximize their use of new products in attaining more predictable and esthetic results. This case demonstrated a methodological protocol for incremental application of composite resins and modifiers to transform a Class IV fracture into a final restoration that mimics nature and is harmonious with the surrounding dentition (Figure 18).

[f] Shofu Dental Corporation, Menlo Park, CA 94025
[g] Leach and Dillon, Cranston, RI 02921

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