Aesthetic Characterization:
The Art of Direct Resin Restorations

Michael J. Morgan, DDS

ABSTRACT

The clinical demands for new resin materials that accurately replicate nature have been driven by patients' desire for aesthetic metal-free restorations. The strategic use of color has become an integral portion of the aesthetic equation. Tetric® Color (Vivadent, Amherst, NY), a component of the Tetric family of Ceromer™ materials, is specifically designed to enhance the characterization of direct resin restorations. The light-cured characterizing and shade-modifying resins facilitate easier, more predictable placement, natural colors, and a higher chroma than alternative materials. This article describes the utilization of the Tetric family in restoring teeth to a natural aesthetic appearance.

The detailed reproduction of the nuances of the human form is dependent not only upon the intricacies of anatomical configuration, but also on the precise utilization of color. As dentistry rapidly evolves from a technical profession to one of artisanship, the understanding and meticulous use of color become more significant. Aesthetic dentistry has raised the standard of the dental profession to a degree in which basic universal shades are no longer sufficient for the fabrication of aesthetic direct resin restorations. The dentin and enamel layers of composite may not be predictably placed and manipulated to simulate ideal color in all situations unless specially designed pigmented resins are employed.

The accurate replication of intricately detailed color has historically been one of the most challenging aspects of performing a direct resin restoration.[1] The reproduction of pit/fissure staining, hypocalcification spots, enamel cracks, incisal translucency and halo, and other maverick colors requires a material with simple, accessible handling properties and natural color selection. The ideal resin characterization material would include easy dispensability with a flowable viscosity and a wide range of natural high-chroma shades. The material would also have the ability to be quickly mixed to produce custom colors, to be easily removed, and to be light cured.

Diminished chroma and variable viscosity rendered previous characterizing resins laborious. High-viscosity tinted resins are difficult to place in precise amounts and proper location. In addition, their lack of flow results in uneven and inconsistent hues. Tints with a low chroma require additional layers of resin to achieve sufficient color. Proper dispensing of the material may be frustrating, often wasting large amounts of the resin.

1. Preoperative view of amalgam restorations with recurrent decay and a large interproximal contact area.

Tetric® Color (Vivadent, Amherst, NY) was designed specifically to fulfill ideal requirements. The monomer base is Bis-GMA, urethane dimethacrylate, and triethylene glycol dimethacrylate. The filler material is a highly dispersed silanized silicon dioxide with additional stabilizers, catalysts, and pigments. Tetric Color is indicated for the simulation of natural and maverick colors in direct resin restorations, masking of discolored tooth structure, and characterization of laboratory-fabricated composite resin restorations, as well as provisional crown restorations and fixed partial dentures. Unique to this composite system is a dark brown resin that exhibits a slight reddish hue.

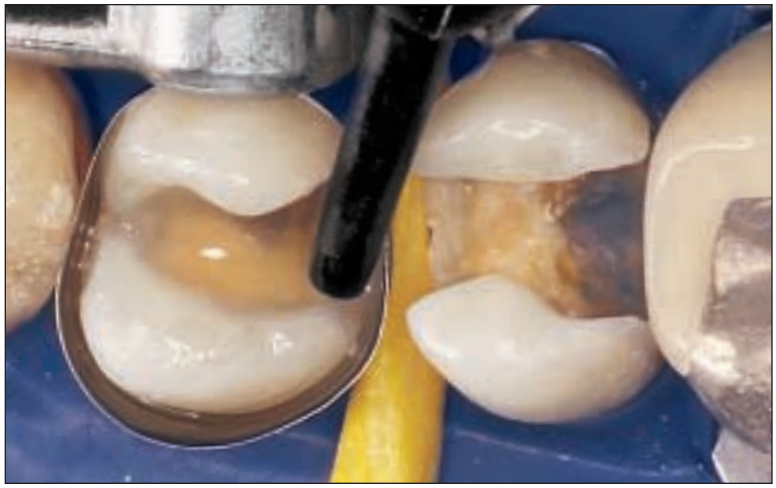
Tetric Ceram System Stratification

A stratified layering system may be utilized sequentially to predictably restore teeth to natural form and function.[2] By strategically combining layers of Tetric® Flow, Tetric® Ceram™ (Vivadent, Amherst, NY), and Tetric Color in the following layering sequence, restorations may be sculpted, resulting in enhanced aesthetics.

1. Tetric Flow—provides intimate adaptation between the hybrid layer and the initial dentin layer of composite. Elastomeric properties decrease stresses induced by polymerization shrinkage and prevent microgaps at the proximal gingival margin.[3]
2. Tetric Ceram—used for the successive incremental buildup of dentin layers and triangular ridges to reduce intercuspal stress.[4] Low value/high

2. *An anatomical wedge is placed to adapt the gingival margin of the Microband (Dental Innovations, Portland, OR).*

3. *A single-component adhesive (Excite®, Vivadent, Amherst, NY) is generously applied in one coat over the enamel margins and dentin.*



4. *Tetric® Flow is applied in a thin layer covering the entire pulpal floor.*

chroma dentin shades reproduce the anatomy and color of natural tooth structure. Areas of high value are often observed on the triangular ridges near the occlusal one third.

3. Tetric Color—applied as fossa colors to highlight, accent, create depth of color, and replicate maverick colors. The use of characterization, particularly in posterior pit and fissure staining, is patient driven. Although the artistic challenge may be more satisfying to the clinician, it is ultimately the patient's choice as to whether the occlusal surfaces of the restorations appear natural or monochromatic.
4. Tetric Ceram—utilized for the enamel layer and sculpted to provide final anatomy, proper contours, and correct occlusion.[5] Tetric® Ceram™ Transparent (Vivadent, Amherst, NY) is most commonly utilized for occlusal and interproximal enamel surfaces, enabling translucency through to the fossa colors and dentin layers to achieve a natural appearance.
5. Tetric Flow—used only in primary and secondary anatomical grooves to soften line angles as a result of deep occlusal anatomy carving. The final layer is placed as a pit/fissure sealant only and not applied over the entire occlusal surface.

Case Presentations

Case 1

A 61-year-old female patient presented with occlusal and interproximal decay surrounding the amalgam margins of teeth #12 and #13 (Figure 1). One recommended treatment plan consisted of Targis™/Vectris™ (Ivoclar, Amherst, NY) indirect resin restorations due to the size of the existing amalgam restorations and the buccolingual and mesiodistal width of the contact areas. Due to travel and time constraints, direct resin restorations were proposed and accepted by the patient.

Overcontouring is one of the most common errors in the fabrication of direct resin restorations. As a result, intricate anatomy and detailed color are compromised during occlusal adjustment and reduction. Marginal and surface integrity are jeopardized,[6] and finishing is significantly increased as compared to resins built to contour. To prevent overcontouring, the occlusal surface and anatomy of the previous restorations were carefully inspected. The opposing dentition and the patient's overall occlusion were also observed. This provided the clinician with guidelines for the final contours and anatomy of the resin restoration.

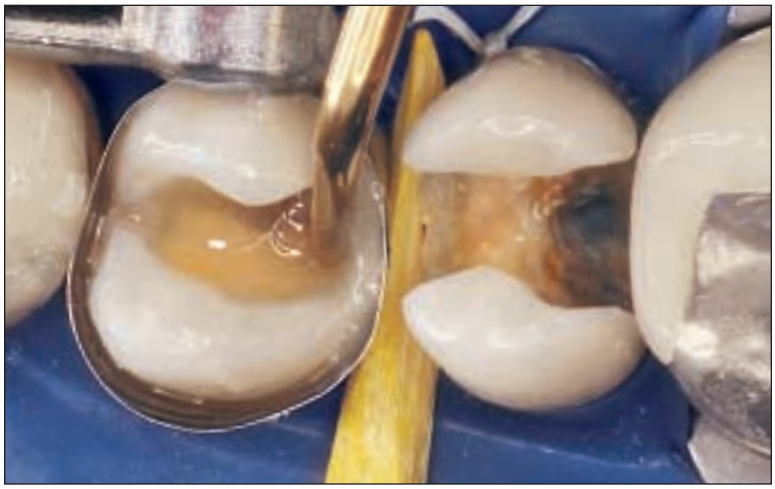
Prior to rubber dam placement, the base or dentin shade (330) of the restorations was selected by examination of the cervical one third of an adjacent nonrestored tooth using the Chromascop™ (Ivoclar, Amherst, NY) universal shade guide. Value, pit and fissure staining, and any maverick colors were also documented in a detailed color map. Following administration of a local anesthetic, isolation of the site was achieved with a rubber dam, and the teeth were ligated with waxed floss. Under magnification, the amalgam restorations were removed in sections utilizing high-speed diamond burs. Any remaining decay was excavated with #4 through #8 slow-speed round burs. A Microband (Dental Innovations, Portland, OR) was placed on tooth #12 with the smooth concave surface toward the preparation. As a result of the extremely thin (.0001") Microband design, a wedge was placed only to tightly adapt the band to the gingival margin and not to separate the teeth (Figure 2).

The preparations were etched with 37% phosphoric acid, which was initially placed on the enamel margins and then in the bulk of the preparations for a total of 20 seconds. The preparations were rinsed with water and subsequently dried, leaving the dentin surface slightly moist and damp.[7] Any excess (puddling) was removed utilizing a Microbrush™ (Microbrush Corporation, Grafton, WI) until a shiny dentin surface remained.

A single-component bonding agent (Excite®, Vivadent, Amherst, NY) was generously placed in one coat (Figure 3) and gently agitated for 20 seconds. The adhesive was lightly air thinned to remove any latent solvent or water until the dentin surface appeared glossy, at which time it was polymerized for 20 seconds.

Approximately 0.5 mm of Tetric Flow (Shade 340) was placed in the proximal box and across the entire pulpal floor (Figure 4) and light cured for 20 seconds. The high chroma/low value shade of the composite restoration aids in blocking dentin discoloration or amalgam staining, as well as creating an elastomeric layer between the hybrid zone and the dentin composite. The teeth were restored using a centripetal buildup technique[8] in order to facilitate easier placement and stratification of the dentin and enamel layers. Missing tooth structure was replaced from the periphery toward the center of the preparation. Class II restorations are essentially converted to Class I restorations utilizing this technique.

A multipurpose composite instrument (Cosmedent, Chicago, IL) was used to build the distal surface and marginal ridge of tooth #12



5. *Utilizing the centripetal buildup technique, Tetric® Ceram™ Transparent is used to create the distal wall.*

6. *The final dentin contours and anatomy are achieved using a stratified incremental buildup technique.*

7. *Tetric® Color white and dark brown are placed to replicate natural characterization.*

8. *Tetric® Ceram™ Transparent is placed as the enamel layer and sculpted to proper anatomy and contours with a fine artist's brush.*

9. *The completed direct resin restorations provide ideal aesthetics and function.*

10. *Incipient and marginal decay are present surrounding existing amalgam restorations.*

with Tetric Ceram Transparent in increments approximately 1.5 mm in width and 1.5 mm in depth (Figure 5). Each increment was gently pressed against the Microband and light cured until final marginal ridge height was achieved. The centripetal buildup was completed on the mesial and distal surfaces of tooth #13. Both teeth were then simultaneously restored with the precise stratification technique. The dentin layers were built up incrementally, which reduced intercuspal stress or cusp deformation[9] using Tetric Ceram (Shade 330) prior to light curing for 10 seconds per increment. The resin was placed and manipulated with Compo-Sculp DD3 - DD6 composite instruments (Suter Dental Manufacturing, Chico, CA). The final dentin layer was placed to within 1.0 mm of the final occlusal contours. Primary and secondary anatomy were sculpted with Compo-Sculp DD1 and DD2 composite instruments (Suter Dental Manufacturing, Chico, CA) (Figure 6) and light cured for 10 seconds.

Tetric Color (white) was placed utilizing a 0.4 mm ultrafine cannula tip to accent the buccal and lingual triangular ridges on the occlusal one third. Following light curing for 10 seconds, a thin layer of Tetric Color (dark brown) was placed directly into the primary fissures and grooves to replicate the contralateral nonrestored tooth (Figure 7). Excess resin was removed with a #1 artist's brush (Cosmedent, Chicago, IL) with the tip bent at a 90° degree angle for easier application; the composite restoration was then light cured for 10 seconds.

Tetric Ceram Transparent was placed as the final enamel layer and carefully sculpted utilizing a composite instrument prior to curing for 10 seconds (Figure 8). Slight excess flash was extended over the cavosurface margins to allow proper finishing and prevent deficient margins. Finally, a thin layer of Tetric Flow Transparent was placed into the primary grooves, thinned with a #1 artist's brush, and light cured for 20 seconds. The final resin layer softened any sharp enamel anatomy, acted as a sealant to protect the characterizing resin from wear, and served as a dispersion layer[10] to enhance aesthetics. Note that the flowable resin was only placed into the grooves, and not over the entire occlusal surface.

Finishing and Polishing

The wedges and Microbands were removed to allow proper finishing. Any interproximal gingival excess was then removed with a #12 scalpel blade. Contacts were checked using waxed floss, and narrow fine-diamond finishing strips were utilized to adjust tight contact areas. The proximal margins, occlusal embrasures, and marginal ridge contours were

corrected using finishing disks. Following removal of the rubber dam, occlusion was verified by centric and eccentric excursions. Proper layering and anatomical sculpting of the resin resulted in minimal finishing requirements. Occlusal adjustments were made using a #7404 finishing bur (Brasseler USA, Savannah, GA) and those areas were polished with silicon finishing and polishing points (Astropol, Vivadent, Amherst, NY). Upon completion, the restorations exhibited acceptable aesthetics and function (Figure 9).

Case 2

A 31-year-old male patient presented with cold sensitivity from interproximal decay on tooth #30 and marginal decay on tooth #31 (Figure 10). The teeth were restored using a centripetal buildup and stratified layering technique. A small notch was cut with a diamond bur in the Microband on tooth #30 to the height of the adjacent marginal ridge for guidance and to prevent overcontouring (Figure 11). Following placement of Tetric Flow and fabrication of the peripheral walls using Tetric Ceram Transparent (Figure 12), the dentin layer was initiated by the formation of individual triangular ridges. Each ridge was created with Tetric Ceram Bleach Incisal to within 1.0 mm of the final cavosurface margin and light cured for 10 seconds.

Tetric Ceram bleach shades (Incisal, Light, and Extra Light) were utilized to replicate the high value of bleached teeth. In the anterior, bleach shades enable the clinician to satisfy patient desires for increasingly lighter shades. In the posterior region, the Bleach Incisal shade can be placed as the final occlusal layer in place of Tetric Ceram Transparent when greater opacity and less translucency are required.

The areas between the triangular ridges were individually restored utilizing Tetric Ceram (Shade 330) and composite instruments. Primary and secondary anatomy was sculpted (Figure 13), and each area was light cured for 10 seconds. Following completion of the dentin layers and related anatomy, an initial layer of Tetric Color (ochre) was placed directly into the primary fissures and grooves, the excess was removed, and the site was light cured for 10 seconds. Tetric Color (dark brown) was subsequently placed into the primary pits in a similar manner and light cured (Figure 14). The Tetric Ceram Transparent enamel layer and Tetric Flow Transparent fissure sealant were placed sequentially (Figure 15). The restorations were checked for occlusion, then finished and polished. The results were in aesthetic harmony with the adjacent teeth and clinically acceptable in form as well as function (Figure 16).

11. *A Microband was placed and notched to the height of the adjacent marginal ridge.*

12. *The mesial and lingual surfaces were restored using Tetric® Ceram™ Transparent and a centripetal buildup technique.*

13. *Dentin layers were stratified between the triangular ridges and primary anatomy was sculpted.*

14. *Tetric® Color ochre and dark brown were added to characterize pits and fissures.*

15. *Final enamel contours were sculpted utilizing Tetric® Ceram™ and Tetric® Flow Transparent.*

16. *Following finishing and polishing, the definitive direct resin restorations exhibit natural aesthetics.*

Conclusion

Aesthetics that replicate natural tooth structure are possible with the proper integration of Ceromer™ material and characterizing resins. Incremental stratification and layering systems facilitate predictable replication of specific characterization of enamel and dentin. Precise color, anatomy, and occlusion may be reproduced with minute detail. The precise use of Tetric Color — in conjunction with Tetric Ceram and Tetric Flow — enables clinicians to impart lifelike color and enhanced aesthetics to direct resin restorations.

Acknowledgment

The author extends his gratitude to Ron Jackson, DDS, and Didier Dietschi, DMD, for their mentorship and friendship during the continuous journey through the art of direct resin restorations.

References

1. Dietschi D, Magne P, Holz J. Recent trends in esthetic restorations for posterior teeth. Quint Int 1994;25(10):659-677.
2. Koczarski M. Direct Ceromer™ stratification: Aesthetic success through a systematic approach. Signature 1998;5(2):2-7.
3. Bayne SC, Thompson JY, Swift EJ Jr, Stamatiades P, Wilkerson M. A characterization of first-generation flowable composites. J Am Dent Assoc 1998;129(5): 567-577.
4. Dietschi D. Anatomical applications of a new direct Ceromer. Signature 1997;4(1):8-11.
5. Fahl N. Direct posterior composite restorations: A great idea. AACD J 1997;3:8-10.
6. Ratanapridakul K, Leinfelder KF, Thomas J. Effect of finishing on the in vivo wear rate of a posterior composite resin. J Am Dent Assoc 1989:118(3):333-335.
7. Jackson R. The importance of technique in preventing postoperative sensitivity when placing bonded restorations. Dent Today 1999;18(9):44-49.
8. Bichacho N. The centripetal build-up for composite resin restorations. Pract Periodont Aesthet Dent 1994;6(3):17-23.
9. Magne P, Holz J. Stratification of composite restorations: Systematic and durable replication of natural aesthetics. Pract Periodont Aesthet Dent 1996;8(1): 61-68.
10. Vanini L. Light and color in anterior composite restorations. Pract Periodont Aesthet Dent 1996;8(7): 673-682.

Michael J. Morgan, DDS, *is Co-Director of the Posterior Aesthetics Course at the Pacific Aesthetic Continuum (PAC-live), University of the Pacific, San Francisco, California. He is an active member of the American Academy of Cosmetic Dentistry and maintains a private practice limited to adult aesthetic dentistry in Chicago, Illinois.*