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Direct Composite Resin Veneers in Nonvital Teeth: A Still Viable Alternative to Mask Dark Substrates

CRF Yanikian • F Yanikian • D Sundfeld • RBE Lins • LRM Martins

Clinical Relevance

Direct composite veneers are a viable approach to improve the color and esthetics of darkened anterior teeth. Additionally, composite resin veneers are not negatively affected by dark substrates over time.

SUMMARY

Direct composite resin veneers are a practical esthetic restorative treatment for reestablishing the shape and color of affected anterior teeth. The present clinical case reports aim to describe restorative treatment techniques for nonvital anterior teeth presenting color alteration. The direct composite resin layering technique has proven to be an efficient method for recovering the esthetics of darkened teeth. The direct vs indirect restorative treatments are debated as well. Clinical follow-ups of the presented case reports demonstrate that direct composite resin restorations are not affected by the darkened tooth substrate over time.

*Cristiane Rumi Fujiwara Yanikian, DDS, MDS, PhD student, Department of Restorative Dentistry, Piracicaba School of Dentistry, University of Campinas–UNICAMP, Piracicaba, SP, Brazil

Felipe Yanikian, DDS, private dental practice, Capão Bonito, SP, Brazil

Daniel Sundfeld, DDS, MDS, PhD, professor, Department of Restorative Dentistry and Prosthodontics, Ingá University Center–UNINGÁ, Maringá, PR, Brazil

Rodrigo Barros Esteves Lins, DDS, MDS, PhD student, Department of Restorative Dentistry, Piracicaba School of Dentistry, University of Campinas–UNICAMP, Piracicaba, SP, Brazil

Luís Roberto Marcondes Martins, DDS, MDS, PhD, professor, Department of Restorative Dentistry, Piracicaba School of Dentistry, University of Campinas–UNICAMP, Piracicaba, SP, Brazil

*Corresponding author: 901 Limeira Avenue, 13414-903 Piracicaba, SP, Brazil; e-mail: cristiane@fyodontologia.com.br

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INTRODUCTION

After the introduction of dentin bonding agents and further development of resin composites, direct resin composite has become a more conservative treatment for esthetic problems in the anterior dentition. Until the mid to late 1980s, there were few composite based resins available on the market that presented good esthetic characteristics. Only after the introduction of composite systems that provided dentin and enamel shades did the color selection process become easier and direct restorations began to look better and more lifelike.[1]

Currently, nanofiller composites are not only time- and cost-effective, but they are also ultimately a high-quality and long-lasting treatment of choice.[2,3] They present superior strength, excellent physical and optical/color properties, and improved polishing characteristics compared with early macrofills, which allow composite resins to be successfully used

in stress-bearing and esthetic areas.[2] This allows clinicians to perform artistic restorations, which can mimic the natural dentition and can equal or even surpass dental ceramics.[4,5]

Direct composites are currently used for treating poor esthetics in anterior teeth presenting unsatisfactory color and shape, defective restorations, slight misalignment, and fractures. Direct composite veneers are applied directly on prepared tooth surfaces with a composite resin material and, in some cases, there is an absence of tooth preparation.[6] Additionally, indirect resin laminate veneer restorations can be a treatment option for patients with poor anterior esthetics when applied judiciously to patients with good oral hygiene motivation and occlusal stability.[6-10]

The tooth can discolor for many reasons, including either extravasations of blood components into the dentinal tubules associated with pulp extirpation or traumatic injury leading to blood cell hemolysis and iron release.[11] This iron reacts with hydrogen sulfide, a metabolic product of bacteria, to form iron sulfide and cause gray staining of the tooth.[11] Incomplete removal of pulpal debris and/or remaining root-filling materials are another cause of discoloration in a single root-filled tooth.[12,13] On the other hand, if the pulp tissue survives a traumatic injury, it can undergo pulp canal obliteration, characterized by rapid deposition of hard tissue beginning within the pulp chamber and continuing along the root canal space, resulting in a yellow to brown discoloration of the clinical crown.[14]

Therefore, the aim of the present clinical case reports was to demonstrate the esthetic recovery of discolored anterior teeth with the aid of direct resin composite restorations through the layering restorative technique. The five-year, four-year, and one-week follow-ups of the clinical cases are also presented.

CLINICAL CASES

Clinical Case 1

A 23-year-old woman was referred to a private dental practice following the loss of smile harmony due to discolored and worn resin composite fillings on the maxillary right and left central incisors and the right lateral incisor (Figure 1). The right central incisor had been endodontically treated and exhibited severe discoloration, which had undergone an attempt of composite covering after failed dental internal bleaching (Figure 1A). Before the intervention on the right central incisor, the unsatisfactory direct composite restoration on the left central incisor and right lateral incisor were replaced (Figure 1B,C).

Shade Selection—Shade was selected prior to tooth isolation (Figure 2), after cleaning the tooth with a prophy cup, a slurry of pumice and 0.2% chlorhexidine. Because the right central incisor was discolored, the shade was assessed using a healthy tooth (in this case, the left premolar, #12). Due to the presence of a severely discolored tooth and the need for extended preparation, the natural layering concept was applied for a correct shade selection, in which small increments of composite resins were placed over healthy tooth structure (Figure 2). A translucent microhybrid, high-value opaque and dentin-like composite was selected to compose the body of the restoration.

Tooth Preparation—After isolation with rubber dam, retraction cord (Ultra-Pack #00, Ultradent Inc, South Jordan, UT, USA) was placed around the facial and proximal gingival margins to protect the tissue from scarring during preparation. The tooth preparation was performed as if for a porcelain veneer.

To avoid random reduction of facial tooth structure, calibrated spherical diamond burs (#1014, KG Sorensen, São Paulo, SP, Brazil) at the cervical region and depth-limiting diamond burs (#4141, KG Sorensen) were used to determine the initial preparation depth (0.5 mm). The remaining facial enamel was reduced to the level of these grooves using a tapered-cylinder, round-end diamond bur (#3215, KG Sorensen). After facial reduction, the degree of tooth discoloration was evaluated to determine whether additional reduction was required to provide adequate space for composite resin layering. A silicone matrix was used to measure the preparation depth; in this case, a 1-mm facial reduction was necessary (Figure 3A). The incisal edge was reduced using a tapered-cylinder, round-end diamond bur, to provide space for characterization using translucent nano-hybrid composites (Figure 3B). Then, the entire preparation was further finished using an extra-fine, tapered-cylinder, round-end diamond bur (#3215FF, KG Sorensen), abrasive disks (Sof-Lex Pop-On, 3M ESPE, St Paul, MN, USA), and rubber cups (Flexicups, Cosmedent, Chicago, IL, USA).

Application of a Dentin Bonding Agent—After tooth preparation, the dentin bonding agent was applied according to the manufacturer recommendations. The enamel was etched using 37% phosphoric acid (Ultraetch, Ultradent Inc) for 30 seconds,

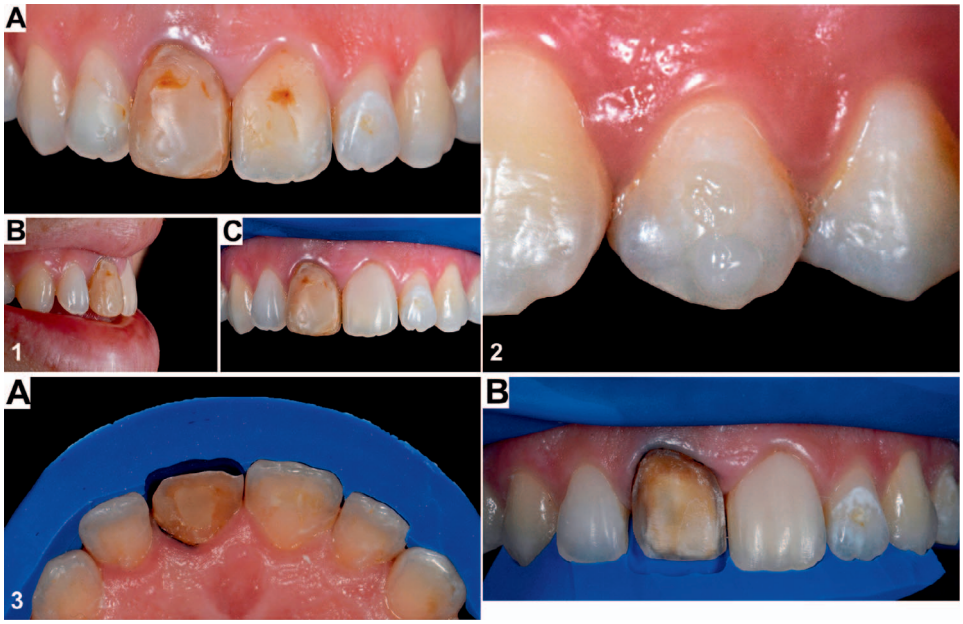

Figure 1. *Initial images of maxillary anterior teeth before (A) and after direct composite restoration replacement on teeth #7 and #9 (B and C).*

Figure 2. *Resin composite color selection by placing resin composite increments in the mid and incisal third.*

Figure 3. *Tooth preparation. The silicone matrix was placed to check facial (A) and incisal (B) reduction.*

rinsed, and carefully air dried. A one-bottle etch-and-rinse adhesive system (Single Bond, 3M ESPE) was applied and gently air dried and light-cured for 20 seconds using an LED curing device at 1000 mW/cm^2 (Valo, Ultradent Inc).

Restorative Procedure—Before the composite resin buildup was performed, a thin layer of high-value opaque flowable composite was applied with a brush (Figure 4A; shade A1, Creative Color, Cosmedent)

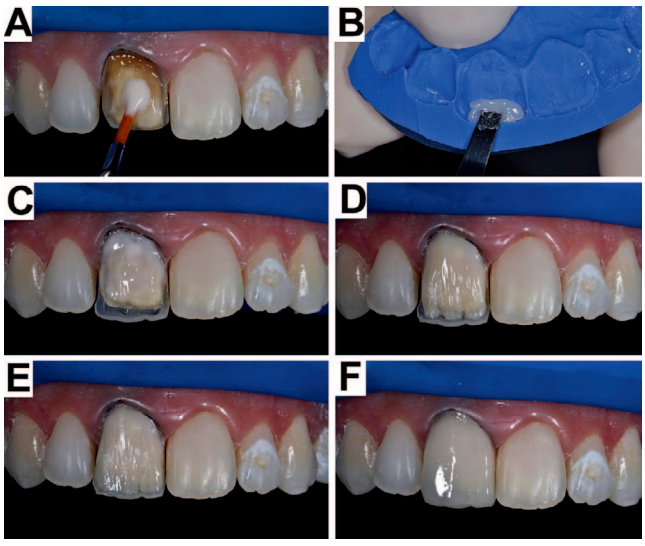

Figure 4. *Resin composite buildup. Application of opaque flowable composite (A); inserting the enamel-like composite into the silicon matrix (B); palatal wall of restoration (C); dentin-like composite layer (D); translucent composite as opalescent effect in the incisal edge (E); and final layer of enamel-like semitranslucent composite (F).*

and light-cured for 40 seconds. Then, a 0.5-mm-thick palatal layer was sculpted using an enamel-like white translucent resin composite (shade PF, Vit-l-escence, Ultradent Inc) and a silicone matrix (Figure 4B,C). Each composite increment, except the opaque composite resin, was light-cured for 20 seconds. Then, the dentin portion was replaced. At the cervical region, a thicker increment of composite resin (shade A2-dentin, IPS Empress Direct, Ivoclar Vivadent, Schaan, Liechtenstein) was used. Mamelon anatomy was created on the incisal edge (Figure 4D). A slightly blue translucent shade composite (shade IrB, Vit-l-escence, Ultradent Inc) was laid along the incisal edge, between the mamelons, to mimic the opalescent effect (Figure 4E). Next, a tooth frame was achieved, and one increment of an enamel-like semitranslucent composite resin (shade PF, Vit-l-escence, Ultradent Inc) was applied to the facial surface, sculpting almost the final tooth contour (Figure 4F).

Finishing and Polishing—Initial finishing was performed using coarse aluminum oxide discs (Sof-Lex Pop-On, 3M ESPE) until the desired anatomy was established (Figure 5A). Then, the occlusion was checked (AccuFilm II, Parkell, Edgewood, NY, USA), and the restoration was further finished using an extra-fine, tapered-cylinder diamond bur (#2200FF, KG Sorensen) with a low-speed rotation to perform surface characterization (developmental groves, lobes, and marginal ridges; Figure 5B). Finally, abrasive polishing rubber cups with different grits (Flexicups, Cosmedent) were used to eliminate some

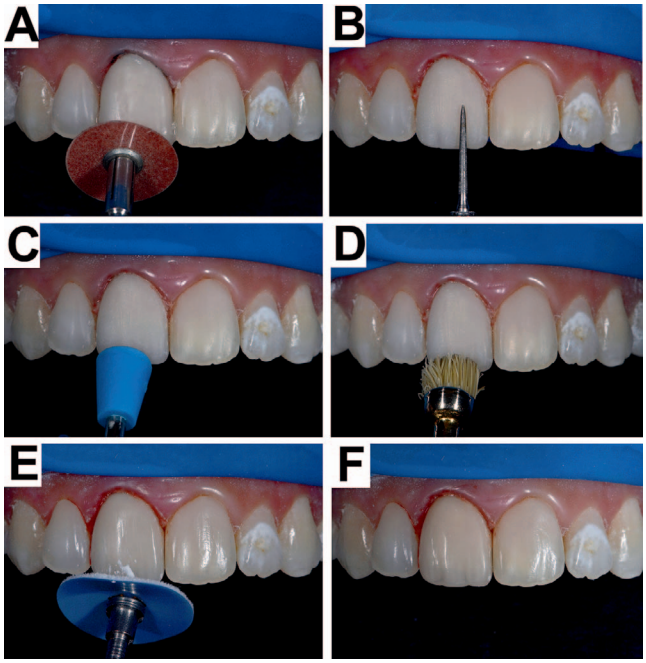

Figure 5. *Finishing and polishing steps. Coarse aluminum oxide discs were used for the initial finishing (A); an extra fine, tapered-cylinder diamond bur was used to perform surface characterization (B); different grits of abrasive polishing rubber cups were used to eliminate some undesired accentuated texturization (C); silicon carbide brush (D); and composite polishing paste were applied with a buffing disc (E) to impart the final shine; postoperative aspect of the restoration (F).*

of the undesired accentuated texturization (Figure 5C). Then, a silicon carbide brush (Figure 5D; Cosmedent) and composite polishing paste (Enamelize, Cosmedent) were applied using a buffing disc (Figure 5E; Flexibuff, Cosmedent) to impart a high shine to the restoration surface while still retaining the designed surface texture (Figure 5F). Despite the limitations of this case, such as a discolored tooth root that could be seen by transparency at the gingival margin, a natural biofunctional restoration was achieved (Figure 6A,B). The restorations' appearance after five years of follow-up is shown in Figure 6C.

Clinical Case 2

A 51-year old man presented to the Restorative Dentistry Clinic of Piracicaba School of Dentistry–UNICAMP/Brazil, requesting esthetic treatment for his maxillary central incisors. The left central incisor had been endodontically treated and further submitted to internal tooth bleaching attempts, without success. Therefore, a direct composite veneer was placed many years ago, which had become discolored, opaque, and lifeless (Figure 7A-C). The discolored direct restorations in the right central incisor and right lateral incisor had been replaced at the same time as the left central incisor.

Shade selection was performed as in the first clinical case report, although a healthy maxillary lateral incisor was used as the reference. The left central incisor tooth preparation was performed as described above; however, the discolored restorations in the right central and lateral incisors were only removed without further tooth reduction (Figure 8A). The etch-and-rinse adhesive system (Single Bond, 3M ESPE) was applied as described before, following the manufacturer instructions.

Initially, a silicon matrix was used to determinate the position of the incisal edge, embrasure forms, and palatal anatomy of the teeth. Then, a thin layer of opaque flowable composite (shade A2, Creative Color, Cosmedent) was applied to the left central incisor to mask the darkened tooth. The resin composite buildups were performed as described before (Figure 8B). The shade A3-dentin (IPS Empress Direct, Ivoclar Vivadent) was used as dentin; shade PA (Vit-l-escence, Ultradent Inc) was used as enamel; and a slightly blue translucent composite (shade IrB, Vit-l-escence, Ultradent Inc) was laid along the incisal edge. The same composite resins were used to restore the right central and lateral incisors. To conclude the restorations, the finishing and polishing were performed as described in the first case (Figure 8C). The patient reported

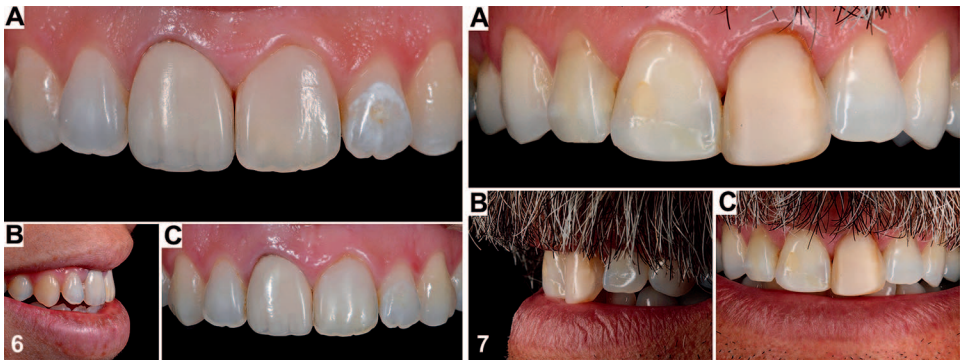

Figure 6. *Final view of the restoration. One-week postoperative aspect (A and B) and after five years of follow-up (C).*

Figure 7. *Initial views of maxillary anterior teeth presenting unsatisfactory composite resin restorations in the central and right lateral incisors (A-C).*

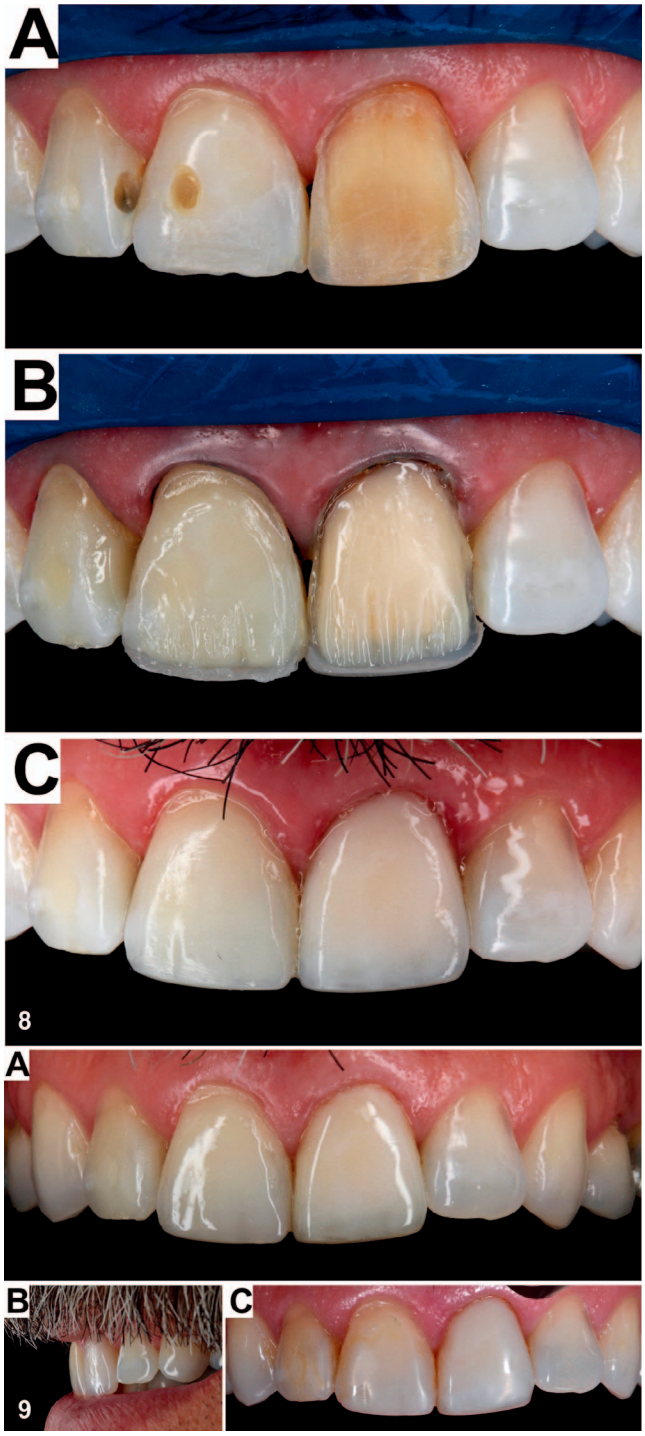

Figure 8. *Clinical view after preparations (A); composite layering step (B); and final restoration immediately after finishing and polishing procedures (C).*

Figure 9. *One-week postoperative restoration (A and B) and after four years of clinical follow-up (C).*

being very satisfied with the achieved result (Figure 9A,B). Figure 9C presents the restorations after four years of follow-up.

Clinical Case 3

A 54-year-old man sought treatment at the Restorative Dentistry Clinic of Piracicaba School of Dentistry–UNICAMP/Brazil, complaining about the esthetic appearance of his maxillary right (#8) and left central incisors (#9). After preliminary examinations, it was verified that the severe discoloration of the right central incisor was caused by endodontic treatment and the moderate discoloration of the left central incisor by trauma (Figure 10). Direct composite veneers were indicated for both teeth, because the patient reported having undergone dental bleaching without success and ceramic veneers were too expensive for him.

The composite resin shade selection was performed as reported in the first case report, using the right lateral incisor as a reference. Both maxillary central incisors were prepared in the same clinical session and as described before; however, the right central incisor required greater tooth reduction due to its severe discoloration (around 1.2 mm depth). The tooth reduction on the left central incisor was approximately 0.5 mm in depth (Figure 11A). The adhesive bonding system (Single Bond, 3M ESPE) was applied as described before and following the manufacturer instructions. A thin layer of an opaque flowable composite resin (shade A1, Creative Color, Cosmedent) was placed over the left central incisor, and a thicker layer of the same opaque flowable composite was placed over the right central incisor (Figure 11B). The restoration buildups were placed as described in the first clinical case, using the appropriate composite shades for this case: shade A2-dentin (IPS Empress Direct, Ivoclar Vivadent) as dentin, shade PF (Vit-l-escence, Ultradent Inc.) as enamel, and shade IrB (Vit-l-escence, Ultradent Inc.) to mimic the incisal opalescence (Figure 11C). Finishing and polishing were performed in the same way as in the previous cases. The patient was very satisfied with the outcome (Figure 11D). Figure 12 presents the one-week postoperative view of the definitive restorations. However, the patient did not present for our recall, and it was not possible to get follow-up for this case.

DISCUSSION

In this article, three clinical cases of severe discolored teeth treated using direct resin composite veneers were presented. When the esthetic com-

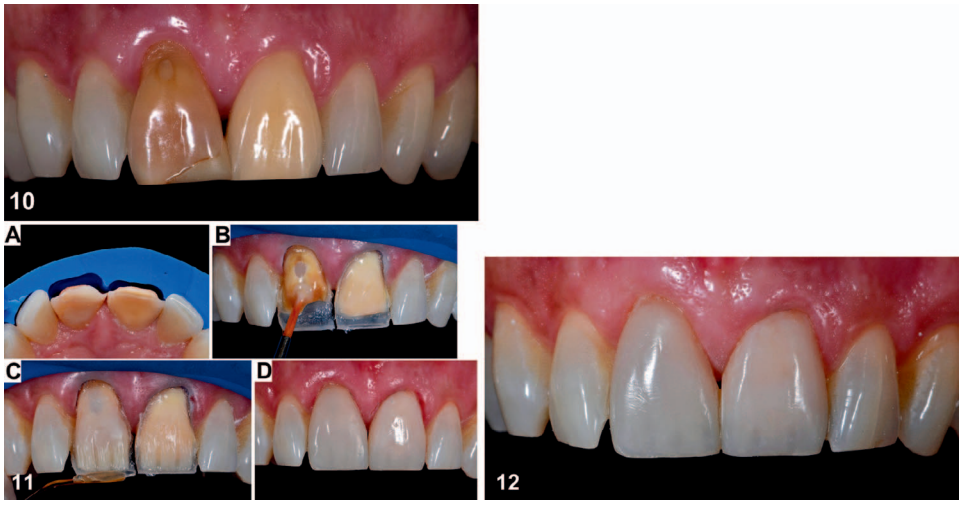

Figure 10. *Darkened initial view of both maxillary central incisors.*

Figure 11. *The right central incisor required greater tooth reduction than the left central incisor (A); opaque flowable composite application (B); resin composite build-up (C); and restoration after finishing (D).*

Figure 12. *One week after direct resin composite veneer restorations in both maxillary central incisors.*

plaint is caused only by tooth discoloration, direct resin composite veneers can be indicated instead of laminated ceramic veneers or total crowns.[4] Ceramic laminated veneers are widely used as a treatment for reestablishing unesthetic teeth, a long-lasting restorative treatment presenting superior esthetics,[15,16] although the major disadvantages of ceramic veneers are the risk of fracture and debonding.[4,16]

Although the literature is emphatic that tooth preparation for direct composites restorations is more conservative than for indirect restorations,[4,17,18] the present case reports required a more invasive preparation to enable the accommodation of various composite layers aiming to mask the severe tooth discoloration. An insufficient preparation leads to the use of more opaque composite resins, resulting in a lifeless artificial restoration. On the other hand, the greater the tooth reduction, the greater the chance of enamel being totally removed, which is likely to jeopardize the retention of the indirect esthetic restoration.[19] Significantly increased failure rates have been associated with porcelain veneer placement over areas with a lack of adequate enamel or where there are existing restorations.[20] In this sense, better marginal adaptation and the absence of luting procedures seems to be an advantage for direct restorations compared to indirect veneer restorations, especially when the preparation exposes dentin.[6,8,21]

Before the restoration buildups, the use of opaque flowable composites was required in all three cases to mask the dark substrates. Effective masking of the axial pulpal wall of a dark tooth is a great and challenging task in restorative dentistry, especially when using direct resin composites. Opacifiers are fluid dimethacrylate resins, typically light cured, which contain metallic pigments to give them a distinct hue, saturation, and opacification potential.[8,22] Without the use of opacifiers, a thicker increment of restorative material would be necessary to mask the dark color of the tooth; however, it can only be achieved by either increasing the tooth reduction or by overcontouring the restoration.

The natural layering concept technique was applied to build the restorations for achieving the expected natural results.[5,23] This required only three basic steps: (1) selection of the dentin shade resin in the cervical area of the tooth; (2) selection of enamel tint or translucent resin by simple observation, mainly at the incisal area; and (3) preparation of a chromatic map (Figure 13), in which the optical effects of the tooth and its peculiarities are noted.[5] In the first clinical case (Figures 1 through 5), the patient was young and had an open bite; therefore, the younger dental characteristics were preserved, including developmental grooves, a serrated incisal edge, and slight blue semitranslucent enamel. The subsequent cases were of two adult men over 50 years old; thus, the incisal edges were very worn and presented with a loss of evident effects/anatomy. Nevertheless, a natural slight translucency was detected in the incisal area. In this technique, the resin composite increments were placed respecting the natural layering of dentin and enamel, that is, a thicker layer of dentin-like composite was placed at the cervical area, simulating the greater thickness of dentin in this region; at the incisal third, the dentin-like composite was thinner and the translucent enamel-like composite was thicker, as with a natural tooth. Incisal effects, such as opalescence, white spots, or hypocalcifications, can be performed using

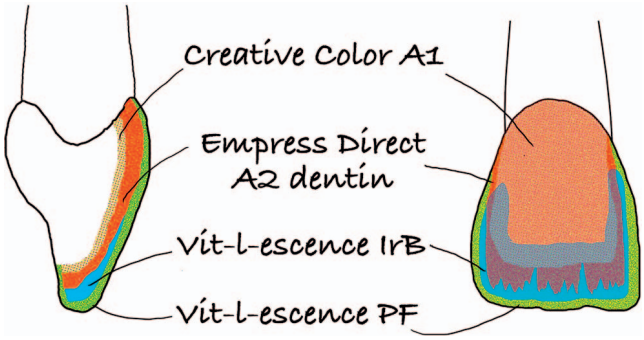

Figure 13. *Chromatic map of the tooth restored in clinical case 1, depicting the different resin composite shades to be used.*

resin-based tints underneath the translucent enamel-like composite.[18]

The natural layering concept through a logical application of two separate composite masses makes the whole procedure easier, efficient, and predictable, which greatly contributes to the clinical practice. The dentin-like composite can be selected using the traditional VITA shade guide (VITA Zahnfabrik, Bad Säckingen, Germany), and three basic rules can be applied for enamel-like composite selection: (1) young enamel appears more milky and less translucent (white semitranslucent composite); (2) adult enamel has intermediate translucency (thinner layer of white semitranslucent composite or thicker layer of neutral translucent composite); and (3) old enamel has higher translucency (translucent neutral composite).[5] To build the natural effect of teeth, it is necessary to perform a minimal observation of the healthy adjacent teeth and make a chromatic map (Figures 2 and 13). Peculiar effects of the tooth should be produced using specific composites with certain optical effects: high opalescence can be reproduced using a slightly blue translucent composite, less opalescence using a neutrally translucent composite, and white spots or yellowish effects using resin-based tints. Thus, although the use of novel direct composite resin systems enables clinicians to exercise creative control over the restorative process, the success of esthetic restorations also requires an understanding of natural tooth structure.

Finally, finishing and polishing steps are crucial to the maintenance and longevity of composite restorations.[24,25] As a result of the improvement of resin-based composites, the most important changes have involved the reinforcing fillers, which have been purposely reduced in size to produce materials that are more easily and effectively polished and that demonstrate greater wear resistance.[2] Finishing and polishing devices, materials, and procedures are intended to produce intentional, selective, and controlled wear of dental restorative material to create a natural restoration.[26] The texture of the direct composite veneers in the current clinical cases was created using an extra-fine tapered-cylinder diamond bur in a low-speed rotation. Thereafter, extraneous texture was removed by gentle buffing with rubber points of different grits, until the surface was smooth and mimicked the contralateral tooth. An aluminium oxide paste was used on a felt-buffing disc to achieve the final gloss. The use of adequate finishing and polishing systems produces a desired restoration surface, which can minimize deleterious effects such as greater surface roughness and consequent composite staining.[26]

CONCLUSIONS

Anterior tooth discoloration is one of the most frequent causes of dental treatment and represents a challenge for restorative dentistry. When there is a need for esthetic tooth correction, direct composite veneers are well indicated as an approach to improve tooth color and esthetics. This treatment presents advantages, including satisfactory bonding between resin composite and dental substrate, low cost, less clinical time, and acceptable esthetic results due to the improved optical and mechanical properties of composites.

Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of the Piracicaba School of Dentistry, Sao Paulo, Brazil.

Conflict of Interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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