Clinical Strategies for Success in Proximoincisal Composite Restorations. Part II: Composite Application Technique

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ABSTRACT

Reproducing the form, function, and optical characteristics of natural dental structures with direct composites in large and moderately large proximoincisal (Class IV) restorations represents a great challenge for clinicians in general. Understanding color is fundamental to achieving success when restoring these defects, as was discussed in Part I of this two-part article (Volume 16, Number 6). The proper restoration of the functional lingual contour is also a challenge that cannot be overcome without close attention to the restorative technique. In this second article, the composite application technique is discussed and presented in detail. Clinical photographs illustrate the proposed technique.

CLINICAL SIGNIFICANCE

The proposed clinical protocol, including a try-in of the shades in a mock-up restoration to more accurately define color and shape, and a silicone guide to transfer the lingual and proximoincisal contour of the mock-up to the final restoration, is of great help to successfully restore proximoincisal defects.

(*J Esthet Restor Dent* 17:11–21, 2005)

Restoring the natural optical and functional characteristics of teeth predictably and reliably has been an important goal for clinicians when using direct composites on anterior teeth with proximoincisal defects. The challenges to be faced when executing proximoincisal restorations include the creation of (1) a natural color transition from tooth to restoration, (2) opacification to mask the intraoral background, (3) a translucent incisal edge (in young teeth), and (4) natural surface texture, as well as a good overall shade match or "blend-in" with the adjacent structures. Rarely can the clinician achieve excellent esthetic results in proximoincisal restorations with a single shade of composite. This can only be achieved when the tooth is relatively monochromatic and the selected composite material "picks up" the tooth color during both refraction and reflection of incident light. However, good results can be often obtained using a layering technique when the clinician understands basic concepts of light and color, as well as applies a protocol supported by a mock-up restoration and a custom lingual matrix.

This article is the second of a series of two that aims to present clinical strategies for optimal success

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when direct resin-based composites are used for the restoration of moderate to large proximoincisal defects. In the first article, we discussed concepts of natural anatomy, color as it relates to dental structures, and composite selection for the restoration of proximoincisal defects. This current article presents a clinical protocol for tooth preparation, matrix selection, insertion, surface characterization, finishing, polishing, and maintenance of moderate and large proximoincisal composite restorations. A brief discussion of the available matrix methods is presented prior to a step-by-step pictorial description of the clinical protocol.

MATRIX SELECTION FOR PROXIMOINCISAL COMPOSITE RESTORATIONS

Different types of matrices and insertion techniques have been proposed over the years for the restoration of moderately large incisoproximal defects with composites, such as the use of polyester film strips (Mylar, DuPont, Wilmington, DE, USA), precontoured polyester crowns, and free-hand techniques.

Use of a contoured, clear Mylar strip is the most popular matrix technique for proximoincisal defects. The strip, which can be slightly deformed to better fit the proximal contour, is secured in place with an interproximal wedge and lingual finger pressure. When the composite is inserted, the strip is closed over the facial surface of the tooth and maintained until the composite is cured. The Mylar strip technique originated with silicate-based and autocured (paste-paste) composite restorations, in which the material had to be inserted in one large increment because of the short working time and lack of adhesion between increments. With the introduction of light curing, clinicians experienced more control over working time allowing the insertion technique to be modified. Certainly simplicity and speed are the main advantages of using the Mylar strip, bulk increment technique, but there are many disadvantages, such as the difficulty to obtain good anatomic form and proper color. Additionally, the amount of composite excess in both incisal and gingival areas is greater than in the incremental technique, requiring more time for finishing and polishing.

Preformed polyester crowns have also been used as semicustomized matrices for incisoproximal defects. In this technique a hollow preformed polyester crown with similar dimensions to the tooth to be restored is selected and modified to fit the condition. This technique can be applied in two different ways. In the first technique, once the clear crown shell is cut to fit the preparation, the composite is placed on the inside of the crown, transported to the prepared tooth, and adjusted, after which excess composite is removed and it is light cured. In the second technique, a window is cut on the labial surface through which the composite is incrementally inserted. This second technique permits the desired shape to be obtained in a more convenient way, without the amount of excess generated by the bulk-fill technique. However, the shape is not perfect as it still results in some excess composite and has some limitations on the insertion of the composite. The interproximal contact tends not to be proper owing to the thickness of the polyester crown. The lingual contour has a predetermined anatomy and needs substantial contouring to achieve adequate results as that surface is not fully customized.[1]

The difficulties associated with the use of a preformed matrix can to some extent be surpassed by the use of a free-hand technique, in which the composite is inserted and light cured incrementally without the use of a matrix. However, this technique can be more difficult to execute, especially for the untrained operator, demanding more training. To facilitate the procedure, the use of a silicone guide has been proposed, copying the preoperative lingual contour (in the case of restoration replacement) or the lingual contour of a diagnostic wax-up or restorative mock-up.[2,3] Once obtained, the silicone guide is used as a custom matrix that, associated with the free-hand insertion technique, generates the final restoration. The anatomic form, including incisal length, height of contour of the lingual embrasure(s), and even occlusal stops and

excursive contacts, can be checked in the wax-up or mock-up stage and copied with the silicone matrix.

As mentioned, the silicone guide can be obtained from a wax-up or from a mock-up restoration placed in situ. The latter method helps to select the color of the restoration as the light conditions for the mock-up are the same as those for the final restoration. If the clinician notices that the composites selected do not produce a good tonality, he or she can fine tune the selections. Consequently, the try-in or mock-up restoration with the selected composites is an important step for color and shape selection. This extra step might, at first, seem like a waste of time, but actually much more time is wasted if the final restoration does not present a good shade match. Part I of this series described color and composite selection in great detail.[4]

Figure 1. Initial view of the maxillary central incisors with deficient composite restorations. Esthetic analysis revealed that the tooth length was the same as the width. A small increase in length was planned.

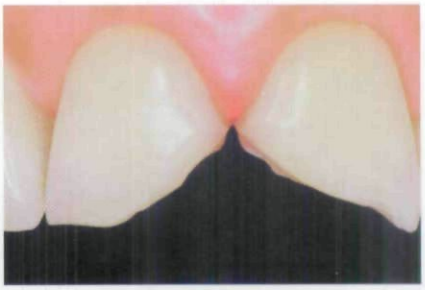

Figure 2. Tooth preparation with emphasis to the 1 mm bevel. This conservative bevel was possible because both central incisors are being restored. Small composite excess beyond the bevel is allowed.

CLINICAL PROTOCOL

The following case report is used to illustrate the proposed protocol. A healthy, 20-year-old female presented to our clinic with a desire to modify or replace the restorations of her maxillary central incisors owing to esthetics (Figure 1).

Cavity Preparation

After an intraoral evaluation, shade selection, and mapping of the details present in the neighboring teeth while they were still moist, the patient was anesthetized and the defective restorations were carefully removed. The tooth preparation for a proximoincisal defect should be as conservative as possible, consisting in excavating any existing carious dentin and/or enamel, removing existing undesired restorative material and/or base, and adding a facial enamel bevel to better mask the facial interface as discussed below. In this case a 1 mm round bevel was placed (Figure 2). The preparation is not extended for retention and/or resistance form to avoid weakening the tooth and exposing the restoration to more lingual functional contacts than is absolutely necessary. The standard preparation design for a proximoincisal restoration involves the placement of a 1 to 2 mm 45° bevel on the facial enamel for esthetics.[5] The length of the bevel as well as its depth typically respects the amount and thickness of the residual natural enamel. Improvements in adhesive systems reduced the need of the bevel to achieve retention,[6] but bevels are still used to allow for a natural color transition from tooth to the restoration.[7,8] The traditional 45° angle flat bevel can be replaced by a round bevel configuration, but there is no conclusive evidence that favors a single-bevel method.[9,10] An extension of the opaque dentin over the bevel helps to mask the interface, as is described below.[7] For esthetic reasons the bevel is more important in the labial and proximal aspects than in the lingual aspect, since the latter is not visible. The bevel could be reduced or eliminated when the aim of the restoration is to discreetly realign the tooth or teeth. If a base material is used for pulp capping or pulp protection, the bevel should be placed after the base to avoid contamination of the margin when placing the base. Restoration margins placed at the middle third of the crown are easily noticed owing to its importance in determining the tooth's value. These cases might require a wider, more pronounced bevel to better hide the restoration's margin. Incidentally, the cervical third of a tooth plays a major role in determining the tooth's

chroma, the middle third determines the tooth's value, and the incisal third determines the tooth's translucency characteristics.[11]

Restorative Try-In and Silicone Guide

Immediately after the bevel preparation, a quick restorative try-in is performed to check the final tonality of the previously selected resins.[2–4] The try-in also determines the best anatomic form for the restoration to be copied on the silicone guide. It could be performed directly on the tooth or previously waxed in a stone model. If made intraorally, the tooth should be maintained hydrated. The restorative try-in should be made soon after the cavity preparation, simulating the exact condition of the composite thickness. In Part I of this series, the relationship between tonality, thickness, and composite type and the lack of precision offered by the commercially available shade guides was discussed,[4] as was the change in tonality that can happen after composite curing.[12,13] The final restoration can have differences in tonality if the restorative try-in has a different thickness from the final restoration. Other methods of shade selection have been described but are not totally appropriate for esthetic and demanding situations such as the one described here. In the case presented, the restorative try-in was concluded successfully (Figure 3). A small increase in the tooth length was accomplished. The restorative try-in was adjusted in the patient's maximum intercuspation position. The time invested in generating a proper try-in and custom matrix is later saved at contouring, finishing, and polishing.

Figure 3. The try-in restoration defines the anatomic form of the restorations and the composite shade and thickness for each increment. These try-in restorations were made with a free-hand technique, without adhesive procedures. Small shape corrections were made with sandpaper disks and diamond points. The lingual surface and the incisal edge receive special attention once they are copied.

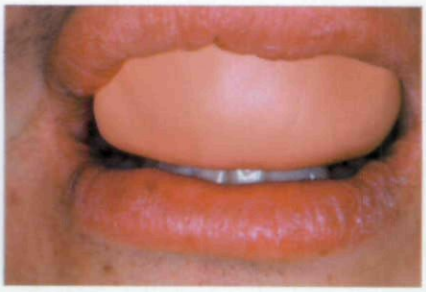

Figure 4. A fast-setting silicone putty material is used to copy the lingual surface and incisal edge. This impression becomes the silicone guide (or key).

The restorative try-in is impressed with a good-quality, fast-setting silicone putty material (Figure 4). The impression should be precise in the lingual surface and incisal border of the affected teeth—free of bubbles, foldings, or fissures. With a surgical blade, the impression is sectioned at about half the thickness of the incisal border, as shown in Figures 5 and 6. Only the lingual half of the guide is used in this technique. Figure 7 shows that the cut guide still maintains half the thickness of the incisal border, which was slightly reduced (Figure 8). Once the custom matrix is obtained, it is set aside for a later use.

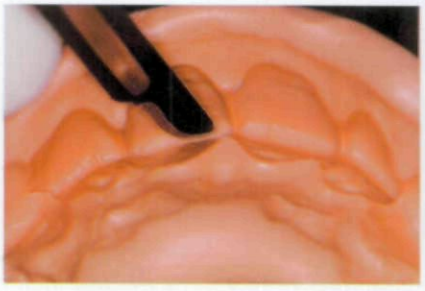

Figure 5. The silicone guide is trimmed at the incisal border. Only the lingual half is used in this technique.

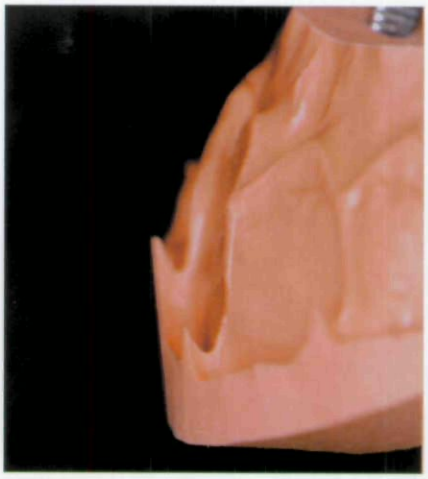

Figure 6. Lateral view of the silicone guide reduced in the correct place.

Figure 7. The guide can be tested until fully adapted. This photograph shows that the matrix needs reduction at the incisal border.

Figure 8. After adjustment the entire facial surface can be visualized.

Figure 9. View of the teeth isolated and bonded.

Bonding

The teeth were isolated with a rubber dam for better visualization of the composite layers, not being mandatory in this type of restoration. The restorative try-in was removed, and the enamel and dentin were etched and bonded following current techniques (Figure 9). The silicone guide was seated and its adaptation confirmed (Figure 10).

Insertion of the Translucent Lingual Enamel

A microhybrid composite (Charisma I, Heraeus Kulzer, Armonk, NY, USA) was selected for the lingual enamel, having a whitish translucent tonality. A small amount of the composite was spread across the corresponding lingual surface of the silicone guide (Figure 11). With the composite still uncured, the guide was seated on the teeth. When observing the profile of the tooth, any excess composite in the dentin area should be redistributed or eliminated. The translucent resin cannot invade the dentin area (Figure 12). After curing the lingual composite layer for 20 seconds with the guide firmly kept in place, the guide is removed (Figure 13); the lingual surface of the tooth is now established (Figures 14 to 16). These illustrations show that the translucent lingual enamel composite does not invade the dentin area.

Insertion of the Internal Layer of Opaque Dentin

The internal layer of opaque dentin defines the chroma and opacity of the restoration.[14] In our case the patient's smile revealed teeth with low chroma (between A1 and A2 in the Vita guide [Vita Zahnfabrik, Bad Sackingen, Germany]). Accordingly,

Figure 10. The guide is tested again to verify the adaptation after the rubber dam insertion. The space that will be filled with the restoration can be seen.

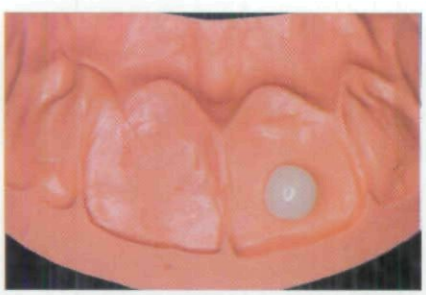

Figure 11. The composite corresponding to the lingual surface is placed inside the guide with silicone points and paintbrushes. Enough composite to fill the restoration area is placed, without too much excess. A translucent whitish resin (Charisma Incisal) was chosen, simulating the lingual enamel layer.

Figure 12. The guide is taken to the patient's teeth prior to curing the composite. With the composite adaptation on the lingual margin, excess composite invading the dentin area or lack of composite is verified. The composite is polymerized for 20 seconds.

Figure 13. The guide is removed from the teeth, and the restoring space is defined (height and width) for the composite plate corresponding to the lingual surface.

Figure 14. View of composite plate on the lingual surface. Note the excellent composite adaptation to the bevel margins, reducing the finishing procedures in this area.

Figure 15. Incisal view of the lingual resin plate.

the opaque dentin needed to be OB2 or OA2 (Charisma OB2; Esthet-X OA2, Dentsply/Caulk, Milford, DE, USA). Next, the composite is inserted against the lingual surface that is already cured (Figures 17 and 18). The dentin layer should cover just a part of the bevel, not extending until its end. This helps mask the interface, resulting in an imperceptible composite-tooth transition. The dentin composite increment is modeled similarly to the initial drawn plan (Figure 19). Such a drawing or map can be helpful in determining with more precision how much of each shade is necessary in each location. Figure 20 demonstrates several forms that the dentin mamelons can assume in the incisal third of teeth. The larger the mamelon contrast is in the incisal third, the larger the opaque dentin extension is to the incisal border. Not all patients require visible mamelons, but whenever necessary, these opaque dentin extensions should be covered by a high translucent enamel composite to increase its visualization (eg, Filtek Supreme YT or GT, 3M ESPE, St. Paul, MN, USA; Esthet-X YE, Dentsply/Caulk). The composite layers are cured using a pulse-delay or soft-start method to minimize shrinkage.[15]

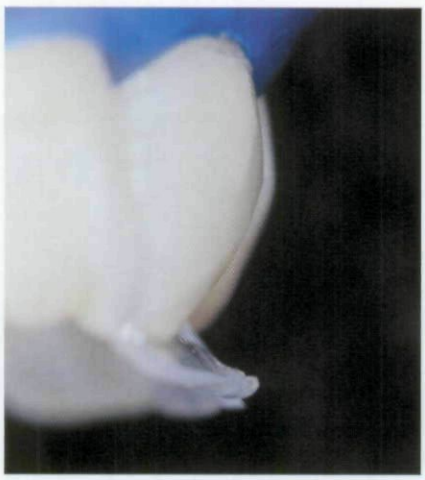

Figure 16. Proximal view of the lingual resin plate. The proximal view is used to observe whether the translucent composite invaded the dentin area of the restoration.

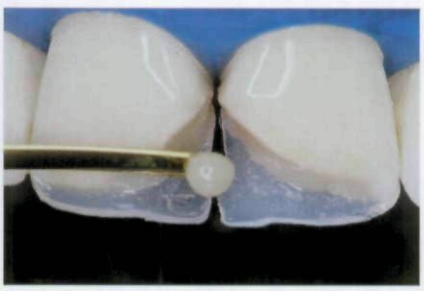

Figure 17. Composites corresponding to the dentin are applied to the resin lingual plate. The placement of these increments is facilitated by the cured lingual increment.

Figure 18. The opaque dentin should reproduce the dentin mamelons.

Insertion of the Translucent Dentin Layer

This layer complements the inner, more opaque dentin. A translucent dentin layer provides optical vitality to the dentin stratum. If only opaque dentin is used, the restoration looks dull, matte, and too opaque. Some composites offer great variation among the opaque

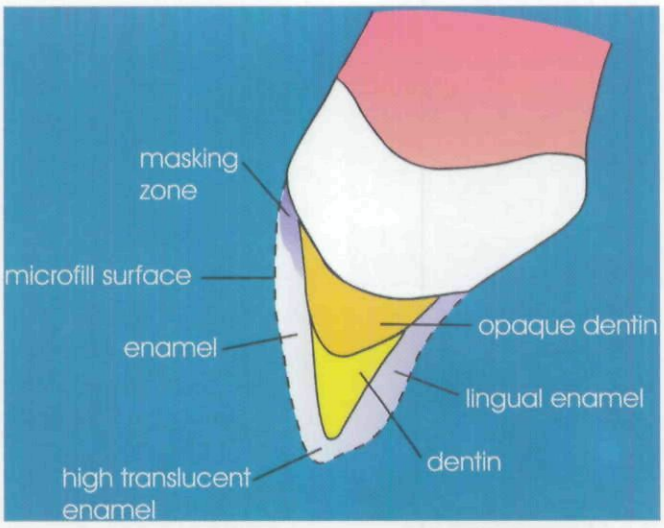

Figure 19. Schematic drawing showing the location and thicknesses of the layers of composites drafted for the restoration of the teeth. When the mamelons need to be more evident, the opaque dentin should be extended to the incisal border, creating a larger contrast with the translucent enamel.

and regular dentin pastes. In the proximal areas and mamelon ends, an A1 composite (Charisma) was applied.

Masking of the Composite-Tooth Junction

To ensure that the composite-tooth junction is not noticeable, this area is covered with a thin layer of opaque microfill composite.[7] If the desired final basic shade is B1 or B0, a lighter opaque resin should be used (eg, Durafill SLO, Heraeus Kulzer). If the final basic shade is universal (A2), an opaque OA2 or OB2 is used. This layer should be thin to not result in an opaque strip in the surface of the final restoration. A microfill composite is the material of choice for this area owing to its brightness and polishability (Figure 21).

Insertion of the Incisal Opaque Border

When an incisal "halo" effect is desired, an opaque hybrid or microfill composite should be applied as a thin line across the incisal border (Figure 22). This optical phenomenon is noted especially in young

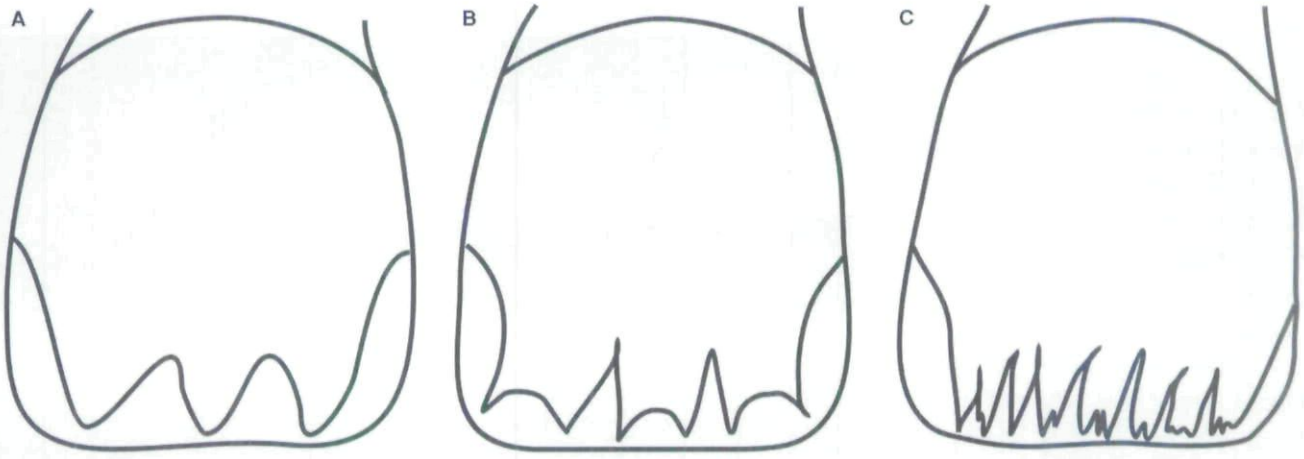

Figure 20. A, *Schematic showing the most classic appearance of the incisal border. This format can be called tridigital because it presents three defined mamelons.* B, *This illustration indicates another way of showing the dentin mamelons. The digital format comes bipartite(it occurs when a single digit divides in two ends), creating dentin fillets that are projected in the direction of the incisal border.* C, *The form of the incisal mamelons shown here is more difficult to recognize and reproduce. Often it is necessary to create internal paintings in this restoration area to evidence these fine projections of the dentin in the direction of the incisal border.*

Figure 21. A small amount of opaque microfill composite is distributed in a strip form following the resin-tooth junction over the bevel. This resin is already positioned in the surface of the restoration. The finish and distribution of this resin layer should be the best possible, emphasizing the good restoration shape.

Figure 22. After the opaque microfill resin is applied, it is possible to notice larger softness in the shade transition from resin to the tooth (in the area of the bevel).

natural teeth and can be reproduced with composites.[16,17]

Insertion of the Enamel Layer

Proximoincisal restorations are located where the natural enamel is the thickest. The enamel composite layer fills the spaces between the mamelons and defines the final restoration shape (Figures 23 and 24). The thickness and degree of translucency of the composite used in this layer is directly proportional to the translucency characteristics of the adjacent natural enamel and/or teeth. Likewise, the tone of the composite should follow the selection of the enamel tonality of the patient's teeth.

Final Coating with Microfill Composite

The long-lasting, high surface gloss and texture are obtained with microfill composites, producing a natural aspect. Gloss and texture should reproduce the existing characteristics of the adjacent enamel and/or teeth.[18] The color selection should be similar to the enamel layer, and usually just one color is used because the desired tonality has already been inserted. The proximal area has a double convexity, facial to lingual and cervical to incisal. Excess composite is removed and paintbrushes help to distribute and plane the composite in the surface. The application of this layer should not require more than three increments, although the number of increments depends on the extension of the defect. If more than one increment is used, care should be taken to avoid the development of undesirable composite interfaces.

Final Evaluation of the Shape and Polishing

The final shape is checked from all angles to certify that no excess or lack of composite is present (Figures 25–27). If an excess is noted, a curved scalpel blade and/or sandpaper disks are used to contour the restoration. Care should be taken when applying the composite layers because too much excess can result in the operator removing the characterization obtained from the layering technique upon adjusting

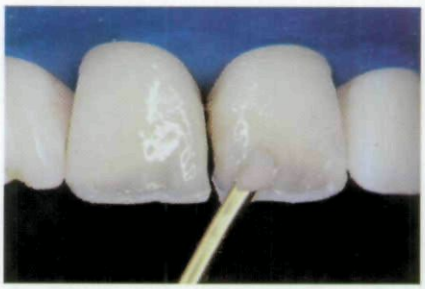

Figure 23. View of the facial enamel layer placement. A thin layer of Charisma Incisal was distributed in the facial area of the restoration, with limits among the incisal border and the layer of the opaque microfill resin and proximal areas. The interproximal contact was not yet established, and care was required to avoid gluing one tooth to another. Fine paintbrushes and fine metallic spatulas were used to model the resin in the proximal areas.

Figure 24. Flat paintbrushes about 3 to 5 mm wide are used to model the facial composite. At this time the shape is practically concluded, but a small space exists for the microfill coating.

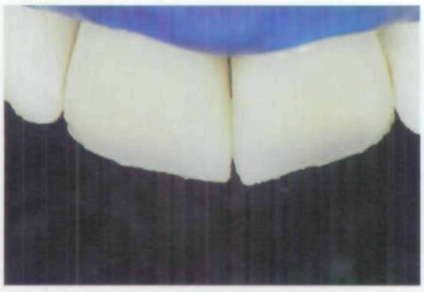

Figure 25. The cervicoincisal view is used to determine deficiencies in the facial contour.

Figure 26. Incisal view. Looking "up" from the incisal edge, the clinician should determine at this point whether more composite is necessary.

Figure 27. Frontal view before removal of the rubber dam.

the restoration contour (Figure 28). As the restoration's contours are established during the insertion of the composite layers, the need for gross reduction and contouring with rotary instruments is greatly minimized. If anatomic form adjustments are deemed necessary after all composite has been placed and cured, fine diamonds or spiral-cut multibladed burs can be used. Round and oval instruments are used on the lingual surface, and flame-shaped instruments are used on the facial surface and proximal embrasures.

Polishing resulting in a high gloss can be obtained in several ways and with different polishing instruments. Surface smoothness generally is produced with low-speed, rubber-based disks or cups (eg, Jiffy Polishers, Ultradent Products Inc., South Jordan, UT, USA; PoGo, Dentsply/Caulk; Contour and D-Fine, Clinician's Choice, New Milford, CT, USA). A paste is typically used for polishing (eg, Opal no. 520-000, Renfert, Hilzingen, Germany). High gloss is obtained with a brush of natural bristles rotating on the resin (Figure 29). The surface of anterior composite restorations is sometimes flat, sometimes rounded, so the goal of finishing/polishing is to generate a composite surface that mimics the adjacent natural tooth surface not only in optical properties but also in surface texture. Care should be taken not to eliminate the natural enamel surface texture adjacent to the restoration during the finishing/polishing process.

Figure 28. Frontal view after the rubber dam has been removed and before polishing. Note the minimal excess composite present.

Figure 29. Frontal view after polishing and rehydration of the teeth.

DISCUSSION

Obtaining an invisible composite-tooth interface when restoring anterior teeth with composites is a difficulty encountered by many clinicians. A dark yellow or grayish line at that interface may occur after the complete hydration of the tooth, which is not noticeable until hours after the completion of the restoration.

The dark line can be caused by sclerotic dentin in the interface increasing the opacity and chroma (Figure 30A and B). When the tooth-restoration is observed in a frontal view, the inner dark tonality appears in the surface as a gray or brown line. For recently fractured teeth in which sclerotic dentin has not yet

Figure 30. Replacement of a deficient proximoincisal restoration on a maxillary central incisor. A, *Preoperative view. Shade selection for this tooth needs a clear and low translucency enamel in the incisal third. Dentin mamelons are not visible. The opaque dentin should be light in tone.* B, *After removing the unsatisfactory restoration, it is possible to notice the opaque and dark sclerotic dentin. To mask such dentin, a less conservative bevel is necessary. A 3 mm bevel was made to increase the material thickness almost simulating the overlay or composite veneer technique.* C, *Postoperative view of the restoration after polishing and hydration of the tooth.*

formed, the interface tends to be less visible. However, the dark line can become visible over time. The dark line can be also caused by light interaction with the interfaces of the composite, adhesive, and tooth owing to more light penetration in this area. If the light is not reflected similarly to the tooth but is rather absorbed, a slight reduction in value is noticed, resulting in the dark color.

An abrupt difference in value and translucency of the dentin composite in comparison with the tooth can also render the restoration noticeable. Knowledge of the tooth structure optical properties and correlation with the composites is necessary. The central area of the tooth is crucial for the visual impression of its value (Figure 30C). The dentin composite layer should react to the incident light (diffusion, reflection, and refraction) similarly to the way natural dentin reacts. If the light penetrates into the composite more than into the tooth, it means that the composite is more translucent than the tooth, which will make it appear too gray.

Finally, it should be noted that restorations placed in relatively translucent areas of teeth, such as proximoincisal composite restorations, even when perfectly matched in the immediate postoperative period, might become visible over time owing to changes in both the natural tooth and the composite material.

CONCLUSIONS

With the improvement experienced on composite technology, more and larger anterior dental defects can be restored successfully with direct composite resins as opposed to more invasive ceramic restorations. This is particularly true with young patients in whom ceramics might not yet be indicated. The restoration of proximoincisal defects with composite requires attention to detail, a good understanding of color and shade selection, and the use of correct composite materials and shade(s), as well as the application of a protocol composed of logical steps that enable the clinician to obtain satisfactory esthetic results with less guesswork.

DISCLOSURE

The authors do not have any financial interest in the companies whose materials are discussed in this article.

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