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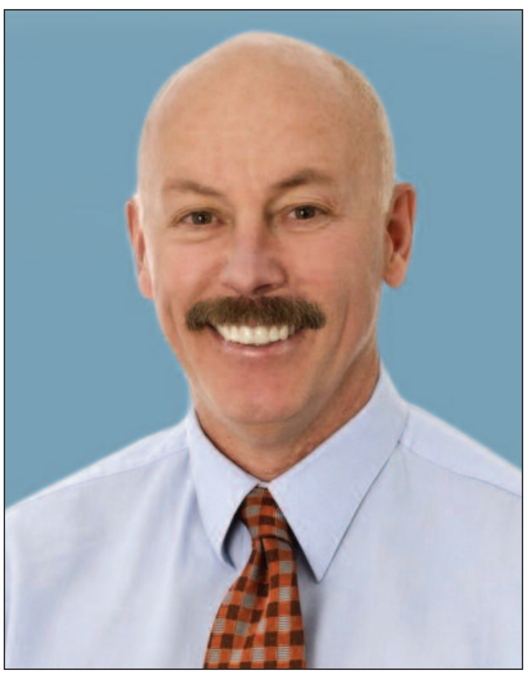
AESTHETICS

Conservatively Recreating a Smile

INTRODUCTION

It is not uncommon for patients to present with faulty, unaesthetic, or failed restorations and lack information regarding the previous condition of their restored teeth. This is particularly true for patients who have relocated to the United States from underdeveloped countries, where the concept of dental aesthetics and approaches to re-establishing tooth anatomy differ greatly from today's conservative and nature-mimicking techniques. Direct composite treatment in the aesthetic zone can be necessary due to damage from trauma, disease, or overpreparation. Initial uncertainty about the extent of a patient's tooth decay or stability can present challenging considerations involving isolation, potential recurrent caries, contamination, tooth characteristics, and predictability of restorative materials.[1,2] Patients' understanding of their condition and treatment possibilities also compounds these issues.



Frank Milnar, DDS

Understandably, when knowledge is limited about the condition of tooth structure beneath existing restorations, a thorough clinical and radiographic examination is warranted, after which accurate anatomical form can be visualized as the first step to re-establishing proper tooth shape and contours. By first establishing accurate anatomy and then addressing the interplay of light, hue, chroma, and value inherent in the tooth structure being replaced, lifelike restorations can be created.[3] It is the precise application of replacement dentin and enamel composites that replicate the complex internal tooth structures that facilitates restorative aesthetics and long-term functionality.[4,5]

However, simply replacing lost tooth structure with appropriate composite materials may be insufficient to restore a patient's smile anatomy to long-term functional aesthetics. One of the major reasons for replacing composite restorations is recurrent or secondary caries.[6-8] When investigators examined a variety of direct restorations placed in permanent teeth in general practices, they found that secondary caries were the main reason for replacement in all types of restorations studied.[9]

Patients who present with multiple, extensive caries are at high risk for secondary caries after restoration and require more cervically and/or interproximally placed restorations. Ensuring tight marginal integrity and seal helps to prevent microleakage—which has been shown to regularly occur at the

Figure 1. Full-face preoperative view of the patient in natural smile.

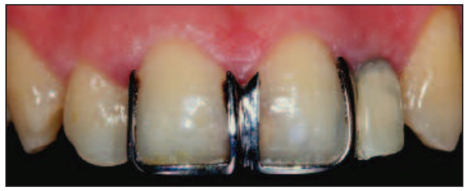


Figure 2. Close-up preoperative retracted view of the maxillary anterior teeth with chrome superstructure visible.

Figure 3. Aesthetic preview of the composite (BEAUTIFIL II [Shofu Dental]) on tooth No. 8 (shade A1) and tooth No. 9 (shade A2).

etched dentin-restoration interface, extending at the cervical cavity wall below the dentin-enamel junction—as well as future caries.[6,10]

Fortunately, newer direct composite materials with fluoride have been shown to neutralize acid to establish a stable pH in the oral environment and inhibit plaque formation, thereby decreasing the risk for secondary caries.[11] The fluoride releasing and recharging direct composite exhibits enhanced handling properties, which enables dentists to improve the marginal adaptation and efficient contouring of restorations, without slumping or sticking.[12] Fluoride release also has been shown to reduce the demineralization frequently caused by enamel cracks and microleakage at the tooth-restoration interface, inhibiting secondary caries.[13,14]

New Composite Chemistry

Scientific advancements in a variety of adhesive materials (eg, direct composites, adhesive bonding agents, etchants) combine to resolve many of the challenges associated with providing predictable, aesthetic, and long-lasting direct anterior restorations.[5] Improved handling characteristics in low-viscosity flowable systems, packable composites, and sculptable small-particle hybrid composites expand the opportunities to use these materials in a wider variety of clinical situations.[15] Additionally, sculptable, moldable, and aesthetic materials enable dentists to more easily freehand their direct restorations.

Further, enhancements to fluoride-releasing composite materials have helped to instill confidence in the long-term stability of restorations placed to treat patients at greater risk for recurrent decay.[16] Fluoride-releasing composites have been shown to increase the fluoride ion density in enamel and dentin adjacent to the restoration.[17-21] The elevated fluoride uptake increases the resistance of interfacial dentin to acid, amplifying the cariostatic effects of the materials.[22] Some in vitro studies have demonstrated that improved fluoridated materials produce an inhibitory effect on the development of marginal demineralization following acid exposure.[6,18,23-26] Another in vitro study found that fluoride-releasing materials reduce lesion depth and mineral loss of adjacent enamel by about 30%.[27]

Also, the development of self-etching primers that combine etching and priming steps[28,29] provides an avenue for fluoride-releasing materials to better penetrate tooth structure. These materials dissolve the smear layer and incorporate it into the mixture of resin monomers and collagen fibers that comprise the hybrid layer.[30,31] In addition to increasing efficiency, self-etching primers have been shown to contribute to reduced postoperative sensitivity.[32,33]

However, a significant advancement to direct restoratives has been the introduction of giomer, a surface pre-reacted glass ionomer (S-PRG), which enables the use of these materials with a simplified application procedure.[22] As a proprietary technology of Shofu Dental, Giomer (S-PRG filler particles) is incorporated into the company's resin-based composite line. The trilaminar structure of S-PRG forms a stable glass ionomer that allows ion release and recharge to occur, while protecting the glass core from moisture to improve the material's long-term durability. In addition to its ability to be a proximate reservoir of fluoride ions for uptake by enamel and dentin, it also contributes to effectively inhibiting recurrent caries.[22] Made by reacting acid-reactive glass containing fluoride and polyalkenoic acid in water prior to being incorporated into resin materials, S-PRG filler particles are different from those used in compomers, where the dehydrated polyalkenoic acid and glass reaction does not occur until water is taken up by the restorative material.[11]

S-PRG filler uniquely releases fluoride, sodium, strontium, aluminum, silicate, and burate.[34] Silicate and fluoride are strong inducers of remineralization of the dentin matrix,[35] while fluoride and strontium act on hydroxyapatite to convert it into fluorapatite[36-38] and strontiumapatite,[36,39] respectively, which improves the resistance of teeth. Fluoride provides additional benefits, since resin composites containing S-PRG filler demonstrate excellent fluoride release and rechargeability.[40,41]

In fact, one study reported that S-PRG filler released 9.32 µg/cm^2 fluoride on the first day and continued releasing fluoride for more than 60 days.[41] Another study found that a composite with S-PRG filler, utilized with a self-etching adhesive, led to an uptake of fluoride by enamel and dentin adjacent to the adhesive, with decreased demineralization following acid exposure in corresponding areas.[22] Additional studies have shown the longevity of restorations with S-PRG fluoride releasing properties, demonstrating that while initial fluoride release may be low, it increases significantly after 21 days.[42]

Materials with Giomer chemistry are available in a variety of shades to pro-

Figure 4. Underlying decay and discoloration were evident following removal of the metal superstructure.

Figure 5. Long bevels were created and the enamel roughened to improve bond strength.

Figure 6. Tooth No. 8 was selectively etched.

Figure 7. Utilizing shade A2 composite (BEAUTIFIL II), tooth No. 8 was constructed to architecturally project the midline.

Figure 8. Shade A2 composite (BEAUTIFIL II) was applied to establish the primary architecture for the smile design in preparation for restoring tooth No. 10.

Figure 9. The outer aprismatic enamel layer was removed from tooth No. 10 to increase bond strength and micromechanical retention.

Figure 10. Shade A2 flowable composite (BEAUTIFIL Flow Plus [Shofu Dental]) was placed precisely around the confines of the cervical margins of tooth No. 10 without light curing.

Figure 11. The composite (BEAUTIFIL II) was then placed against the flowable to ensure a complete seal through a co-curing method.

Figure 12. The final build-up of tooth No. 10 created the primary anatomical outline of a tooth consistent with the smile design established across teeth Nos. 7 to 9.

Figure 13. Utilizing abrasives (Dura-Green Stone [Shofu Dental]), unified and diffused facial surfaces were created.

Figure 14. The diffused surfaces were evaluated.

Figure 15. Polishers (OneGloss [Shofu Dental]) were used to create pre-luster surfaces and highlight line angle reflection.

Figure 16. Additional polishing into the midline was performed with polishing points (OneGloss).

Figure 17. Pre-luster discs (Super-Snap SuperBuff Disk [Shofu Dental]) were used with water to initiate hand polishing.

Figure 18. A 1:2 postoperative view of the patient's restored smile.

Figure 19. Close-up postoperative retracted view of the patient's maxillary anterior restorations.

vide lifelike aesthetics, but the combination of handling characteristics, optical properties, and higher microtensile bond strengths when enamel is roughened contribute to its functionality as a durable and predictable direct restorative.[43] Improved bond durability of the resin-dentin bonds may result from the strengthened dentin produced by fluoride ion uptake, as well as retention of the relatively insoluble 4-acryloxyethyl-trimellitic acid calcium formed around remnant apatite crystallites within the hybrid layer of self-etching adhesives.[44]

Therefore, when faced with treating patients with recurrent decay beneath existing defective restorations in using a conservative, direct approach, incorporating materials with S-PRG filler particles may be ideal for achieving multiple goals (ie, strengthening tooth structure with fluoride release, establishing natural tooth aesthetics and anatomical form, ensuring restoration durability, creating accurate anatomical structures through freehand application). Incorporation of precise finishing and polishing techniques and armamentarium used in a logical, sequential, and predictable manner will enhance the outcomes in terms of harmony and balance of facial contours, texture, and tertiary anatomy.[4,5]

CASE REPORT

Diagnosis and Treatment Planning

A 36-year-old male presented with an unaesthetic chrome superstructure on his anterior maxillary teeth (Figure 1). The patient was very conscientious about his smile and reluctant to smile due to poor aesthetics. At the age of 17, the patient was treated by a dentist in Mexico to correct the appearance of the palatally/lingually positioned upper left lateral incisor (tooth No. 10), which appeared to be missing. At that time, the dentist stripped the contacts of the patient's virgin teeth, destroyed healthy tooth structure, and fabricated a chrome superstructure to create an illusion of tooth No. 10 (Figure 2). The patient requested that the chrome be removed, and he was particularly interested in conservative procedures. As a result of his previous dental experiences, he had not seen a dentist in more than 10 years.

The teeth appeared fairly monochromatic. Examination of the lingual scaffolding revealed that the superstructure was a piggyback build on top of the original tooth No. 10. A comprehensive preoperative examination and assessment indicated the presence of microleakage and bacterial invasion throughout teeth Nos. 8 to 10.

The patient's conservative treatment would require the use of a sculptable, blendable, and bioactive material to restore teeth Nos. 8 to 10. Because microleakage and decay were visibly evident, yet the exact condition of the tooth structure beneath the chrome superstructure remained unknown, a material would be needed that would demonstrate the ideal chemistry, aesthetics, and flexibility. In particular, a material with Giomer chemistry (BEAUTIFIL II [Shofu Dental]) was selected based on its handling characteristics, optical properties, and fluoride-releasing chemistry. To determine the appropriate composite shades, the material was tried on the teeth to preview the colors (eg, shade A1 on No. 8 and A2 on No. 9) (Figure 3).

The chrome superstructure was removed, and the viable tooth structure was evaluated (Figure 4). Rampant decay, bacterial infiltration, and residual cement created biological, structural, and gingival challenges. Utilizing a diode laser (Odyssey Navigator [Ivoclar Vivadent]), the gingival margins were troughed and isolated for hemostasis, after which the tooth decay was removed and viable tooth structure assessed.

An updated treatment plan was developed that included a monochromatic buildup on teeth Nos. 7 to 9 to create the primary outline of the teeth in the aesthetic zone. Then, the illusion of tooth No. 10 would be created by placing a direct composite veneer on top of the palatally/lingually positioned tooth.

Figure 20. Full-face postoperative view of the patient's natural smile.

Clinical Protocol

The teeth were prepared for direct composite restorations using a No. 6 and No. 8 round carbide bur. Long bevels were created with a diamond bur (Artistic Composite Kit, Robot Diamond, fine, 835F-1 [Shofu Dental]) to roughen the enamel for improved microtensile bond strength with self-etching adhesives (Figure 5).[43] Selective etching was performed on the proximal aspect of tooth No. 7 and the distal aspect of tooth No. 9 (UltraEtch [Ultradent Products]), after which a 7th generation bonding agent (BeautiBond [Shofu Dental]) was placed and light cured (Silverlight [GC America]). Then, the mesial aspects of teeth Nos. 8 and 9 were also selectively etched (Figure 6), after which the same bonding agent was applied and light cured.

An initial, monochromatic buildup of teeth Nos. 7 to 9 was completed by applying shade A2 of a Giomer composite (BEAUTIFIL II). These teeth were built up anatomically, yet generically, to enable visualization of the primary architecture. While completing the build-out of tooth No. 8 (Figure 7), the midline was projected to be anatomically true prior to approximating the midline on tooth No. 9. By developing this primary architecture as the basis for form and color (Figure 8), the direct veneer for tooth No. 10 could then be blended. The incisal edges were rolling and blending, with excellent line angle development and symmetry.

Tooth No. 10 was minimally prepared for an additive direct veneer using a rotary abrasion diamond bur (Artistic Composite Kit, Robot Diamond, superfine, 793V-1 [Shofu Dental]) to remove the aprismatic enamel layer and ensure maximum bond strength (Figure 9).[43] A contour strip (Contour-Strip II [Ivoclar Vivadent]) was used as a clear matrix for circumferential cervical adaptation to isolate the tooth from crevicular fluids, as well as to contain the material and allow slight subgingival placement.

Tooth No. 10 was then acid-etched with a 37% phosphoric acid (FROST [CLINICIAN'S CHOICE]). The etched surface was verified to ensure that everything was isolated and sealed, and the margins maintained. A bonding agent (BeautiBond) was placed on tooth No. 10 and then cured. Flowable composite in shade A2 (BEAUTIFIL Flow Plus [Shofu Dental]) was precisely placed and flowed around the confines of the cervical margins without light curing (Figure 10). The shade A2 composite (BEAUTIFIL II) was then placed and pushed against the flowable to ensure it was fully sealed, and then light cured (Figure 11). Utilizing the 2 composite materials, a 2-layer buildup occurred, with co-curing performed into the flowable. Then the final layer of composite in shade A2 was placed to form the final, preconceived tooth shape in a totally additive way, after which multidirectional light curing was performed.

The primary anatomy was evaluated; the midline, line angles, and incisal embrasures were accurate, and the forms of teeth Nos. 7 and 10 were similar, despite slight differences between the gingival margins (Figure 12). Pencil lines were drawn to determine the proximal angles to create symmetry and light reflection, after which polishing discs (Super-Snap X-Treme [Shofu Dental]) were used to create the primary anatomy. Midline refinement using polishing discs (Super-Snap X-Treme) created slight concavities in the interproximal embrasures to prevent light reflection. Abrasives (Dura-Green Stones [Shofu Dental]) were used to establish unified surfaces without delaminating, as well as to defuse any high contour or light reflected areas (Figure 13). The diffused surfaces were then evaluated (Figure 14).

To create pre-luster surfaces and highlight line angle reflection, polishers (OneGloss [Shofu Dental]) were used (Figure 15). The midline was then polished (Figure 16). In a careful circumferential motion, the pre-luster disks (Super-Snap SuperBuff Disk [Shofu Dental]) were used to create the pre-gloss necessary for light reflection (Figure 17), with polishing paste (Direct DIA Polishing Paste [Shofu Dental]) used to create the final luster. Using ceramic principles of buildups and line angles, the reflective architecture using these direct materials was established.

CLOSING COMMENTS

Many complications can occur with previously restored teeth, including microleakage, caries, secondary caries, and loss of healthy tooth structure. Advancements in filler particles and nanohybrid chemistry have led to materials with increased sculptability, better handling and longevity, and ideal aesthetic properties.

In this case, freehand direct composite bonding techniques enabled a transformation of the patient's anterior anatomy. The restorations, although monochromatic, demonstrated incisal embrasures, line angles, and gingival architecture that blended harmoniously. The blending capabilities of the composite, its Giomer chemistry, and minimally invasive treatment demonstrated the capabilities of responsible aesthetics (Figure 18). The patient was pleased with his aesthetic results, and the dramatic transformation restored his confidence in dentistry (Figure 19). After disguising his smile for 20 years, the patient had a confident smile of which he was proud (Figure 20).✦

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Dr. Milnar is a graduate from the University of Minnesota School of Dentistry. He is an accredited member of the American Academy of Cosmetic Dentistry and a board examiner for accreditation. He maintains a full-time practice in St. Paul, Minn, emphasizing appearance-related dentistry. He has published numerous articles and lectured extensively within the US Armed Forces as well as internationally about direct composite restorations, shade selection, and porcelain materials. He is on the editorial review boards for multiple journals and is co-founder of the Minnesota Academy of Cosmetic Dentistry. He has been voted "Top Dentist" for the last several years in *Minneapolis/St. Paul Magazine*, and he is one of *Dentistry Today*'s Leaders in Continuing Education. He can be reached via email at frank@milnardds.com, or visit the website stpaulsmiles.com.

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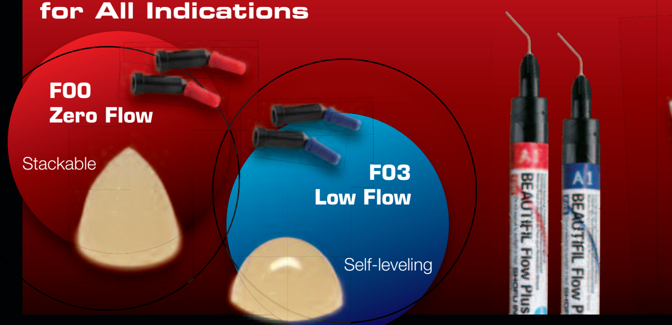

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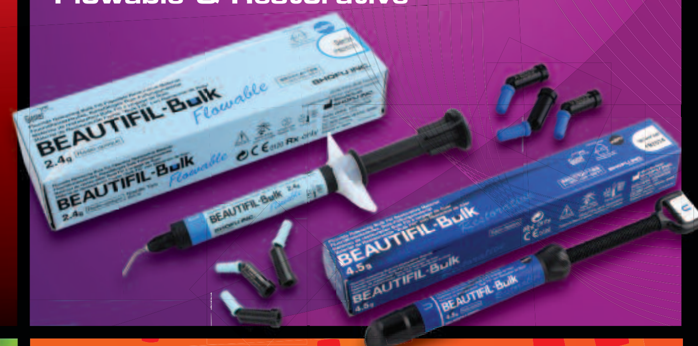

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