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Extending the boundaries of feasibility in direct restorative procedures

A clinical case combining a high-performance material and clearly defined protocol

Dr Gauthier Weisrock
France

Modern high-performance composite materials and standardised treatment protocols have led to more direct composite restorations being fabricated in the anterior region than ever. Even extremely challenging cases may now be treated chairside with predictable results and minimal loss of tooth structure.

A 24-year-old female patient presented at our practice with a request regarding aesthetics. She disliked the appearance of tooth #11, which showed severe discoloration after endodontic treatment. A clinical examination revealed that the root had been extirpated after an accident and that a fractured piece had been reattached with a composite material (Figs. 1 & 2). Upon radiological examination, it was found that the root-canal treatment had been performed incorrectly. However, a post had not been used.

Owing to the fact that approximately half of the original tooth structure had been lost, we opted for a direct composite restoration, provided that a tooth-whitening procedure could be successfully completed. Along the spectrum of possible treatments, this approach is located between “conventional” composite restoration and ceramic veneering and, therefore, appeared to be clinically appropriate.

The patient, whose primary concern was a natural tooth shade and minimal loss of tooth structure, agreed to the recommended procedure. We decided to use the nano-hybrid composite IPS Empress Direct (Ivoclar Vivadent) to fabricate the restorations. In addition to dentine and enamel materials, this product is also available in an opalescent material version.

Preliminary treatment

First, internal bleaching was performed on the tooth, on which the success of treatment would depend. Access to the endodontic chamber was created through the old restoration. The gutta-percha increment was removed up to 5 mm below the cemento-dentinal junction. At the bottom of the cavity, a plug with a thickness of 2 mm made of glass ionomer cement was inserted to prevent the bleaching agent from accessing the sensitive areas. We used a mixture of sodium perborate and distilled water for the bleaching procedure. The access to the cavity was then sealed with a temporary material. Since the desired tooth shade was not achieved upon initial bleaching, the entire procedure had to be repeated after one week. After another week, the result was finally optimal (Fig. 1). In order to neutralise the bleaching agent, calcium hydroxide was placed into the cavity and left in place for at least one week. (An adhesive may only be applied 15 days after conclusion of the bleaching procedure, in order to ensure optimum adhesion and stable shade.)

Aesthetic diagnosis and shade determination

After tooth-shape analysis, we concluded that the preparations were harmonious compared with tooth #21. In order to avoid a misinterpretation of the shade owing to dry adjacent teeth, the tooth shade was determined prior to any intervention and in daylight. The IPS Empress Direct shade guide was used for the determination of the enamel and dentine materials. We determined the dentine shade based on the cervical third and the enamel material based on the incisal third of the adjacent tooth. Particular attention was paid to the anatomical structure of the adjacent tooth and the various opalescent reflections visible on the incisal surface, since it was our aim to imitate these features. A layering diagram detailing all the materials that we planned to use was prepared. In this case, only four shades were used: A5/A2 Dentin, A2 Enamel and Trans Opal.

Subsequently, we created a palatal silicone key on tooth #11 with the appropriate shape and occlusion. Once in place intra-orally, this key helped to create the palatal wall of the restoration in one step. The key included the teeth adjacent to the tooth that needed to be restored and covered the incisal area. A thin layer of light-cured composite was applied to the prepared tooth, and the silicone key was accurately positioned using a thin layer of light-cured composite. The key was removed, and the impression was made, allowing the preparation design and the fact that most of the restoration would be created on enamel, this type of adhesive proved superior to self-etching products. In order to facilitate penetration into the dentine tubules, the adhesive was gently massaged into the cavity walls. (After the adhesive has dried, the cavity must exhibit a glossy appearance. If this is not the case, the procedure needs to be repeated.)

The adhesive was then light-cured for 10 seconds with a bluephase curing light (Ivoclar Vivadent).

Building up the palatal and proximal walls

As a first step, the palatal enamel was built up. A thin layer of enamel material (shade A2) of less than 0.5 mm was applied to the palatal key and smoothed out with a brush. Then the key loaded with composite material was placed in the mouth and the fit was checked again. If necessary, the material may be modified before it is polymerised for 10 seconds.

Preparation and application of the adhesive

The existing restoration was removed with the help of both rotary and ultrasonic instruments and with care to prevent any damage to the adjacent teeth. During the preparation of the tooth, the mechanical properties of the material used and the aesthetic integration needed to be taken into account. In the case of IPS Empress Direct, the ideal preparation design involved a vestibular chamfer and a straight, right-angle proximal and palatal margin (Fig. 4).

Before proceeding with the adhesive cementation, it was necessary to protect the operator field from saliva or blood in the oral cavity. Therefore, we isolated the anterior teeth, including the canines, with a rubber dam. The expanded treatment area allowed us to assess the incisal line, and the size and shape of the adjacent teeth.

We checked whether the silicone key could be positioned exactly. (If required, interfering areas can be adjusted using a scalpel until a precise fit is achieved.) The enamel areas were etched for 30 seconds and the dentine for 15 seconds. Both were then thoroughly rinsed and dried.

Subsequently, the adhesive was applied, while the adjacent teeth were protected with a metal matrix. We used the Excite F total-etch adhesive (Ivoclar Vivadent) for this step. Owing to the non-retentive preparation design and the fact that most of the restoration would be created on enamel, this type of adhesive proved superior to self-etching products. In order to facilitate penetration into the dentine tubules, the adhesive was gently massaged into the cavity walls. (After the adhesive has dried, the cavity must exhibit a glossy appearance. If this is not the case, the procedure needs to be repeated.)

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The palatal wall created in the process showed the exact desired shade and did not touch the adjacent teeth (Fig. 5).

Applying a thin layer of enamel material (A2) to the proximal walls changed the complex cavity into a simple one. In order to create the thin layer, we fixed a transparent matrix in place with a wooden wedge, which allowed us to create the transition lines (the convex area that separates the proximal from the vestibular area)—the restorative outcome is influenced by the successful design of these transitional areas because it is not possible to design them with rotary instruments. We then applied composite material from the distal side of tooth #11, while tightening the matrix from the opposite side and polymerising the material in this position (Fig. 6). Thus, sufficient composite material could be added until the desired transition area was achieved. The mesial side was built up in the same manner (Fig. 7).

Building up the dentine core

Using dentine materials, a restoration is created that shows decreasing saturation from the cervical to the incisal and from the palatal to the vestibular area. In order to achieve this, a 3-D layering technique is applied, using materials with different levels of saturation. In our case, a material with a saturation one degree higher than the desired final tooth shade was applied. Therefore, dentine material in shade A3 was used in the area of the cervical margin.

The layer was applied to the palatal wall using a flat spatula suitable for composite resins (Fig. 8). Subsequently, a layer consisting of dentine material with a lower saturation was applied (shade A2). A pointed silicone instrument was used to design a slightly wavy margin covering half of the chamfer up to 1 mm below the incisal edge (Fig. 9). (If this technique is applied, the translucency of the enamel material becomes visible in the area of the incisal edge and the transition from tooth structure to composite material is masked.)

Each layer was polymerised with the bluephase curing light for ten seconds.

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Designing the enamel portion

The opalescence effect was enhanced by applying a thin layer of Trans Opal material in the area of the incisal edge. Since the visible effect of this material is very intense, only a small amount could be used. An enamel layer (shade A2) was applied in several steps to the vestibular area, then contoured with brushes and cured for ten seconds. This enamel material covered the entire restoration (Fig. 10).

Finishing and polishing

The patient’s teeth exhibited a very pronounced macro- and microtexture (vertical pits and horizontal streaks, respectively). Imitating these features to achieve a lifelike reflection on the restorative surfaces was a challenging task.

This step was similarly important to determining the appropriate shade. We imitated the surface texture with fine-grain diamond-coated burs, using flame- and lens-shaped instruments (first with the red and then with the yellow colour code). The burs were used in the red handpiece without water irrigation.

Another important step was the finishing of the transition lines and the interproximal areas. It is advisable to use abrasive strips for this purpose because rotary instruments may produce flat areas that cause inappropriate reflections. OptraPol Next Generation polishers (Ivoclar Vivadent) with water irrigation were used for the polishing process. We always take great care to polish restorations perfectly whilst avoiding any damage to the surface texture we design. The polishing was greatly facilitated as a result of the extraordinary polishability of this composite material (Fig. 11 & 12).

Conclusion

Owing to high-performance materials such as IPS Empress Direct, which are consistently improving, and a clearly defined approach, we may use direct restorations for more indications than ever before, thus constantly extending the boundaries of feasibility. The advantage of direct restoration procedures is that they are time saving and conservative. Nevertheless, it may happen that directly restored teeth show discoloration again in spite of the perfect aesthetic outcome. In this case, another treatment is inevitable.