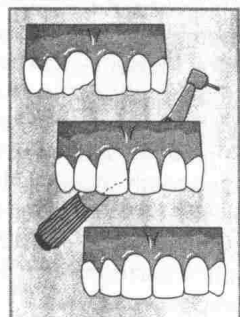


## RESTORATIVE DENTISTRY



# Optimizing the Esthetics Of Class IV Restorations With Composite Resins

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### ABSTRACT

Direct bonding is the most commonly-used treatment for the conservative esthetic restoration of anterior teeth. Class IV defects deserve special attention because of their high incidence in anterior teeth. One of the major challenges for the practitioner treating defects in this category is disguising the fracture line, through the correct use of masking and restorative resins, to make the restoration imperceptible to the eye. This paper discusses the morphologic, histologic, and optical characteristics, as well as the polychromy of sound natural teeth, and the way they correlate with composite restoratives.

### SOMMAIRE

La liaison directe constitue le traitement le plus fréquent pour la restauration conservatrice et esthétique des dents antérieures. Les défauts de classe IV exigent une attention spéciale à cause de leur grande incidence sur les dents antérieures. Pour le praticien qui veut corriger ces défauts, l'un des principaux défis est de dissimuler la ligne de fracture en utilisant correctement des résines masquantes et restauratrices afin de rendre la restauration imperceptible à l'oeil. Dans cet article, on explique les caractéristiques morphologiques, histologiques et optiques et la polychromie des

*dents naturelles saines, ainsi que la façon de les mettre en corrélation avec des matériaux de restauration composites.*

### Introduction

The esthetics of anterior restorations have long been an area of concern for esthetically conscious and demanding patients, as well as for meticulous dentists. Ultimately, the goal of the restorative dentist is to create direct or indirect restorations that mimic all the artistry and beauty of nature, but still impart strength and function.

Unfortunately, the prevalence of fractured anterior teeth is increasing, and the restoration of this type of defect now accounts for a significant percentage of the treatment provided in many dental practices.<sup>1</sup> Considerable progress has been made in the esthetic repair of fractured anterior teeth during the past 20 years.<sup>2,3</sup> Various materials and invasive techniques that elicited unsightly results have been advocated in the past.<sup>4</sup> However, recent advances in adhesive technology and composite resin materials have enabled us to create restorations that not only preserve and reinforce tooth structure, but also present truly superb esthetic results. With the aid of spatulas and brushes, the artist-dentist can now incrementally sculpt a restoration to its final shape and color. Through the use of an incre-

mental technique, the esthetic result of a restoration can be scrutinized from shade selection to final polishing, and the free-hand bond can maintain absolute control of each restorative step.

Several reports proposing a thorough and methodical protocol for the incremental application of composite resins in the restoration of anterior teeth have been published, and are of special interest for the restorative dentist.<sup>5,6</sup> This article describes a method of clinically implementing the protocol outlined in these reports, with particular emphasis on the major problems that can occur with Class IV restorations, namely, selecting the shade and correlating it with the restorative resins, disguising the fracture line at the tooth-composite interface, and blending the various composites with the tooth structure to achieve a life-like restoration.

### Initial Case Evaluation

After an accurate patient history has been obtained, initial radiographic and clinical examination of the fracture site is imperative to determine the extent of trauma and pulpal injury. In addition, if probable acute pathologies are observed, all necessary action must be taken to resolve them. Next, for restorative purposes, a thorough visual assessment should be carried out to determine: a) the occlusion; b) the morphologic,

histologic, and optical characteristics of sound adjacent teeth; and, c) the polychromy of sound adjacent teeth.

### Occlusion

If the fracture is large, it is imperative to evaluate whether the composite restoration will be under great occlusal stress. Depending on the situation, a stronger restorative material, such as a metal-ceramic or an all-ceramic option, should be preferred.

### Morphologic, Histologic and Optical Characteristics

A sound contra-lateral tooth should be used as a reference guide to ensure that a natural-looking restoration is attained. All information on the morphologic, histologic, and optical characteristics of the planned restoration must be collected and recorded in a chart. The primary, secondary, and tertiary anatomy can also be deduced from a natural tooth. Similarly, the basic shape of the restoration, which is the geometrical form of a tooth, is projected according to the principle of symmetry. For central incisors, absolute symmetry is the key to morphologic success. One central incisor must be a mirror image of the other. Slight asymmetric discrepancies between lateral incisors may be regarded as esthetically pleasing, however. The form of the lobes, depth and length of the developmental grooves, and surface texture should be assessed, preferably, with the aid of magnifying loupes, and charted accordingly in a schematic drawing.

A precise determination of the amount of lost enamel and dentin will help the operator to select the appropriate restorative composite resins to substitute the missing tooth structure, according to the varying degrees of translucency and opacity, strength, and polishability required. Just as a ceramist uses different porcelains with different optical characteristics to obtain the desired effect, the dentist must understand the histologic and optical properties of a natural tooth, and the way they correlate with various restorative composites, to be able to incrementally build up the missing tooth structure for an esthetically pleasing result.

### Polychromy Of Sound Adjacent Teeth

A variation in hue, chroma and value renders the tooth polychromatic. When the facial aspect of the anterior dentition is thoroughly examined, the value of Munsell's tridimensional color system can be readily perceived. Even though monochromatic teeth are found, polychromatic nuances are generally thought to be more attractive to the esthetic eye. A fourth color dimension, described by Muia as maverick colors, can also be encountered.<sup>7</sup>

Age factors, which will reveal variations in chroma (higher), value (lower) and, most probably, hue, should be taken into account when the polychromatic characteristics of a tooth are evaluated.<sup>8</sup>

Subtleties in color variation — although generally not perceived from a conversation distance — are perhaps one of nature's greatest wonders. Achieving them with fidelity in the finished anterior restoration is a challenging goal.

### Pre-Operative Considerations

#### Establishing Tooth Contour

The optimal length of the central incisors must be determined first. Typically, the correct ratio suggests a width of approximately 75 per cent to 80 per cent of the length of the clinical crown. A composite mock-up may be used for further subjective esthetic assessment, and a calliper should always be used to record the measured length and width. In reconstructing the tooth to its right proportions, dentists may find it helpful to use a polyvynilsiloxane matrix made from an impression of the mock-up.<sup>9</sup> This aids in building each composite increment to its exact contour, without trespassing the boundaries of the desired tooth form.

#### Shade Selection

Invariably, shade selection must be performed before rubber dam isolation, since tooth dehydration results in an elevated value, and may lead the dentist to select an incorrect shade. Prior to shade selection, the teeth must be cleaned with a prophylaxis cup, a slurry of pumice, and 4.0 per cent

chlorhexidine. If the tooth to be restored is severely discolored, or considerable structure has been lost, a sound central or lateral incisor may be used as a reference for shade selection. A "blinder" — a gadget consisting of a small piece of neutral grey cardboard with a cut-out in its centre of approximately the size of a maxillary central incisor — can be used as a practical adjunct in shade selection.<sup>10</sup> The device is held against the patient's mouth, with the selected tooth showing through the cut-out portion. This eliminates any color interference from the tooth's surrounding. Since most composite resins are now coded according to the Vita shade guide, the following steps should be followed for proper shade selection.

#### Value Selection

The Vita shade guide must be rearranged according to the observed value (from B1 to C4), and divided into three by imaginary lines. With the aid of a color-corrected shade selection light (Esthelite, Efos, Williamsville, N.Y.), the dentist then selects the third of the guide that is closest in value to the reference tooth.

#### Hue Selection

The basic hue of the tooth, which can be best seen in the middle and cervical thirds, is selected according to the Vita shade guide: A (brown), B (yellow), C (grey), and D (red).

#### Compartmentalization Of the Tooth

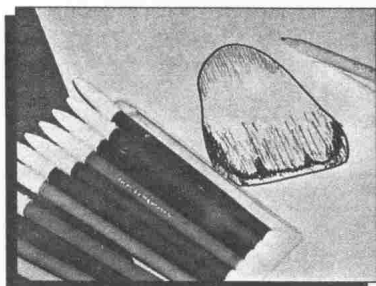
To compartmentalize the surface area, horizontal and vertical imaginary lines are pictured along the thirds of the clinical crown. This facilitates a much more detailed visualization of the intricate polychromatic characteristics of each area of the crown.

#### Chroma Selection

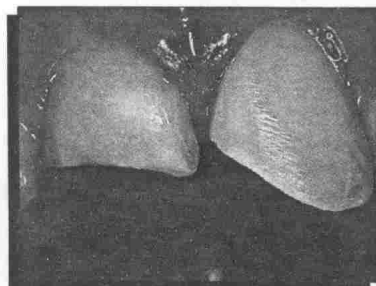
Subtle or striking chroma variations can be perceived for each individual compartment. Usually, the cervical third presents a higher chroma (more saturated hue) than the middle third.

#### Selection of Maverick Colors

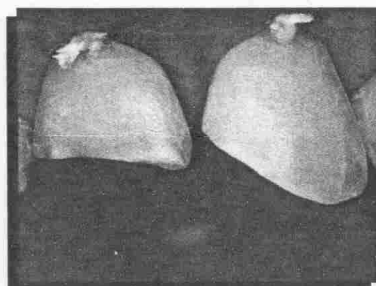
Maverick colors, as well as hypoplastic spots and mottled enamel, which normally contribute to a pleasing hue variation, must also be observed.



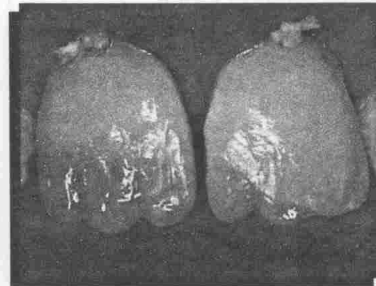
**Fig. 1:** A schematic drawing, depicting the tooth's four-dimensional color pattern, should be used as a reference during the reconstructive stage, especially in cases of severely impaired teeth.



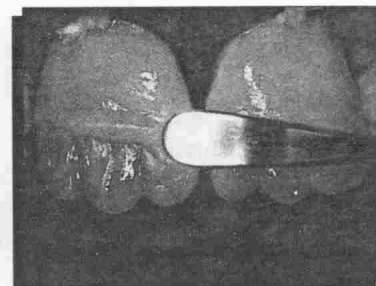
**Fig. 2:** A long facial bevel, extending from the DEJ (dentin-enamel junction) to the outer surface of the tooth, and a shorter lingual bevel are placed with a medium grit diamond or flame-shaped 12-fluted bur. Generally, the larger the fracture the longer the bevel required.



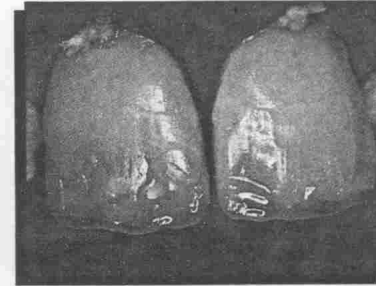
**Fig. 3:** Isolation can be accomplished with rubber dam or by using cheek and lip retractors in conjunction with retraction cords, cotton rolls and gauze.



**Fig. 4:** A "frame" of material is built up to establish a point of reference for the subsequent layers of composites, which will be applied labially, proximally, and palatally. The artificial dentin must be slightly feathered onto the beveled facial and lingual enamel, to allow the blending-in of the composite resin to begin. The desired shape of the dentin mamelons should also be achieved at this stage.



**Fig. 5:** A thin layer of opaque micro-filled resin or resin opaquer is applied to cover the junction between the artificial dentin and the labial enamel, masking the fracture line.



**Fig. 6:** To achieve the required translucency and strength at the incisal third, a translucent hybrid incisal composite is used. The incisal composite is placed along the incisal ridge between the mamelons and around the inciso-proximal edges, slightly covering the mamelon lobes labiopalatally, and is sculpted accordingly.

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8. Since free-hand bonding relies on the dentist's ability to sculpt composites into a precise anatomic form, it is essential to determine the exact size and shape of each increment prior to its placement. This can be achieved by squirting some of the composite onto a clean glass slab. The resulting amorphous mass of composite can then be manipulated and carved with a thin, semi-flexible, sharp-edged instrument to the desired shape and

thickness. This author recommends a carver #2 instrument (Thompson Dental Manufacturing Co., Missoula, Mont.), which can also be successfully used for sculpting gingival embrasures and other areas. Another excellent instrument is the golden composite instrument (Almore, Portland, Ore.). This instrument is recommended for most of the initial increment placement and sculpting. One end is spoon-shaped and quite slender, the other is a thin, flexible spatula that provides a great tactile sense.

9. After each layer of composite has been tacked down and sculpted, a series of nylon or sable artist's brushes should be used to contour the build-up to a smooth and precise morphology. Several brands of brushes are available, however, this author recommends the following: for fine-tipped brushes, #00 (Takanishi, Ren-

fert, Hilzingen, Germany), or #0, #1, #2 (Loew-Cornell, Teaneck, N.J.); and for flat-tipped brushes, #4 (Loew-Cornell, Teaneck, N.J.).

10. Either a sharp-ended calliper, set at the predetermined final crown length, or the polyvinyl-siloxane mould should be used at this stage to verify the amount of space left for the incisal third build-up.
11. A thin layer of opaque micro-filled resin (Silux Plus Opaque (3M, St. Paul, Minn.)) or resin opaquer (Creative Color (Cosmedent, Chicago, Ill.)) is applied to cover the junction between the artificial dentin and the labial enamel, masking the fracture line<sup>13</sup> (Fig. 5). These opaque materials should be the same shade as the microfilled artificial enamel. The Creative Color opaquer may be selected according to the Vita shade guide, but a shade selection table is necessary to



**Fig. 7:** The artificial enamel is usually applied in one increment and tacked to the facial aspect. To obtain proper facial contour and proximal contact, the golden instrument can be used to smear the microfill, veneering the underlying "frame" of artificial dentin cervico-incisally and mesio-distally.



**Fig. 8:** After the artificial enamel is sculpted to its proper anatomical form, brushes are used to begin finessing the primary anatomy of the labial aspect.

select the appropriate Silux Plus O restorative microfill (Table I). For a successful esthetic result to be achieved, there can be absolutely no shine through by the fracture line at this point.

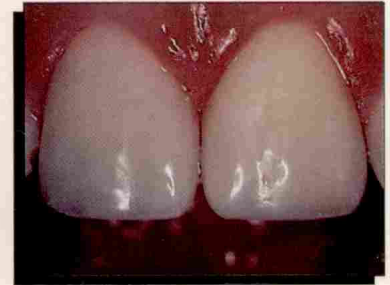
12. To achieve the necessary translucency and strength at the incisal third, a translucent hybrid incisal composite, such as Herculite XRV medium or light incisal (Kerr, Glendora, Cal.), is used. The incisal composite is placed along the incisal ridge between the mamelons and around the incisal proximal edges, slightly covering the mamelon lobes labiopalatally, and is sculpted accordingly (Fig. 6).
13. To emphasize the polychromy and brilliancy of the incisal third, tints and opaques, such as Creative Color (Cosmedent, Chicago, Ill) or Kolor+Plus (Kerr, Glendora, Cal.), can be sparingly applied.
14. The artificial enamel is usually applied in one increment and tacked to the facial aspect. To obtain proper facial contour



**Fig. 9:** Guide lines can be drawn along the ideal position of the proximo-labial line angles to help the dentist attain symmetrical light-reflecting areas.

and proximal contact, the golden instrument can be used to smear the microfill, veneering the underlying "frame" of artificial dentin cervico-incisally and mesio-distally (Fig. 7). After the artificial enamel is sculpted to its proper anatomical form, brushes are used to begin finessing the primary anatomy of the labial aspect (Fig. 8). To avoid bonding two adjacent restorations together, the first restoration must be thoroughly finished and polished proximally using strips (e.g., Epitex (GC America, Chicago, Ill.) and superfine aluminum oxide disks (e.g., Sof-Lex Pop-on XT (3M, St. Paul, Minn.) or Flexi-Disks (Cosmedent, Chicago, Ill.)) before the other restoration can be polymerized against it. The lingual marginal ridge and proximal contact can be achieved using the mylar strip "pull-through" technique. Further refinement and adaptation of the microfilled resin can be done with fine-tipped brushes. Finally, the labial and lingual aspects of the restoration should be light-cured for 60 seconds.

15. At this stage, the restoration must be checked for morphological refinement, width/length ratio, embrasure forms, and line angles. If every thing is in order, it is ready to be finished and polished.
16. Contouring of the restoration should be initiated using coarse aluminum oxide disks (e.g. Sof-Lex XT (3M, St. Paul, Minn.) or Flexi Disk (Cosmedent, Chicago, Ill.)), until the desired primary anatomy is established. To create the desired



**Fig. 10:** The final restoration.

secondary anatomy, i.e. developmental grooves, lobes, cingulum, and marginal ridges, a combination of medium-grit diamonds and 12-fluted carbide finishing burs should be used. Surface texturization can be accomplished using medium-grit bullet-nosed diamonds.<sup>14</sup> Guide lines can be drawn along the ideal position of the proximo-labial line angles to help the dentist attain symmetrical light-reflecting areas (Fig. 9). Both diamond (Compo-Strips (Premier, Norristown, Pa.)) and plastic strips (Epitex (GC America, Chicago, Ill)) are used for interproximal finishing and polishing.

17. The entire restoration should be buffed with polishing cups and points (e.g., PoliTip finishers and polishers (Vivadent USA, Tonawanda, N.Y.); or Flexi-Cup and Flexi-Point (Cosmedent, Chicago, Ill.)) to eliminate some of the undesired accentuated texturization. Composite polishing pastes (e.g., Foto-Gloss (Kota, São Paulo, Brazil); Enamelize (Cosmedent, Chicago, Ill.); Prisma Gloss (Caulk, Milford, Del.)) with buffing discs (Flexibuff (Cosmedent, Chicago, Ill.)) or felt wheels are used to impart a high shine to the restoration surface, while still retaining the desired surface texture. The convex areas of the restoration (i.e., labial lobes, line angles, marginal ridges, and incisal edges) should be "highlighted" with superfine aluminum oxide discs (e.g. Sof-Lex XT (3M, St. Paul, Minn.); or Flexi-Disk (Cosmedent, Chicago, Ill.)). After final polishing, the restoration should

## Conclusion

The extensive esthetic reconstruction of severely impaired teeth with composite resins is a feasible undertaking, and is not as elusive as it may seem. However, the ultimate esthetic result will rarely be achieved without adequate training and the use of a proper armamentarium. Esthetic dentistry demands keen observation, patience, and the meticulous application of technique protocols learned through motivation and intensive training. Creativity is also part of our lives as dentists, and making use of it as we provide direct-bonding restorations will make our profession even more enjoyable. ■

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