Re-anatomization of Anterior Eroded Teeth by Stratification with Direct Composite Resin

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ABSTRACT

Gastroesophageal reflux disease (GERD) is a condition where stomach acids are chronically regurgitated into the esophagus and oral cavity, resulting in the irreversible erosion of tooth structure. The dentist often is the first health care professional to identify the affected dentition. Restorative treatment should be accomplished after management of the systemic condition. Dental treatment improves the patient's oral hygiene, reduces thermal sensitivity, prevents pulpal involvement and further abrasion, and esthetics are improved. This article presents a case report where dental erosion was present because of GERD. Conservative dental treatment of the eroded dentition is described, including diagnosis, treatment planning, bleaching, and restorative reconstruction with direct composite layering techniques without any preparation of the tooth structure. After 1 year of clinical service, the restored teeth present an excellent clinical appearance and require no repair or polishing.

CLINICAL SIGNIFICANCE

The treatment of eroded teeth, caused by gastroesophageal reflux disease (GERD), with direct composite resin appears to be a conservative and esthetic procedure that is well accepted by patients. However, this treatment can be carried out only after complete management of the causes of the GERD.

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INTRODUCTION

Chronic exposure to acids in the oral cavity may result in dental erosion. Dental erosion is an irreversible process characterized by mineral loss, and is usually a secondary manifestation of systemic illnesses. Dental erosion by acids may be caused by external or internal sources. An example of external sources is acidic foodstuff, whereas internal sources typically comprise regurgitation and/or vomiting.[1]

Dental erosion can be associated with gastroesophageal reflux disease (GERD). GERD, popularly called *reflux*, is a gastroesophageal disorder characterized by transient relaxation of the lower esophageal sphincter and passive regurgitation of stomach acids into the esophagus and oral cavity.[2] Manifestations of GERD include esophageal erosion and ulcers with resultant blood loss, asthma-like symptoms and chronic cough if refluxed material is spilled into the larynx

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Figure 1. Pretreatment view of the patient. Note the yellowish color and the presence of several diastemas between the anterior teeth.

and tracheobronchial tree, and dental erosion.[3–5] Once a diagnosis is established, the purpose of the medical intervention is to reduce the production of stomach acid.[6]

Dental erosion associated with GERD might occur both on the facial and lingual surfaces of the teeth. The action of the intrinsic acid may be modulated by the protective influence of the tongue, which forces regurgitated acid over its surface, along the palate, and into the buccal vestibule.[7] The dentist should consider restorative treatment when: (1) the structural integrity of the affected teeth is threatened, (2) the teeth are hypersensitive, (3) there is significant loss of tooth structure, vertical dimension, and/or function, (4) the defect is esthetically unacceptable to the patient, and (5) a pulpal exposure is likely to occur.[8]

Nowadays, there are many modern composite resins developed for highly esthetic procedures that, when properly used, can result in restorations that are indistinguishable from the natural dentition. This can be achieved by supplying the dentists with a high variety of dentin, enamel, and characterization materials whose shades and levels of translucency are coordinated with each other and with the natural dentition. Therefore, by employing composite stratification techniques to reproduce the shade, shape, and translucency of the teeth in such a way that they regain their original appearance, clinicians can reproduce the esthetics of the natural teeth without the need of a substantial tooth preparation required for indirect ceramic restorations.

The following clinical case describes a conservative approach to restoring dental erosion resulting from GERD using direct resin composite. After management of the disease with medication, dental treatment including diagnosis, at-home vital bleaching, and direct restorative reconstruction of the eroded dentition was completed.

CASE REPORT

A 24-year-old patient came to the University Estadual de Ponta Grossa, Paraná, PR, Brazil with complaints of dissatisfaction about the appearance of his teeth, such as yellowing and chipping of the incisal edges of his incisors (Figure 1). Clinical evaluation revealed marked wear on the palatal surface and incisal edge of the maxillary teeth. In the palatal surfaces, the dentin was already exposed in the four maxillary incisors and in the two canines. Shallow erosive lesions were also present on the cervical region of the maxillary anterior teeth. The patient had no complaint of sensitivity. His medical history was contributory. The patient confirmed having a history of gastrointestinal problems during his teenage years, which was treated accordingly by a gastroenterologist.

Figure 2. Night guard vital bleaching with a custom-fitted tray and 7.5% hydrogen peroxide gel.

Figure 3. Frontal view of the patient after 3 weeks of vital bleaching.

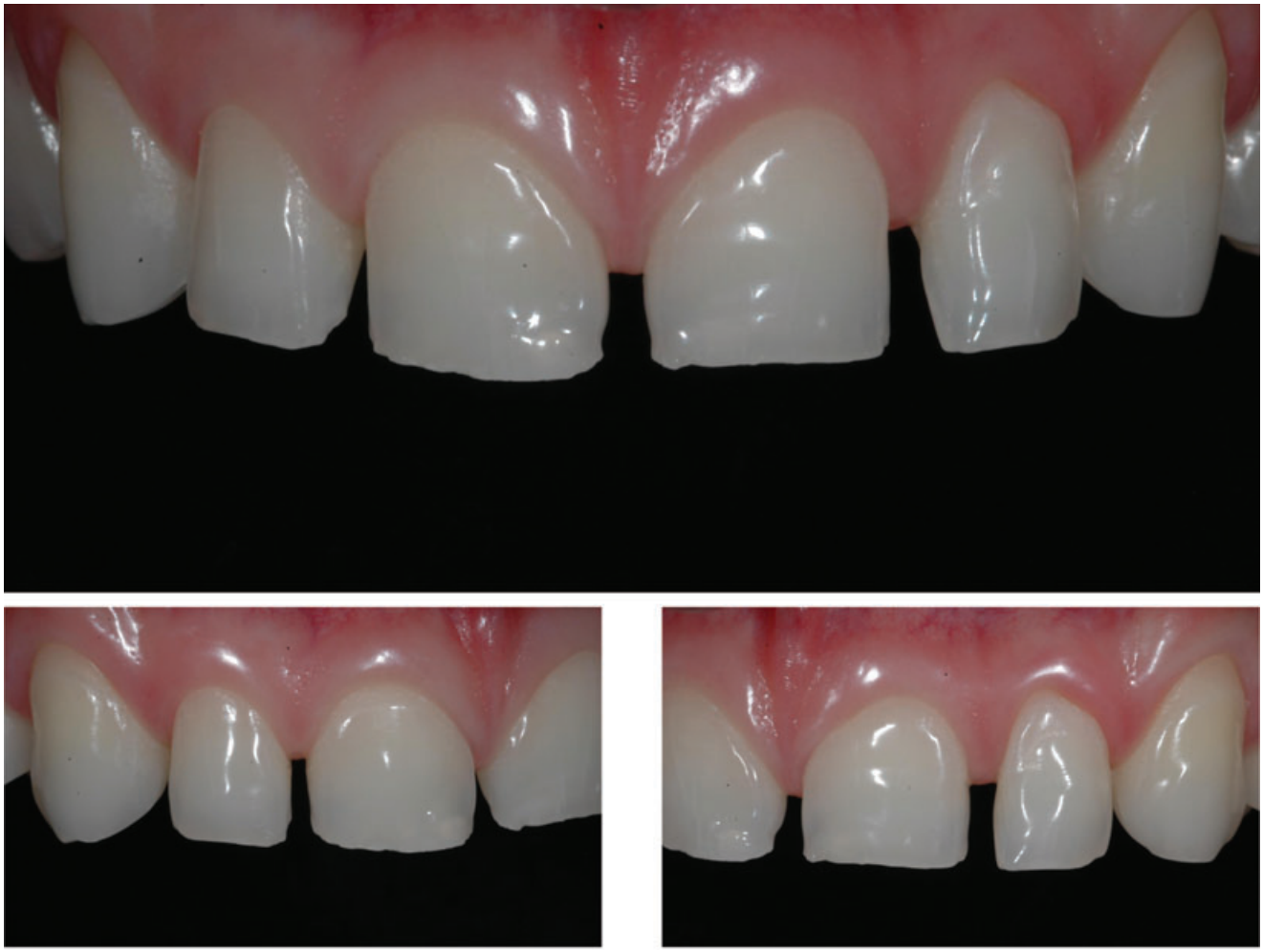
Considering that the systemic condition was controlled and stabilized, the esthetic and restorative procedure was initialized. Before the beginning of the restorative treatment (i.e., reconstruction of the dental tissue lost because of chemical dissolution) the patient had his teeth bleached. The initial shade (A3.5) of the central incisors was recorded using a value-oriented Vita Classical shade guide (Vita, Vident, Baldwin Park, CA, USA). An alginate impression (Jeltrate Plus, Caulk/Dentsply, Milford, DE, USA) was taken from the maxillary and mandibular arch, and filled with dental stone to produce study models. No block-out material was applied onto the labial surfaces of the study model teeth.[9] A soft vinyl material of 0.9 mm (FGM Dental Products, Joinvile, SC, Brazil) was used to fabricate the custom-fitted tray for the whitening gel. The excess of labial and lingual surfaces was trimmed just 1 mm away from the gingival junction (Figure 2).

The tray and 7.5% hydrogen peroxide gel syringes (White Class, FGM Dental Products) were delivered to the patient with instructions for use. The patient was instructed to wear the agent twice a day for 30 minutes. This procedure was carried out for 3 weeks until the achievement of a B1 shade (Figure 3). The patient did not report any tooth sensitivity throughout the bleaching regimen.

After planning the restorative treatment (Figures 4–6), a new alginate impression was taken from the maxillary arch of the patient, and a new stone model was fabricated. The stone model was waxed-up so that the patient's diastemas were closed and the cervical–incisal dimension re-established. The central thing in this type of wax-up is the palatal surface and the incisal edge, as the format of the facial surface will not be guided by the wax-up model.

The overall vertical dimension of the patient was preserved, as the molar and premolars were not affected by the erosive action of the acids from the GERD, which facilitated the restoration of the anterior vertical dimension.

Using a putty addition silicone impression material, an impression of the palatal and incisal third of the teeth surfaces from the wax-up cast model was prepared to fabricate the silicone guide (Figure 7). The facially portion of the silicone guide was removed with a sharp blade to outline the palatal surface; the silicone guide should envelop the incisal edge of the waxed tooth but not embrace it facially. Shade



Figures 4–6. Preoperative view of the anterior teeth for esthetic analysis. Note the reduced length of central incisors, the vestibular positions of lateral incisors, and the spaces between the teeth. The mesial to distal and cervical to incisal length of the anterior teeth need to be restored.

selection must be performed prior to rubber dam isolation because tooth dehydration results in an elevated value and may cause the selection of an incorrect shade. Initially, the shades were selected using the oriented-value Vita Classical shade guide (Vita, Vident). The artificial enamel is the shade that will overlay the entire restoration and is usually determined first. The shade selected by the Vita shade guide is then tested with the composite restoration to be used. A small increment (usually with the thickness that will be used, as an increase in thickness results in an elevated chroma) is placed onto the incisal third of the tooth and polymerized within the time recommended by the manufacturer. The composite and the teeth are then moistened with the patient's own saliva to simulate the appearance of a highly polished composite. Only then can it be determined whether the selected resin will accurately match the tooth. Bear in mind that microhybrid composites are usually "lighter" (higher value, lower

Figure 7. A diagnostic wax-up carried out to determine the desired restorative outcome and a silicone guide created to aid the first increment of the restoration.

Figure 8. Intraoral test of silicone guide.

chroma) at the unpolymerized stage, attaining a "darker" tone (lower value, higher chroma) after polymerization. In this clinical case, a chroma variation could be perceived cervico-incisally, and therefore, the same procedure was repeated for the middle third of the teeth.[10]

The same protocol was followed to the determined dentin shade; however, the area selected to place and polymerize the resin increment was the cervical third where the enamel thickness is lower and affects less the dentin shade. The incisal third usually presents the greatest restorative challenge because of its variation in hue, chroma, translucency, opacity, and presence of opaque halo.[10] All these variations should be recorded in a chromatic map of the tooth highlighting the translucent areas; the presence of opaque incisal halo; and possible characterizations, such as white or yellowish stains, as well as the corresponding selected shades.

After tooth prophylaxis, modified rubber dam isolation was fitted and stabilized. In this modified technique, four to six holes are perforated side by side in a way that a groove instead of circular holes is created. Then, all the anterior teeth to be restored can be placed altogether in this groove. Some advantages can be listed by use of this technique. Clinicians can have free access to the gingival area while maintaining the field free of saliva coming from the parotid glands, the wet environment caused by the breathing is reduced, and the rubber dam isolation prevents the contact of the tongue with the teeth.

Prior to initiating the restoration procedures, the silicone guide should be tested as to its adaptation (Figure 8). A 35% phosphoric acid gel (CondAc, FGM Dental Products) was applied for 15 seconds over the entire tooth surface (both facial and palatal). This procedure was done after protection of the neighboring teeth against the action of the acid. The tooth was then washed with an air–water spray. The entire tooth surface was air-dried and the exposed dentin surfaces were re-wetted with a disposable brush (Cavibrush, FGM Dental Products). Afterward, the adhesive system Adper Single Bond 2 (3M ESPE, St. Paul, MN, USA) was applied in two coats following the manufacturer's guidelines. Care was taken to ensure an adequate solvent evaporation prior to the light curing step (10 seconds),

Figure 9. A thin layer of translucent microhybrid composite resin inserted on the guide.

Figure 10. The silicone guide with the artificial palatal layer positioned on the tooth.

which was performed with a quartz tungsten halogen light set at 500 mW/cm^2 (VIP, Bisco Inc., Schaumburg, IL, USA).

Using a round-ended spatula (26/27S Burnisher, Hu-Friedy, Chicago, IL, USA), a small ball of translucent enamel microhybrid composite (T-Neutral shade, Opallis, FGM Dental Products) was placed on the silicone guide and spread over the silicone guide surface, as this layer of composite was aimed to cover all the exposed dentin at the palatal surface (Figure 9). Care was taken to avoid the insertion of large air bubbles and also the application of an excessively thick layer of resin. Subsequently, the silicone guide was placed into position (Figure 10), and the first resin layer was polymerized for approximately 40 seconds with the same light-curing unit described earlier. Then, the silicone guide was cautiously removed.

With the aid of a special spatula (Thompson #1, Thompson Dental Products, Houston, TX, USA), a small ball of dentin shade (DB1, Opallis, FGM Dental Products) was placed into position, and the mesial, median, and distal lobes were constructed in one operation. Some small grooves were created with the help of a probe (Thompson Dental Products) before the polymerization of the resin (Figure 11). Using the same spatula, a very small ball of blue hue opalescent enamel (T-Blue, Opallis, FGM Dental Products) was placed in the region of the incisal third in between the mamelon spaces, and between the mamelon extremities and the incisal edge without reaching it (Figure 12). This composite is more translucent than the enamel shades, and therefore can optimize the translucency of the incisal areas in between the mamelons, and between the mamelon extremities and the incisal edge, conferring a sensation of "depth" on the restoration. The composite was then light cured for 40 seconds. A small strip of a high opaque composite (OW, Opallis, FGM Dental Products) was placed on the incisal edge to intensify the effect and shape of the opaque halo (Figure 13). This composite increment was light cured for 40 seconds.

The artificial enamel was restored with the same microhybrid resin (Opallis, FGM Dental Products). Shade EB1 was selected for the cervical third, E-Bleach L for the medium third, and VH for the incisal third (Figure 14). The three composites were carefully

Figure 11. Dentin lobes sculpted with an opaque composite resin. Note the spaces left in between the lobes, and between the lobes and the incisal border characteristic of young teeth.

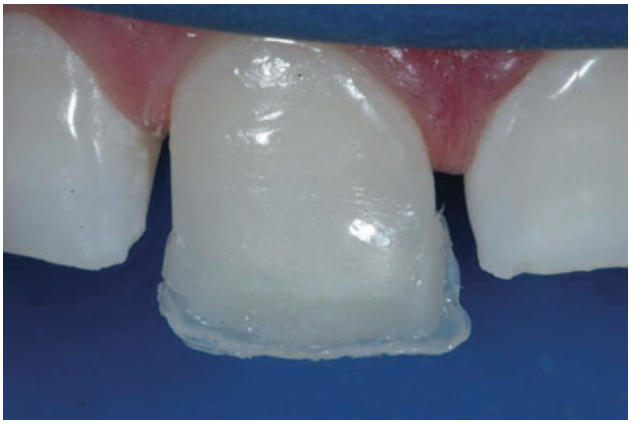


Figure 12. An opalescence composite resin was positioned on the lobes to simulate the bluish appearance of the incisal third.

Figure 13. The incisal halo created with a white opaque composite resin.

Figure 14. Application of translucent resin to create the artificial facial enamel. The cervical third was created with EB1 shade, the middle third with bleach shade, and the incisal third with a high-value shade composite resin.

applied from cervical to incisal area with a flat spatula to completely cover the underlying resin layers in one operation. The shades were blended with the help of a flat-tipped artist brush (Hot Spot Design, Cugy, Switzerland), and light cured for 80 seconds: 40 seconds at the cervical area and 40 seconds at the middle and incisal area.

After an initial finishing of the right central incisor (Figure 15), the same procedure was repeated for the left central incisor, both lateral incisors, and canines. The final restorative treatment without finishing and polishing procedure can be seen in Figure 16. A sharp, curved blade was used to remove composite excess in the cervical area of all teeth (Figure 17). In order to achieve facial symmetry,

Figure 15. The completed restoration of right maxillary central incisor after initial finishing and polishing previously the restoration of left maxillary central incisor. This procedure is fundamental to avoid bonding of two central incisors when achieving proximal contacts.

Figure 16. Facial view of maxillary anterior teeth restorations prior to finishing and polishing procedures.

Figure 17. Removal of composite resin excess of cervical area with sharp curved blade.

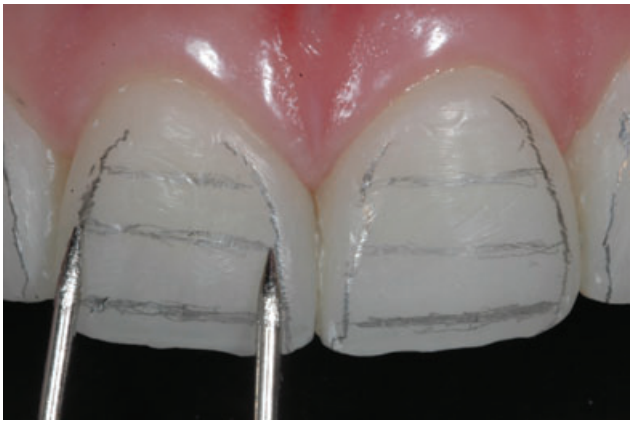


Figure 18. Lines were drawn along the proximolabial line guides to determine the light-reflecting areas of anterior teeth. The width and contour of these lines must be symmetrical and can be measured with a caliper.

the distance between the vertical ridges of both incisors should be verified. As seen in Figure 18, the vertical ridges of both incisors were outlined with a pencil, and the distance in the cervical, middle, and incisal third of both teeth were checked by means of a sharp-ended caliper. In case of any discrepancy, a coarse disc (Sof-Lex Pop-On, 3M ESPE) can be used to achieve symmetry between similar teeth at opposite arch sides (Figure 19).

After reaching the desired cervico-incisal and mesial-to-distal length, the facial and palatal surface was finished with a coarse silicone impregnated cup (Astropol F, Ivoclar Vivadent, Amherst, NY, USA) in order to prepare the teeth

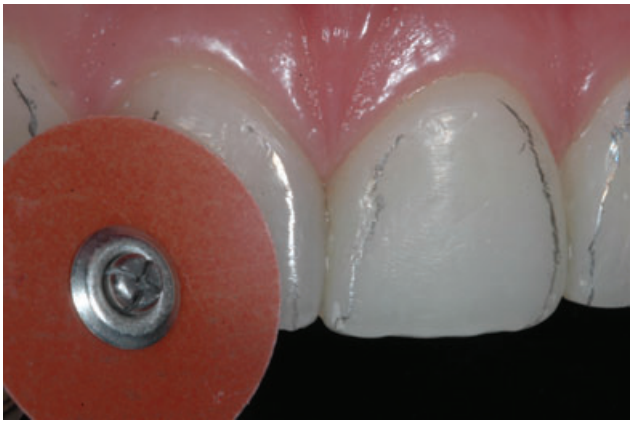


Figure 19. The finishing of contour and the symmetry of light-reflecting areas were established with abrasive disks.

Figure 20. Finishing of surface with silicone abrasive cups.

Figure 21. The surface texture was drawn with pencil and re-created with a tapered extra-fine diamond bur.

Figure 22. Polishing with silicone rubber cups to eliminate undesired excessive texture.

for macro surface texturization (Figure 20). Lines were drawn along the ideal position on the facial surface of the restored teeth to guide the attainment of the surface texture, which was performed by means of a fine-grit diamond tapered bur (3195F, KG Sorensen, São Paulo, SP, Brazil) (Figure 21). The entire restoration was then buffed with a green silicon impregnated cup polisher (Astropol P, Ivoclar Vivadent) in order to eliminate some of the undesired accentuated texturization (Figure 22). Final polishing of facial surface was achieved in two stages: first, an Astrobrush (Ivoclar Vivadent, Schaan, Liechtenstein) was employed (Figure 23) followed by the use of a special felt (Flexi-Buff, Cosmedent, Chicago, IL, USA) with an oxide aluminum paste (Enamelize, Cosmedent) to luster the restoration surface (Figure 24), and one abrasive strip (Oraltech, São Paulo, SP, Brazil) was used for interproximal finishing and polishing. The positioning of the strip in the form of an "S" avoids excessive flattening of the restored proximal surface[11] (Figure 25). Special heed must be

Figure 23. Polishing with abrasive brush.

Figure 24. Buff wheel used with polishing paste to obtain high shine of composite resin restorations.

Figure 25. The interproximal regions were polished with abrasive strips.

taken to avoid wearing away too much resin, and therefore, removing the contact with the neighboring tooth. Protrusive and lateral occlusal contacts were checked after the end of the treatment.

Different views of the complete restoration after the end of the treatment can be seen in Figures 26–28. The appearance after 1 year of clinical service can be seen in Figure 29. Note that no significant difference is detectable.

DISCUSSION

Dental treatment in the affected teeth of patients with GERD improves the patient oral hygiene maintenance and reduces thermal sensitivity that many patients experience because of loss of tooth structure. It also helps to prevent pulpal involvement, dentifrice abrasion, acid erosion, food impaction, and discomfort of the tongue and cheeks. In addition, esthetics are improved and the teeth can be strengthened.[12,13]

Two factors must be considered when choosing a dental material for restoration: the wear resistance of the material and the need of further preparation to receive the new restoration. It is clear the chosen material must resist having enough wear and fracture endurance to resist the mastication forces without causing excessive abrasion of the opposing teeth. Considering that the affected teeth were already reduced in size by the erosion process itself, it would be sensible that the chosen material required the minimum preparation in order to preserve tooth structure.

Figures 26–28. Different views after the end of the treatment. The spaces between teeth were restored as well as the cervical length of the anterior teeth. The gingival tissue of the anterior teeth shows signs of normality; Figure 29. The patient 1 year after the treatment.

Before the development of modern composites, the report case could only be solved by means of porcelain veneers requiring preliminary preparation of the dental structure. However, the improvement in the mechanical properties of resin composites, as well as their optical properties, allowed the use of resin composite stratification methods as the one used in the present case report, which is less invasive and more conservative than the use of indirect restorative restorations, as no dental structure was abraded to reach the results obtained.

Extensive reconstruction of severely impaired teeth with direct composite resin is not only feasible but also predictable. However, the success of this procedure depends on the understanding of the intimate structure of natural teeth because it constitutes the basis of knowledge in the field of esthetics in conservative dentistry.[13] Natural teeth are composed of dentin and enamel, two types of hard tissues that are distinguishable by their embryonic origin and therefore they possess individual features. The way light interacts with these two substrates is also different, and this renders the tooth its vital appearance.

Light passes through these two tissues, entering them from the front. Some light is reflected from the surface of the tooth; the remainder penetrates the surface and is either reflected, refracted, or

absorbed by the inner layers of the tooth or passes through the entire tooth into the dark oral cavity. The typical color and light effects, which are created in the process, constitute the mark of the natural appearance of the teeth. It goes without saying that restorations that mimic only the shade and shape of natural teeth are easily recognized as foreign even by the untrained human eye. They must also mimic their treatment of light.

That is why clinicians should know the features of these substrates, use compatible artificial enamel and dentin composites, as well as know the morphology and the optical features of all parts of the tooth to be restored in order to achieve optimal esthetic and functional results. Dentin is opaque and represents the complex core, rich in hue, chroma, and fluorescence.[11] It is covered by the enamel layer, which is translucent and opalescent.[11,14] The most opaque composite used in the present case report was the OW for the reproduction of the opaque halo. The translucency of this composite is only 33–35%. The translucency of the dentin shade DB1, the enamel shades (EB1 and E-Bleach L), and the effect enamel shades (T-Neutral and T-Blue) is respectively 41–44%; 55–56% and 70–80% according to the Opallis technical product profile. All these variations can re-create the optical features of the dental structure, giving the tooth structure the vitalescence back, if properly placed.

Many other aspects should be taken into consideration as the inner morphology of the dentin, the thickness of dentin and enamel in each third, the differences between young and old teeth, and the simultaneous knowledge of the composite resin system for the accurate selection of the shades to be used to reproduce the lost tissue. The selection of the correct hue/chroma, as for instance B1, does not necessarily mean that the final color of the restoration will match the remaining tooth structure. In translucent bodies, the chroma is strongly influenced by the increment thickness; in other words, the greater the thickness, the greater the saturation.[15] This means that the awareness of the enamel and dentin thickness variation in the cervical to the incisal direction is an essential requirement for composite build-ups, as this will favor the achievement of excellence.

Another important aspect that clinicians should be aware of is that, of the three components of color,[15] value is most influential,[11,16] followed by chroma and hue. This was in fact confirmed in a recent study that demonstrated that multihued composite systems did not necessarily yield better optimal integration to the remaining tooth structure.[17] This is in agreement with the fact that color matching is as much a color problem as a problem of material opacity. A lack of opacity in the dentin shade can create a low-value restoration that is more likely detectable than a mistake in hue.

The literature still lacks long-term text information on this procedure. Few reports on the durability of this procedure reveal that this procedure is a valuable and effective procedure for esthetic and conservative treatment for malformed and misaligned anterior teeth in the medium to long term. The results at 5 years for color match, translucency/opacity, and surface smoothness were favorable.[18,19] Restorations on central incisors and small unilateral restorations generally showed the best esthetic performance. Loss of anatomical form, occurrence of incisal chipping, and/or marginal discoloration were the reasons for replacement of the 11% clinically unacceptable restorations after 5–6 years.[18,19]

CONCLUSIONS

In summary, bearing the structure of teeth in mind, one realizes that truly indiscernible, lifelike restorations can only be fabricated with adequate range of dentin and enamel, and characterization materials are available, which allow not only the reconstruction of the

external shade and shape but also the reproduction of the inner tooth structure and the resultant optical effects. After 1-year of clinical service, the procedure appears with an excellent clinical appearance and requires no need of repair or polishing.

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