

Polychromicity in Anterior Class 4 Restorations:

The Ultimate Artistic Expression in Dentistry

The direct marketing to the public of indirect ceramic restorations through various makeover programs on television has altered patient expectations and demands. However, the overpreparation of anterior teeth and overuse of indirect restorations, particularly in the anterior dentition, has come under question by a segment of our profession. In certain clinical situations, it may be faster and easier to restore anterior teeth indirectly. The laboratory technician is then entrusted with the responsibility of accurately replicating not only the basic shade but also all the polychromatic nuances of the missing tooth structure. Most technicians do not observe the patient directly and therefore must use photographs, color maps, and other written instructions as a guideline for proper design of the restoration.

Patient demand for improved esthetics, coupled with desire for conservative treatment, have driven clinicians to improve their direct resin skills. Conservation of tooth structure is one of the most important clinical advantages that direct resin restorations have over indirect composite or porcelain restorations.² Direct resin restorations are inherently conservative in nature and do not follow the historic GV Black preparation designs. Direct resin restorations require the removal of only the current restoration, any carious tissue, and the placement of appropriate bevel or finish lines. Less invasive than indirect alternatives, direct resin treatment requires no reduction of healthy tooth structure. "Direct resin restorations are made to fit the requirements of the tooth, instead of the tooth made to fit the requirements of the restoration."³

Renewability is a unique advantage of direct resin restorations over

Abstract

A Class 4 lesion restoration and the replacement of defective composites in the anterior dentition can be achieved by direct or indirect methods. Direct resin restorations are often the treatment of choice for patients who are more conscious of the conservation of tooth structure and who are seeking alternative choices to full crowns and veneers. Single-shade restorations will not adequately match the current and adjacent dentition and, therefore, will not fulfill most patient expectations. The natural replication of polychromicity is the key to the restoration of natural esthetics and harmony.¹ It is the clinician's responsibility to become familiar and skilled in the use of multilayered and multichromatic resin restorations. An array of resin systems exists today, which allow the clinician to achieve long-term, natural, esthetic results, while maintaining the natural tooth structure. This article describes in detail the restoration of a single-fractured, maxillary central incisor, using an incremental build-up with varied esthetic restorative systems. Two other cases are briefly reviewed.

Learning Objectives

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

- Identify the factors involved in choosing direct anterior resin restorations vs porcelain restorations.
- Explain three methods of fabricating the lingual contours, incisal edge position, and occlusion of Class 4 resin restorations.
- Discuss the clinical protocol for the anatomical build-up of multichromatic anterior restorations.
- Explain the polishing sequence to achieve a high gloss for anterior direct resins.

indirect alternatives.⁴ Porcelain materials are difficult to repair predictably unless the entire restoration is removed. Small fractures of resin or incipient lesions can be renewed or restored conservatively and predictably. Should a tooth require endodontic treatment after placement of a resin restoration, the access opening and core build-up can be completed with resin also. The high-gloss finish that may be lost over time from resins, particularly hybrids, can be readily polished and resealed when necessary.

Of all the materials available today for the restoration of the anterior dentition, resin exhibits wear rates closest to that of the enamel⁵ and results in minimal abrasion of opposing dentition, particularly when compared with

the abrasion caused by feldspathic porcelain.

From a clinician's standpoint, another benefit of direct resin restorations is the artistic satisfaction derived from the creation of natural beauty. The successful combination of restorative and artistic skills results in a restoration that is highly esthetic and functionally sound. Unlike laboratory-fabricated restorations, the final outcome of direct composite restorations is entirely controlled by the clinician, who may choose from a palette of resin colors. Drawing on personal experience and technique, the nature of the individual artist is revealed in the ultimate artistic expression in dentistry.

Fortunately, there are a variety of excellent direct resin systems avail-



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able to allow clinicians to predictably restore simple and complex multichromatic restorations, while maintaining current natural tooth structure. Manufacturers have developed new generations of products, which can mimic the diverse anatomical, optical, and polychromatic properties of the natural dentition.

The physical properties of direct resin materials have also been enhanced to increase strength, durability, and long-term function. Among the direct resin materials available to enable clinicians to achieve predictable and esthetic results or are: Filtek Supreme (3M ESPE); Esthet-X (Dentsply Caulk); Four Seasons (Ivoclar Vivadent, Inc); Gradia Direct (GC America Inc). These products can be used in anterior and posterior restorations and provide various enhancements for handling characteristics, shade matching, optical properties, polishability, and overall esthetics according to manufacturer's data.

This article details a clinical restoration of a fractured maxillary central incisor, using a combination of esthetic restorative systems. In addition, two complex Class 4 restoration cases are briefly reviewed.

Case Presentation

A 10-year-old boy presented with a fractured maxillary he suffered as a result of a pool-diving injury the same day. The patient had fractured the same central incisor 4 years earlier. In addition, the mesial facial corner of the right central incisor had been chipped (Figure 1).

Complete and thorough clinical, radiographic, and photographic examinations were performed. The



Figure 1—Chipped mesial facial corner of the right central incisor.



Figure 2—A coarse finishing disc removed any residual debris and the aprismatic layer of the enamel.



Figure 3—A scalloped and irregular finish line was created with a fine diamond bur to blend the resin restorative margin with the current tooth structure.



Figures 4 and 5—The final preparations were etched with 37% phosphoric acid for 20 seconds and thoroughly rinsed.



pulp chamber was not directly involved, but a pinkish hue was visible on the lingual aspect of the fractured area. The tooth had no mobility and was not thermally sensitive. The parent was informed that although root canal therapy was not necessary at this time, it might be necessary at any time in the future as a result of trauma to the pulpal tissues. When treatment was complete, the patient would be monitored and reevaluated at 3-month intervals for the first year for any pulpal changes.

The patient's age, the amount of tooth structure missing, the adjacent dentition, the polychromicity of the area to be restored, and the intricate facial anatomy were all factors to be considered in treatment planning. Digital photographs in color and black-and-white were reviewed with the patient and parent. After discussing all treatment alternatives, a direct resin restoration was recommended as the treatment of choice to rejuvenate the fractured teeth.⁶ The patient and parent were informed that 2 weeks after the teeth were restored there would be a reevaluation, at which time any discrepancies in color or anatomy could be adjusted and corrected.

To prevent bacterial invasion of the pulpal tissues and decrease the opportunity for thermal sensitivity between the examination and operative appointments, a self-etching primer (OptiBond SE, Kerr Corporation) was placed according to the manufacturer's specifications and light-cured. Alginate impressions were taken for the fabrication of a diagnostic wax-up and putty stent. The patient was scheduled for the operative appointment.

Development of Esthetics

There are three methods for

restoring the lingual contours, incisal edge position, and occlusion of a fractured central incisor.⁷ The clinician can visually estimate the correct contours and thickness of the resin layers. A gloved finger can be employed as a lingual stop for the first increment of composite. This method is initially the fastest and easiest for clinicians who are not comfortable with the use of diagnostic wax-ups. However, it is difficult to correctly estimate the proper contours, which affect not only the occlusion but the esthetics as well.

The second method is the fabrication of a composite mock-up directly in the mouth. The occlusion can be adjusted and the basic shade and contour is determined. A putty matrix or quickset polyvinylsiloxane impression can be fabricated from the mock-up to create a stent for restorative guidance.

The third method is to create a diagnostic wax-up on mounted models from the alginate taken at the initial appointment. This allows the clinician additional time to carefully examine the case and design the exact contours and incisal edge position. A putty stent is fabricated from the wax-up.

The foundation for the replication of natural esthetics is accurate color mapping of the current dentition. This provides a road map and guidance for the accurate restoration of harmonious form. At the beginning of the operative appointment, the teeth were cleaned with pumice and thoroughly rinsed. While the teeth were wet, the value, hue, chroma, opalescence, translucency, incisal halo, and maverick colors were noted and mapped. A custom shade guide, fabricated with individual shades of different manufacturers' composites, was used to select the value first. Hue, chroma, and other characteristics

were subsequently chosen and noted. The teeth were then dried, and the intricate facial anatomy examined and noted. Digital photographs of the wet and dry stages were taken and placed on a large monitor as reference points during treatment.

Preparation Design

The patient was anesthetized and rubber dam isolation was established with floss ligatures. Proper preparation of a Class 4 restoration requires three distinct marginal finish lines. A coarse finishing disc (Sof-Lex, 3M ESPE) removed any residual debris and the aprismatic layer of the enamel⁸ (Figure 2). The entire facial surface of the maxillary right central incisor was polished <QA: Edit okay?>, as well as approximately 50% of the left central. Removal of the aprismatic layer allows for complete etching of the enamel surface and the creation of an infinite bevel, which will disguise the adhesive margin and finish line in the final restoration.

A scalloped and irregular finish line was created with a fine diamond bur (F888-012, Axis Dental Corporation) to blend the resin restorative margin with the current tooth structure (Figure 3). The irregular preparation allows for reflection and deflection of light, which imparts a chameleon effect to the restorative margin.

A 45° bevel was placed along the primary fracture line. This allowed for sufficient bulk of resin for strength, as well as a means to prevent show-through of the fracture line when the restoration was complete. The dentin lingual area of the fractured tooth <QA: Correct?>, previously sealed with a self-etching adhesive, was lightly dusted with a fine round diamond bur on high dry to allow for maxi-

mum visibility. The lingual enamel margins were then conservatively prepped with the same diamond with water spray.

Plumber's tape was placed on the adjacent teeth to protect the exposed enamel from etchant. The final preparations were etched with 37% phosphoric acid (UltraEtch, Ultradent Products, Inc) for 20 seconds (Figure 4) and rinsed thoroughly (Figure 5). Excess water was removed with a high-speed evacuation until the dentin was damp/moist. A single-component binding agent (OptiBond Solo, Kerr Corporation) was applied with a Microbrush (Microbrush, Inc) in multiple coats with a light scrubbing motion (Figure 6). The area was thoroughly air dried until all excess adhesive and solvent were removed. The adhesive was light-cured for 40 seconds.

Polychromatic Build-up

Anterior direct resin restorations can be fabricated using an anatomical or shaded technique.⁹ The putty matrix was seated over the rubber dam to examine for accuracy in preparation for the anatomical build-up.¹⁰ A small increment of milky white resin (Filtek Supreme white enamel; Esthet-X WE; Gradia Direct WT; Four Seasons enamel bleach light) was placed in the lingual area of the putty matrix approximately 1 mm short of the incisal edge and light-cured for 10 seconds (Figure 7). This layer replicated the fractured and missing lingual enamel.¹¹ The putty stent was removed as the lingual contour had been established (Figure 8). The incisal halo effect was created with a thin bead of opaque white resin (Filtek Supreme extra white body; Esthet-X W-O; Gradia Direct BW; Four Seasons enamel white effect). A thin blade



Figure 6—A single-component binding agent was applied with a microbrush in multiple coats with a light scrubbing motion.



Figure 7—A small increment of milky white resin was placed in the lingual area of the putty matrix approximately 1 mm short of the incisal edge.



Figure 8—The putty stent was removed, as the lingual contour was established.



Figure 9—DE Connector was placed to enhance optical properties before the placement of the final enamel layer.

composite instrument was used to place the effect along the incisal edge and mesial incisal margin. After verifying the incisal edge position with the putty matrix, the increment was light-cured for 10 seconds.

<QA: Please clarify this first sentence. Is a word missing and should last word be shell?> The dentin noted aligned on the color map (Filtek Supreme A2D; Esthet-X A2; Gradia Direct A2; Four Seasons A2 dentin) was placed over the lingual enameled shall<QA: shell?>. Irregularities in the dental lobes were created and sculpted to create internal dentin mammelons. Care was taken not to over-contour the material to provide clearance for the remaining facial layer. The resin was light-cured for 10 seconds.

Clear incisal resin (Filtek Supreme translucent grey; Esthet-X GE; Gradia Direct CT; Four Seasons enamel translucent clear) was placed between the mammelons and the opaque incisal edge to create the illusion of incisal translucency. If necessary, additional translucency can be created in specific areas using the appropriate tints and special effects resins. The translucent resin layer was light-cured for 10 seconds. DE Connector (Ultra-dent Products, Inc) was placed to enhance optical properties before the placement of the final enamel layer (Figure 9). This material mimics the natural protein layer that exists between the dentin and enamel and is responsible for light scattering in the natural dentition.¹²

The remaining facial enamel was replicated, using a thin layer of high-value enamel (Filtek Supreme white body; Esthet-X W; Gradia direct WT; Four Seasons enamel value high). Artists' brushes were used to smooth the facial surfaces



Figure 10—Artist's brushes were used to smooth the facial surfaces to the desired final contours.



Figure 11—Initial finishing was achieved using a medium disc to blend the composite margins seamlessly with the natural enamel surfaces.



Figure 12—Developmental contours and primary facial anatomy was created using a superfine diamond bur at the low range of a high-speed electric handpiece.



Figure 13—The polished facial surface was produced with the Jiffy Brush on slow speed, using a light intermittent touch.



Figure 14—The final luster was achieved with a fine diamond polishing paste on a Flexibuff polishing disc.



Figure 15—Final digital photographs were taken to verify natural esthetics.



Figure 16—Photograph converted to black-and-white to verify value.



Figure 17—Fractured maxillary left central incisor of a 12-year-old boy.



Figure 18—An athletic mouthguard was fabricated to provide protection for the patient's new restoration and the entire maxillary dentition.



Figure 19—Previous composite restorations that were mobile on the maxillary central incisors of a 58-year-old woman.



Figure 20—Occlusal harmony and natural esthetics created by closely adhering to the protocol for restoration of multilayered, polychromatic, Class 4 resin restoration.

to the desired final contours (Figure 10). The resin was feathered out over the scalloped preparation margins and light-cured for 10 seconds. When the maxillary right central incisor was restored, the left central was similarly restored with the lingual, halo, and facial increments only because of its smaller size.

Finishing and Polishing

Restorations built to correct anatomical contour require minimal finishing and polishing. Initial finishing is achieved using a medium Sof-Lex disc to blend the composite margins seamlessly with the natural enamel surfaces (Figure 11). Removing any excess resin from the interproximal areas was achieved using a 12 B scalpel and fine diamond finishing strips.

Developmental contours and primary facial anatomy was created using a superfine diamond bur (SF859-014, Axis Dental Corporation) at the low range of a high-speed electric handpiece (Figure 12). The short light strokes were

done initially with water spray and then on high dry for maximum visibility. Secondary anatomy can similarly be placed using a medium diamond to impart horizontal scratches and contours. Care was taken to replicate the facial surface of the adjacent teeth and the original anatomy present. Optimum visualization of the reflective and deflecting zones can be ideally achieved by placing grey artists' glitter over the facial surfaces. The glitter accentuates the minute changes in light refraction and allows for minute corrections in contour.

The polished facial surface was produced with the Jiffy Brush (Ultradent Products) on slow speed with a light intermittent touch (Figure 13). Excessive pressure on the brush can remove facial anatomy and degrade the resin surface by overheating. The final luster was achieved with a fine diamond polishing paste (Cosmedent, Inc) polishing disc (Figure 14). The excess paste was

thoroughly rinsed, and the restoration was examined for overall esthetics.

The rubber dam was removed and the occlusion adjusted. The lingual surface was finished and polished, using Enhance polishing cups (Dentsply Caulk) and a Jiffy Brush. The restoration was then fully light-cured for 40 seconds each from the facial to the lingual surfaces.

The patient was reexamined 2 weeks later to check for functional and esthetic harmony and any minor occlusal or color adjustments were made at that time. Final digital photographs were taken to verify natural esthetics (Figure 15). One photograph was converted to black-and-white to verify value (Figure 16).

Case Presentation No. 2

A 12-year-old boy fractured his maxillary left central incisor during a sporting event (Figure 17). The patient's mother was definitively against any type of porcelain restorations because of previous fami-

ly experiences. A direct Class 4 resin restoration was recommended as the most conservative treatment modality. The treatment protocol of a putty stent, proper preparation, anatomical build-up, and finishing were followed to restore the incisor to proper form and function. An athletic mouthguard was fabricated to provide protection for the patient's new restoration and the entire maxillary dentition (Figure 18).

Case Presentation No. 3

A 58-year-old woman presented with previous composite restorations that were mobile on both maxillary central incisors (Figure 19). In addition, the patient had profuse interproximal bleeding. Clinical and radiographic examinations revealed extensive marginal decay around the current restorations. The advantages and disadvantages of all treatment alternatives were thoroughly discussed. The patient's primary concern was to achieve the most conservative treatment possible and to avoid full-coverage restorations if possible. Because of the depth of interproximal decay, the removal of interproximal granulation tissue and a minor gingivectomy were completed with a diode laser before the restorative procedure. Care was taken to maintain biologic width, and isolation was achieved using subgingival retraction cord and a modified rubber dam. Occlusal harmony and natural esthetics were

created by closely adhering to the protocol for restoration of multilayered, polychromatic, Class 4 resin restoration (Figure 20).

Conclusion

The restoration of the anterior dentition requires knowledge of both indirect and direct restorative materials. In the case of a single, highly polychromatic anterior

tooth, color matching and overall esthetics may be superior using a direct resin restorative method. The development of new anterior composites allows restorations to be more accurate and predictable. Natural tooth structure can be rejuvenated in a matter that is conservative and highly esthetic. ■

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Product References

Products: Filtek Supreme, Sof-Lex
Manufacturer: 3M ESPE
Address: Bldg. 275-2SE-03
 St. Paul, MN 55144
Phone: 800.634.2249
Fax: 800.782.0956

Products: Esthet-X, Enhance polishing cups
Manufacturer: Dentsply Caulk
Address: 38 West Clarke Ave.
 Milford, DE 19963
Phone: 800.532.2855
Fax: 800.788.4110

Product: Four Seasons
Manufacturer: Ivoclar Vivadent, Inc
 175 Pineview Dr.
 Amherst, NY 14228
Phone: 800.533.6825
Fax: 716.691.2285

Product: Gradia Direct
Manufacturer: GC America Inc
Address: 3737 West 127th St.
 Alsip, IL 60803
Phone: 800.323.7063
Fax: 800.423.2963

Products: UltraEtch, Jiffy Brush, DE Connector
Manufacturer: Ultradent Products, Inc
Address: 505 West 10200 South
 South Jordan, UT 84095
Phone: 800.522.5212
Fax: 800.842.9024

Products: OptiBond SE, OptiBond Solo
Manufacturer: Kerr Corporation
Address: 1717 West Collins Ave.
 Orange, CA 92867
Phone: 800.KERR.123
Fax: 800.KERR.345

Product: F888-012, SF859-014
Manufacturer: Axis Dental Corporation
 2928 W. Story Rd.
 Irving, TX 75038
Phone: 800.355.5063
Fax: 972.257.3647

Product: Microbrush
Manufacturer: Microbrush, Inc
Address: 1376 Cheyenne Ave.
 Grafton, WI 53204
Phone: 414.375.4011
Fax: 414.375.2777

Product: Flexibuff
Manufacturer: Cosmedent, Inc
Address: 401 North Michigan Ave.
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1. Direct resin restorations have distinct clinical advantages over indirect composite or porcelain restorations, the foremost being:
 - a. Technical skill required.
 - b. Conservation of tooth structure.
 - c. Lack of allergic reactions.
 - d. Final hardness.
2. Direct resin requires:
 - a. The removal of only existing restorations.
 - b. The removal of any carious tissue.
 - c. The placement of appropriate bevel or finish lines.
 - d. All of the above
3. Porcelain materials are difficult to repair predictably unless:
 - a. The entire restoration is removed.
 - b. They can be etched.
 - c. They can be silanated.
 - d. They can be wetted.
4. The methods for restoring the lingual contours, incisal edge position, and occlusion of a fractured central incisor include:
 - a. Visually estimating the correct contours and thickness of the resin layers.
 - b. Fabrication a composite mock-up directly in the mouth.
 - c. Creating a diagnostic wax-up on mounted models.
 - d. All of the above
5. The foundation for the replication of natural esthetics is:
 - a. Accurate color mapping.
 - b. Using fluorescent lighting.
 - c. Using incandescent lighting.
 - d. Only taking shades using digital subtraction methods.
6. A custom shade guide, fabricated with individual shades of different manufacturers' composites, was used to select the:
 - a. Value first.
 - b. Hue first.
 - c. Chroma first.
 - d. Chroma last.
7. Proper preparation of a Class 4 restoration required how many distinct marginal finish lines?
 - a. One
 - b. Two
 - c. Three
 - d. Four
8. The irregular preparation allows for:
 - a. Reflection of light only.
 - b. Deflection of light only.
 - c. Reflection and deflection of light.
 - d. Neither reflection nor deflection of light.
9. What was placed on the adjacent teeth to protect the exposed enamel from etchant?
 - a. Plumber's tape
 - b. Glycerin
 - c. Wax
 - d. Quick setting acrylic
10. Optimum visualization of the reflective and deflective zones can be ideally achieved by placing what over the facial surfaces?
 - a. Saline
 - b. Saliva
 - c. Clear nail polish
 - d. Grey artists' glitter

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