Selecting Nanotechnology-Based Composites Using Colorimetric and Visual Analysis for the Restoration of Anterior Dentition: A Case Report

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ABSTRACT

Currently it is possible to use direct composites and layering techniques to replicate the complex internal structures, visible shape, color, and surface anatomy of natural teeth. To do so, however, requires dentists to understand the principles of nature and the science of dental materials to determine the most suitable restorative material for a specific indication. By incorporating relatively new technologies—colorimetric analysis, which provides computerized shade guide definitions of a tooth and essential information to verify shade mapping, and a new nanotechnology-based direct composite—into composite layering techniques, dentists can more predictably replicate the esthetics of natural teeth. This article presents a case in which both technologies, used in combination with a composite layering technique, contributed to the esthetic and functional restoration of the maxillary central incisors.

CLINICAL SIGNIFICANCE

By applying the knowledge of color and tooth anatomy to the direct restoration of anterior teeth, direct composite materials continue to be efficacious in esthetically replicating natural dentition. To this end, a nanotechnology-based direct restorative material demonstrates promise for providing dentists with an ample range of composite shades from which to choose, and the use of a colorimeter may provide an objective assessment tool in the determination of appropriate restorative shades.

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Esthetic considerations are growing in importance for restoring anterior and posterior dentition, and more and more products and techniques are available to help dentists perfect the art of creating esthetic direct composite restorations. A fortunate result of these developments is that innovative technologies are changing the manner in which we practice and deliver quality dental care, in addition to enhancing our ability to replicate nature.

A broader understanding and recognition of the manner in which anatomy and optical properties affect the color of natural teeth have partially contributed to advancements in dental material science and restorative techniques. In particular, this understanding has contributed to the production of direct composite restorative materials that enable dentists to deliver a polychromatic direct composite restoration.[1,2]

Manufacturers have also advanced the physical properties of these materials to the extent that recently introduced composites demonstrate the improved durability and strength required for long-term function, not just esthetic characteristics.[3] The mechanical strength of

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early hybrid composite restoratives (ie, those composed of small and large filler particles) had been inadequate for use in stress-bearing areas, and their appearance precluded their use when esthetics were of primary concern.[4] Indirect porcelain veneers and crowns have demonstrated the best longevity and higher patient satisfaction when restoring anterior teeth. However, porcelain techniques involve multiple visits and substantial cost.[5,6]

Although composite materials have not fully matched the physical characteristics of indirect all-ceramic or porcelain-fused-to-metal restorations, they can be predictably built up to provide realistic esthetics with intermediate durability and immediate patient satisfaction.[7] With improvements in the physical and optical properties of composites has come the recent introduction of a variety of universal microhybrid restoratives that are designed to address the increasing demands for greater durability and esthetics combined.[8] As a result, the advantages of placing direct veneers, as opposed to indirect restorations, are increasing and include immediate single-visit treatments, reduced cost to patients, and conservative preparations. When properly placed, direct composite restorations, including veneers, can be a viable treatment modality.[2,9]

Whether directly placed or laboratory processed, it is generally accepted that polychromatic restorations are more attractive and best mimic natural dentition. Achieving such effects with direct composites depends on the clinician's ability to impart the variations of hue, chroma, and value that contribute to a polychromatic effect. *Hue* refers to the color name or basic color of an object, such as blue, green, and yellow, and refers to the wavelength of light reflected from an object.[2] *Chroma*—which compares colors of equal hue—refers to the intensity, the vividness or dullness of a color.[1] *Value,* on the other hand, describes the brightness of color and distinguishes light colors from dark colors.[10] To create natural-looking polychromatic effects, the color variations found in the enamel and dentin must be replicated in the restoration.

Such artistic acuity inherently requires the use of the correctly colored composite applied in the appropriate places and proportions and done in a manner that imitates the effects of light observed in natural teeth.[2] Therefore, consideration must be given to the densities of restorative materials since these determine the manner in which wavelengths of light are perceived as tooth color.[1]

Given the seemingly endless variety of direct restoratives available today, it behooves dentists to develop a greater understanding of color and the different optical properties of the components of natural teeth. For example, the manner in which light interacts with dentin, enamel, and the underlying pulp influences the color of a tooth and, hence, that tooth's restoration.[11] This knowledge must be supplemented by a further understanding of the manner in which available direct restorative composites imitate those naturally occurring properties to make the most appropriate material selection.[2,12]

Additionally, dentists must also accurately match the shade of the selected restorative material to the affected tooth and the surrounding teeth. Historically, this has been accomplished through visual assessment to determine the shade(s) for a restoration. Unfortunately, a range of factors, including uncontrolled lighting conditions, age, and eye fatigue, influences human vision.[13] Further, the compositional and emotional effects of color cannot be rationally measured.[14] As a result, present shade-matching techniques can be inconsistent and unpredictable.

Given all of these considerations, the sequence in which to layer the composite must be determined during the preoperative treatment planning stage to ensure predictability of the final esthetic result,[15] including determination of the proper volume and thickness of the material. Once the vitality of the dentition is ensured and maintained, the dimensions of color can then be built up within the restoration using a layering technique.[16,17]

NEW-GENERATION TOOLS FOR A NEW ERA OF DENTISTRY

Composite layering techniques represent an artistic approach to creating more natural-looking restorations.[1,2,16–18] Since many factors affect tooth color, including the color of the enamel, the dentin, their combination, and outside influences, layering provides a directly controllable means to replicate the diversity of colors distributed throughout a tooth. However, because there are shade gradations in natural teeth, dentists must also consider the most accurate means for shade selection. Nanotechnology and colorimetric analysis are helping to make the artistic nuances of the direct composite restorative process more predictable.

Specifically, a recently introduced universal composite (Filtek™ Supreme Universal Restorative, 3M ESPE, St. Paul, MN, USA) based on nanotechnology is demonstrating promise as an artistic tool for direct anterior and posterior indications, giving dentists greater control over the shades that can be placed within a restoration and the manner in which the material is handled and layered. The material was created using two fillers: nanomers (ie, individual filler particles, roughly spherical in shape) and nanoclusters (ie, loosely agglomerated collections of nanoparticles) that contribute to polish retention and control of transparency, as well as to radiopacity and handling characteristics, respectively.

Because the nanomer and nanocluster fillers are combined directly with a reduced-shrinkage resin, the material represents a composition similar to that of a universal or hybrid composite, not a microfill. As a result, the material demonstrates the mechanical properties and wear resistance observed in hybrid composites but with the polishability, polish retention, and optical characteristics seen with microfills.

Other technologies such as colorimeters and spectrophotometers have been introduced to the dental industry that can be useful in determining the appropriate composite shades necessary for a specific restoration by helping to ensure predictable shade matching.[19–21] A tristimulus colorimeter (X-Rite® ShadeVision™ System, X-Rite, Inc., Grandville, MI, USA) measures the radiant energy for each primary color of red, blue, and green.[20] Spectrophotometers measure the amount of visible energy for each hue of the spectrum.[19]

ShadeVision is a colorimeter engineered to measure and communicate accurate tooth shades so that restorations can predictably match not only the tooth it restores but also the teeth surrounding it.[20] Human subjectivity is eliminated by using precision optical measurement instruments that respond to light in a manner similar to that of the human eye but that also identify the shades of the tooth by measuring the tooth color in terms of its three attributes: hue, value, and chroma.[21]

Specifically, the human eye reacts to light stimulus in complex ways that are interpreted by the visual cortex of the brain and influenced by a variety of factors, such as fatigue, environment, and emotions.[13] Each part of the eye serves a specific purpose. The cornea and lens focus ambient light, and the pupil controls the amount of light. The cornea, lens, and pupil direct the light onto the retina, which creates a picture of the light through neural sensors called rods and cones. It is the wavelength of the light perceived by the eye that determines what color we see.[13]

Similarly, the colorimeter (X-Rite ShadeVision System) reacts to light that is reflected from the tooth and captured by a receiver (like the human eye). Just as the eye has color cones that detect blue, red, and green wavelengths, the colorimeter's hand-held device contains red, blue, and green filters that pick up the reflected light,[20] capturing 22,000 measurements of a tooth's hue, value, and chroma. The images captured by the hand-held device are uploaded into a computer, where the details of the tooth's color map can be viewed.[21]

CASE PRESENTATION

A 37-year-old female patient presented with a maxillary left central incisor (tooth no. 9) that had been treated previously with a composite restoration. There were discrepancies of opacity and value in the incisal third, in addition to disharmony of hue, chroma, value, and translucency (Figures 1 and 2). There was also an asymmetry in width between the left and right maxillary incisors (teeth no. 8 and 9).

The treatment objective was to create a direct veneer on the left central incisor that would match the esthetic qualities of the right central incisor while simultaneously correcting the midline to create symmetry. Although this case could have been treated with indirect veneer or crown restorations, the patient selected direct composite restorations owing to their minimally invasive nature, preservation of tooth structure, relative immediacy of treatment outcome, and lower cost.[2] Given the previously discussed improvements to the physical and optical properties of direct composites, the patient was comfortable with her informed decision.

Preoperative Procedure

In an appointment prior to initiating restorative work,[15,16] and following a thorough examination, a preoperative visual color analysis (Figure 3) was completed on tooth no. 8 since an accurate shade could not be taken from tooth no. 9 owing to its dull lifeless composite restoration. A template illustration (Visual Thinking Strategy™ [VTS], Dr. Frank Milnar, St. Paul, MN, USA) was created with colored pencils and the Vitapan® Shade Guide (Vita Zahnfabrik, Bad Säckingen, Germany) as a reference. This visual analysis outlined the primary characteristics of the preoperative dentin and enamel, including shade, chroma, value, texture, shape, and surface gloss.[16] Subjective assessment indicated a high value shade, B1, in the middle third of the tooth; underneath it, the assessment indicated three mamelons of A2. Additionally, an incisal halo would require a slightly translucent shade with high value.

This same visual assessment identified gray areas in the incisal third in which gray translucent composite would be used. There were also diffuse white spots in the incisal third between each mamelon. It was determined that some diluted color tints would be used with a brush to capture those spots. On the left central incisor, White Body would be used to mask out dentin, and a matte finish would help create the same texture and identical reflection.

An electronic shade scan (X-Rite ShadeVision System) was also taken of the intact tooth no. 8 to verify that the composite shades and tints selected based on subjective visual assessment were accurate. These scans (Figures 4 to 6), which are not widely used for direct composite selection, were helpful in gener-

Figure 1. Shade differences between teeth no. 8 and 9 were apparent using the Vitapan Shade Guide.

Figure 2. 1:1 preoperative view of the patient's central incisors.

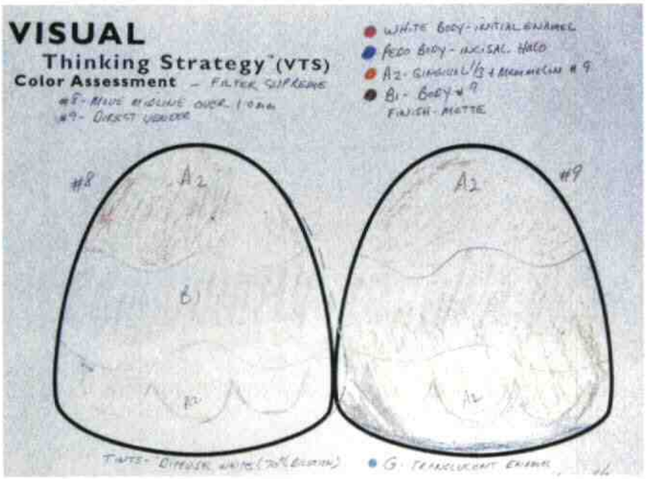

Figure 3. A preoperative shade analysis was completed.

ating topographic maps that showed the zones of chroma, value, and areas of translucency for the teeth to be treated. The electronic map clearly indicated that the intact natural tooth no. 8 was not monochromatic and underscored the need for multiple shades and layers of direct restorative material.[2,7,16]

Ideally, both shade-mapping methods—VTS and colorimetry (X-Rite ShadeVision System)—should produce a restoration that is optically pleasing and blends well with the surrounding dentition. Although the colorimeter produces an elaborate shade map, in some cases it may be too difficult to duplicate exactly with composite. However, unlike the subjectivity of the human eye, colorimetry does provide objective and comprehensive color information to study and interpret prior to and during the restorative process.

A mock-up was completed on the unetched tooth no. 8 to test the high chroma zone in the cervical third. The VTS analysis indicated A2, so it was placed on the tooth, blended well, and determined to be the correct choice. A mock-up was also completed on the middle third. Since the digital image indicated C1 as the correct shade—although the clinician saw B1 as correct—C1 Enamel was tried and blended well.

Again on tooth no. 8, the low-value shade, Gray Translucent, was placed in the incisal third to simulate the translucent layer. This was placed between the mamelons to create contrast, lower the value of the incisal third, and create a restoration with depth of color. The final yellow translucent shade was mocked up to the incisal third, tapering into the middle third. This also helped create

Figure 4. Full-color image taken of tooth no. 8 using the ShadeVision System.

Figure 5. The average color of tooth no. 8. Red C1 indicates that the Vitapan Classical Shade Guide does not correlate well to that shade on the tooth surface. Other shade guides are available to crossmatch, such as the Vita 3D Master and others already in the ShadeVision System database.

Figure 6. Complete color map of tooth no. 8.

depth of color and serve as the "enamel" layer of the tooth. It was determined that the shade selections were sufficiently close to proceed clinically.

During the restorative appointment, additional preoperative procedures were completed (Figure 7). A study model was created from an alginate impression, and a caliper was used to measure the widths of teeth no. 8 and 9. The model was then esthetically enhanced with wax to correct all discrepancies in the contours, form, size, shape, symmetry, and midline placement of the tooth. It was determined that tooth no. 9 was wider than tooth no. 8 by 1.0 mm. Therefore, it was deemed prudent to increase the width of tooth no. 8 prior to restoring tooth no. 9 to achieve symmetry.

Additionally, a putty stent was made from the esthetically enhanced study model—which served as a blueprint for the final composite restorations—for spatial reference using a vinyl polysiloxane material. When tried in the mouth, it indicated that the midline should be moved mesially on the right central incisor about 0.5 to 1 mm. The putty stent also preserved the exact facial/lingual line angle and indicated where to place the composite material to ensure symmetry with the contralateral tooth. Pencil lines drawn on the tooth facilitated the determination of the transitional line angles and light reflecting areas (Figure 8). Surface texture differences were noted, along with surface gloss differentiations.

Clinical Protocol

It was determined that the midline would be moved first and the width of tooth no. 8 increased prior to fully restoring tooth no. 9. To accomplish this, a diamond strip (Visionflex™, Brasseler, Savannah, GA, USA) was used to strip the teeth interproximally and open the midline (Figure 9). A caliper was again used to reexamine the widths and lengths of the maxillary central incisors to ensure accurate reduction. Prior to moving the midline, a dead-soft metal matrix band (Tofflemire .001, Adult Universal matrix band, Arnel, Inc., Hampstead, NY, USA) was used to isolate tooth no. 8. Etchant (Scotchbond™ Phosphoric Acid Etchant, 3M ESPE) was applied for 15 seconds and then rinsed and gently air dried.[22–24] Adhesive (Adper™ Single Bond Adhesive, 3M ESPE) was applied, gently air dried, and light cured for 10 seconds using a light-emitting diode curing light (Elipar™ FreeLight Curing Light, 3M ESPE), which was also used for all curing during this restorative treatment process.

C1 Enamel (Filtek Supreme Universal Restorative—experimental shade not available for sale) was placed with a spatula (Gold Microfill, Almore International, Portland, OR, USA) onto the mesial interproximal aspect of tooth no. 8. The dentin shade composite was not necessary, and light transmission was essential. Sculpting was completed with a no. 4 Mini DE Composite Placement Instrument (Hu-Friedy, Chicago, IL, USA) and a no. 3 artist brush used for fine details, and the material light cured for 20 seconds.

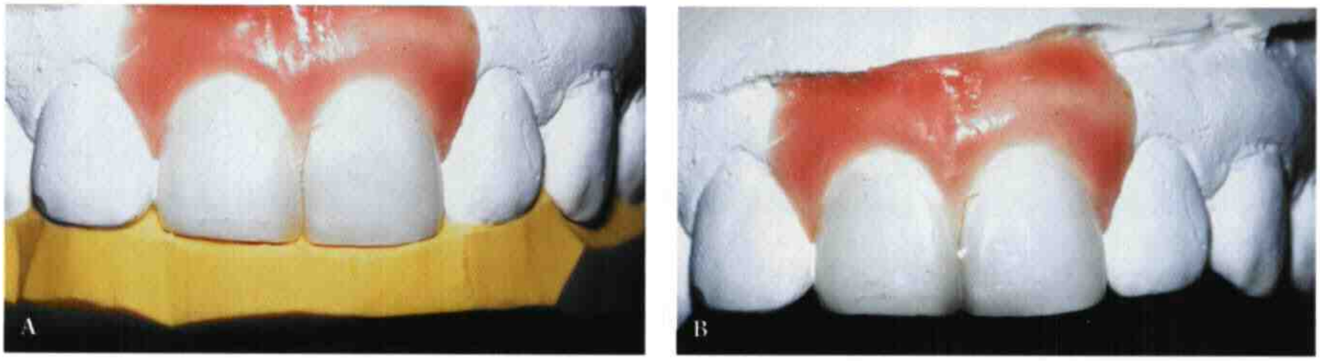

Figure 7. A *and* B, *A preoperative diagnostic wax-up and putty stent were created.*

Figure 8. Preoperatively, pencil marks delineated light reflecting and deflecting zones.

Yellow Enamel (Filtek Supreme Universal Restorative) was placed over the C1 layer on tooth no. 8 in the incisal third for translucency, and care was taken to ensure the exclusion of air voids. A brush and a no. 4 Mini DE Composite Placement Instrument were again used for sculpting. A no. 1 Mini DE Composite Placement Instrument (Hu-Friedy) was used for fine detail work, and the final layer was light cured for 20 seconds. Following removal of the matrix, an abrasive polishing disk (Sof-Lex™ Extra Thin Contouring and Polishing Disc, 3M ESPE) was used. Final texturing and polishing would be accomplished at the completion of tooth no. 9.

After the patient was anesthetized, tooth no. 9 was minimally prepared for a direct composite veneer restoration (Figure 10) using a Brasseler USA no. 6844-014 diamond. Defined circumferential margins of 0.5 to 1.0 mm were created, and clearly defined exaggerated chamfer margins of 0.5 mm were placed on the lingual surface, apical to the centric stop, in order for the restoration to withstand occlusal and incisal forces. The final preparation consisted of clearly defined supragingival chamfer margins with rounded edges. A long bevel was placed on the incisal edge of the preparation using a diamond bur (Brasseler no. 6844-014) to enable a smooth and gradual transition zone of opacity and color at the tooth-composite interface. An abrasive disk (Sof-Lex) was used to shave excess material and ensure the absence of sharp edges.

After etching the preparation for 15 seconds, lightly air-drying and applying adhesive (Adper Single Bond Adhesive), the material was light cured for 10 seconds. The putty stent was used as a guide (Figure 11) for the initial layer of White Body composite (Filtek Supreme Universal Restorative), which was applied in a thin layer to manage opacity. The material was pushed into the lingual aspect of the preparation (Hollenback no. 6, Hu-Friedy), avoiding the interproximal contact area.

A Mylar® matrix (Contour Strip, Ivoclar Vivadent, Amherst, NY, USA) was placed around the preparation (Figure 12) and trimmed, and an unfilled resin (Adper™

Figure 9. The midline was moved over tooth no. 8.

Figure 10. Tooth no. 9 was prepared for a direct composite veneer.

Scotchbond™ Multi-Purpose Adhesive, 3M ESPE) was applied and light cured for 10 seconds. This sealed matrix helped to isolate the prepared tooth and created an environment free from sulcular fluids and saliva while completing the direct composite veneer buildup.[25] Ultimately, the smooth surface of the Mylar strip would be transferred to the composite below the free gingival margin so that upon removal of the strip and unfilled resin, only supragingival finishing would be necessary.[25]

Following the placement of the Mylar strip, the buildup of the restoration began; subsequently a variety of composite shades and tints were used (Figure 13). The first cervical layer of composite (A2 Body, Filtek Supreme Universal Restorative) was sculpted against the Mylar matrix with a composite placement instrument (no. 4 Mini DE Composite Placement Instrument), feathered into the midsection of the tooth, and applied up to the cavosurface margin (Figure 14). A no. 4 artist's brush was used to smooth the material and eliminate voids, and the composite was light cured for 20 seconds. A thin layer of White Enamel composite (Filtek Supreme Universal Restorative) was applied with a no. 4 Mini DE Composite Placement Instrument to form the incisal halo and create a slight contrast with the White Body composite; it was then light cured for 20 seconds.

A2 Body composite (Filtek Supreme Universal Restorative) was used to create mamelons in the incisal third of tooth no. 9 while blending it over the long bevel. It is important to note that A2 was used to impart a deeper hue to the preoperative shade selection of C1 or B1. This effect created contrast with the lighter enamel shade.[26]

Two concavities were created to form three dentin lobes, and care was taken to bring the material just shy of the incisal edge. An artist brush was then used to smooth the material, which helped to scatter reflected light. The Hollenback no. 6 was used to redefine the mamelons prior to light curing the material for 20 seconds.

Gray Translucent composite (Filtek Supreme Universal Restorative) was added to the incisal third to fill the grooves created between the mamelons to produce a polychromatic effect in the final restoration. An unfilled adhesive wetting resin (Ultradent Products Inc., South Jordan, UT, USA) helped to sculpt the material, and the Hollenback no. 6 was again used to redefine the mamelons. An artist's brush was used prior to completing a 10-second light cure of the material.

During the subjective visual analysis and colorimetry performed preoperatively, three areas of diffuse white had been identified. Therefore, high-value white tints (Kolor+ Plus White, Kerr/Sybron, Middleton, WI, USA) (Figure 15) were diluted by 70% to create a subtle effect. White Body or Pedo shades of composite could have also been used to produce this effect.

Figure 11. The veneer preparation was verified using the putty stent.

Figure 12. A Mylar contour strip was placed.

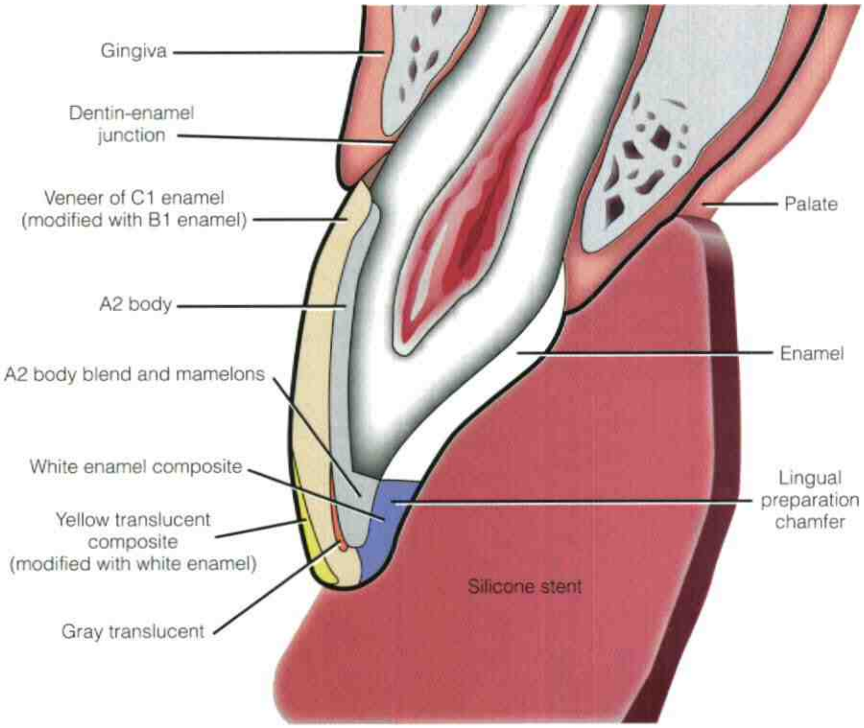

Figure 13. Schematic drawing outlining the composite materials and layering technique used in creating the restoration on tooth no. 9.

At this time, the A2 Body, subtinting, and Gray Translucent materials had been added. Next, the C1 Enamel composite material was carefully layered on top using a spatula (Gold Microfill Spatula, Product no. 96041, Almore International). This layer was slightly overbuilt to allow for some removal of composite during the finishing and polishing procedures. An artist's brush was used to smooth the material, and a mirror was used to check the bulk of the composite material, viewing the restoration from the incisal edge.

The Hollenback no. 6 was used to redefine the mamelons, and the material was light cured for 20 seconds. Because the adjacent tooth was desiccated, a true color match could not be evaluated at that time.

The final layer of composite (Yellow Translucent, Filtek Supreme Universal Restorative) was added to the incisal third using a spatula and an artist's brush, and the mamelons were again redefined. The restoration was verified to ensure a sufficient volume of material and polymerized for 20 seconds each on the lingual and labial surfaces. The Mylar matrix was removed.

Finishing and Polishing

Contouring, gross reduction, and finishing and polishing were accomplished using a series of burs and disks.[27] A polishing disk was used to form the incisal edge, a diamond bur (no. 8379-018, Brasseler) to

Figure 14. The first dentin cervical increment was placed.

Figure 15. Kolor+ Plus tints were placed.

remove the bulk from the lingual aspect, and a polishing disk (no. 4 Mini DE Composite Placement Instrument) to create a 30° bevel on the lingual aspect of the tooth. Pencil marks helped with visualization of the three zones in which surface texture and anatomy would be created with the polishing disks (Figure 16).

Excess unfilled resin was removed from the area in which the Mylar matrix had been placed, and the dental assistant helped guide the finishing procedure by viewing the restoration from several additional angles. Owing to a slight void in the composite on the mesial aspect of the restoration, a minor repair was made using B1 Enamel composite (Filtek Supreme Universal Restorative).

The primary anatomy was verified using the putty stent, and pencil lines were again drawn to visualize the secondary anatomy and ensure the creation of symmetric light reflecting and deflecting zones. A pencil line was drawn at the height of contour. Primary anatomy was established using disks, and secondary anatomy was created with burs (no. 7901-009, Brasseler). Tertiary anatomy and surface texture were established using a diamond bur (no. 6844-014, Brasseler). This bur was also used lightly on the contralateral tooth to create similar surface textures on both central incisors.

A dull disk removed any pencil marks, and a polishing brush (Sof-Lex) was used to help create surface gloss. A disk (Visionflex) was again used to slightly open the embrasure between the central incisors. Final surface irregularities were removed and secondary anatomy was reestablished with a series of burs (ET-9, ET-6, ETF 9, ETF 6, ETUF 6, ETUF 9, Brasseler). Finally, a polishing disk (Diacomp Composite Polishing Kit, Brasseler) was used to clean the mesial and distal line angles and place horizontal texturing on the tooth.

Residue was removed with an artist's brush, and polishing paste (Enamelize Composite Polishing Paste, Cosmedent, Inc., Chicago, IL, US) was used with a goat hair brush (Goat Hair Brush, Ultradent Products Inc.) to polish both central incisors. After flossing and verifying the occlusion, the restoration was complete. Throughout the procedure, the gingival tissues were well managed, resulting in little or no bleeding.

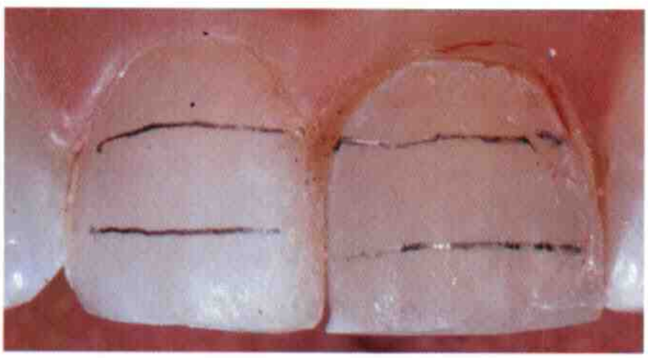

Figure 16. Transitional planes were identified on teeth no. 8 and 9.

Since the teeth were desiccated, the color match could not be judged immediately. However, it is not uncommon for a direct restorative case with this level of complexity to require slight shade adjustments. This case required modification to the dentin layer using B1 to elevate the value. White Enamel was added to the final layer to adjust the value of the restoration, and the final results were natural looking and blended harmoniously with each other and the adjacent natural dentition (Figure 17).

DISCUSSION

To overcome the challenges inherent in obtaining an accurate shade match, dentists must grasp both the science and art of color. Color perception, as previously noted, is subjective and can vary from person to person. If the human eye cannot perceive color in a consistent manner, inaccurate shades will be recorded. By using two shade-taking modalities—one of which is subjective, requires the use of shade tabs, and remains the most clinically accepted technique, despite producing the most uncertainty, and one that is objective, is technology based, and

Figure 17. Postoperative view of the final restorations.

incorporates computer imaging—the dentist can realize an evolving standard in color detection and material shade selection.

Specifically, it is important to note that I do not necessarily believe that VTS is more accurate than the ShadeVision colorimetry. Rather, traditional techniques, such as using shade tabs, combined with colorimeter technology (eg, ShadeVision), provide the ideal formula for producing a natural-looking esthetically pleasing restoration. In addition, the use of this technology may help dentists gain important insights when evaluating esthetic outcomes before, during, and after the restorative sequence.

In my opinion, had this case relied exclusively on either shade tabs or the newer software-based technology, the clinical result would not have been as esthetically acceptable. In particular, I have demonstrated more clinical experience using traditional shade tab techniques. It is only natural to believe that with more familiarity with the newer more advanced technology, the prospect of producing even more natural-looking esthetic direct composite restorations will only improve.

CONCLUSIONS

As dental professionals, we are now in an era when we can marry the artistry and beauty of nature with the strength and function of state-of-the-art dental materials and techniques. When the knowledge of color and tooth anatomy is applied to the direct restoration of anterior teeth, direct composite materials continue to be efficacious in esthetically replicating natural dentition.[28]

However, successful determination and transfer of color to an esthetic restoration are dependent upon the clinician's ability to understand and interpret color and its relationship to the anatomy of the tooth. Ready familiarity with the capabilities of available restorative materials and tools must also be understood.[1] Dentists must comprehend and implement the rules and principles of nature, art, and material science and apply them to the selection and placement of the most appropriate restorative materials.

Filtek Supreme Universal Restorative demonstrates promise for providing dentists with an ample range of composite shades from which to choose. Further, X-Rite ShadeVision System may provide an objective assessment tool in the determination of appropriate restorative shades. When used with a layering technique that combines two or more shades and opacities for each restoration, these new technologies offer the potential to create the best possible esthetic result. In particular, the ShadeVision eliminates the subjectivity of the human eye, and it is the job of the clinician to work with the technology—not against it—to interpret the data accordingly. There is no singular solution to creating a natural-looking restoration; it is often the combination of techniques that can yield the optimum results.

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