Closing multiple diastemata - a minimally-invasive approach

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Abstract
In the clinical case described, a 23-year old female patient is provided with minimally-invasive direct adhesive resin restorations to close multiple anterior diastemata and correct tooth proportions. To predictably carry out the clinical treatment sequence a Silicone key that was individually produced from the wax-up on a plaster model was used as a blueprint for chairside layering of the composite increments. Adequate layering, plus finishing and polishing techniques, led to anatomical contours with an esthetically pleasing result. The use of a highly esthetic composite material with optical properties similar to that of natural tooth tissue and different levels of translucency, ideally mimics nature and is recommended for the management of esthetically challenging anterior cases.

Introduction
Modern adhesive dentistry allows the clinician to restore the patient’s smile almost to perfection. In the past, composite resin materials in the anterior region were predominantly applied in Class III, Class IV and Class V cavities. Today these materials are increasingly used to create direct veneers, lengthen incisal edges, alter tooth shapes and close diastemata. They enable the dentist not only to create esthetic tooth-colored restorations, but at the same time to practise minimally-invasive procedures. Patients will continue to demand both attributes within their individual treatment plan.

Case presentation
The 23-year-old female patient was not satisfied with her existing smile because of multiple diastemata and, as she expressed, her “vampire-like” canines.

She had previously sought the advice of an orthodontist who suggested closing her diastemata orthodontically with a series of teeth aligners. However, she preferred to pursue an alternative, cost-effective treatment option with a minimally-invasive approach.

Figure 1: The 23-year old patient
Figure 2: The smile displaying multiple diastemata, divergent central incisors and “vampire-like” canines
prepared on the distal aspects using a diamond coated wheel. A wax-up in the laboratory was then made by the clinician himself (Figure 4).

The following desired tooth proportions and the planned clinical goals were anticipated:

1. Reshaping the canines to correct the “vampire-like” appearance
2. Lengthening and correcting the incisal edge position of the central incisors
3. Reducing the width of the central incisors
4. Increasing the width of the lateral incisors.
5. Closing the diastemata

From this wax-up a silicone key (Virtual® Putty, Ivoclar Vivadent) was produced (Figure 5). This template predictably facilitated the planned procedures as a guide to reproduce the desired tooth dimensions chairside exactly.5

All anterior teeth, as well as the surrounding soft tissues were immaculate and healthy. The smile analysis revealed divergent tooth axes of her central incisors.

The width : length ratios of both lateral incisors were too small (< 60%), respectively. Moreover, the visible width of central, lateral incisors and canines were not in harmony with each other.

Based on the necessity to change tooth proportions, orthodontic intervention as the sole treatment option was abandoned, with restorative procedures preferred in this case. The patient explicitly wished to solve the esthetic problem in a minimally-invasive manner.

Hence, the decision was made to improve her smile with a conservative, direct adhesive procedure using resin composite.2-4

**Preparations for the chairside treatment**

To predictably conduct the planned direct diastema closure a plaster model was made from an impression taken with an addition-reaction Vinyl Polysiloxane material (Virtual® Putty, Ivoclar Vivadent) (Figure 3).

On a duplicated plaster model the central incisors were

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**Figure 3: Plaster model.**

**Figure 4: Duplicated plaster model with wax-up.**

**Figure 5: Silicone key on wax-up.**

**Figure 6: Shade selection with an A-D shade guide.**
In order to harmonize tooth proportions, the width of the centrals needed to be reduced, while the width of the laterals needed to be increased. For this reason both central incisors were lightly prepared on their distal aspects with a diamond-coated wheel (as previously executed on the plaster model) without exposing the dentin (Figures 9 and 10). If the centrals had not been prepared distally they would have appeared too wide and dominant after the closure of the diastema mediale. All prepared enamel surfaces were subsequently polished with extra-fine polishing strips (Epitex®, GC Corporation).

**Chairside treatment sequence**

For effective lip and cheek retraction a flexible aid (OptraGate®, Ivoclar Vivadent) was applied. Prior to any restorative procedures, an accurate, yet fast shade determination was necessary due to rapid tooth color changes from the effects of dehydration. To achieve an accurate shade selection the following shade taking sequence was carried out:

1. Shade selection with an A-D shade guide that is re-arranged with increasing value (Figure 6)
2. Confirmation of the pre-selected shade with the specific shade guide of the composite system to be used: In this case IPS Empress® Direct shade guide which is based on the CIE-LAB color coordinates and made of ceramic shade tabs. (Figure 7).
3. Reconfirmation of the pre-selected shade by placing a small amount of composite on the tooth with subsequent polymerization. In this case a sample of an A1 and B1 enamel shade, respectively (Figure 8).

**Tooth preparation**

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**Bonding procedure**

The enamel surfaces were etched with 35% Phosphoric acid (Ultra-Etch®, Ultradent Products). Un-cut enamel requires an increased etching time compared with ground enamel as it is either characterized by an apsrtismatic surface layer (in younger patients) or by a higher degree of mineralization.
Since the bonding procedure also involved uncut enamel the etching time was increased to 30s to create a pronounced etching pattern for optimized adhesion (Figure 11).

After rinsing off the acid gel and drying all tooth surfaces an “Etch & Rinse” bonding agent (ExciTE® F, Ivoclar Vivadent) was applied directly using a VivaPen® (Figures 12 and 13). A precise amount of bonding agent can be directly dispensed on the tooth surfaces with a click on the blue button. After evaporating the solvent (Ethanol) with an air syringe the bonding layer was light-cured for 10s using an LED curing light with an energy density of 1.100 mW/cm² (Bluephase® Style, Ivoclar Vivadent)

Direct diastema closure

The labside produced silicone key was applied on the palatal-incisal aspects of the patient’s upper anterior teeth and checked for fit (Figure 14).

To create the palatal enamel shelf of the restoration a thin layer of a highly translucent flowable composite (IPS Empress® Direct Flow Trans 30, Ivoclar Vivadent) was applied with the silicone key in place, spread to a thin layer and light-cured for 10s (Figure 15).

The Trans 30 shade shows a much higher degree of translucency (30%) compared with standard enamel shades (13-15%, Figure 16) and allows the light to pass through the
temporary restorative material the modelling instrument was slightly rotated to gently wedge the central incisors (Figure 18). The result was an individual clear matrix that helped to create a good contact point and an ideal emergence profile without black triangles.

A thin layer of highly translucent flowable composite (IPS Empress® Direct Flow Trans 30, Ivoclar Vivadent) was then injected into the space between the central incisor and the mylar strip. The latter was firmly adapted to the palatal aspect of the tooth. Care was taken not to introduce air bubbles within the flowable composite layer (Figure 19).

With the uncured flowable composite in place the modelling instrument was rotated slightly against the adjacent incisor and subsequently light-cured for 10s.

A medium-translucent enamel layer shade B1 (IPS Empress® Direct, Ivoclar Vivadent) was applied over the translucent palatal shelf, shaped and light-cured for 10s.

Closing the diastema mediale with an alternative matrix technique

One of the major challenges for diastema closure is to create anatomical contours with a good contact point. The use of a wedge is, in most diastema closure cases, not recommended since so-called “black triangles” are created interproximally.

The following alternative matrix technique, without the use of a wedge, was clinically predictable and more esthetic:

- A mylar matrix strip was placed interproximally and a small amount of light-curing temporary restorative material (Telio® CS Onlay, Ivoclar Vivadent) applied on the mesio-palatal and mesio-labial surface of the adjacent central incisor without bonding.

- The mylar strip was then attached to the uncured adjacent temporary material and contoured to the desired shape using a thin composite modelling instrument (Slix™ Mini IPC, Premier Dental Products). Prior to the polymerization of the temporary restorative material the modelling instrument was slightly rotated to gently wedge the central incisors (Figure 18).

The result was an individual clear matrix that helped to create a good contact point and an ideal emergence profile without black triangles.

A thin layer of highly translucent flowable composite (IPS Empress® Direct Flow Trans 30, Ivoclar Vivadent) was then injected into the space between the central incisor and the mylar strip. The latter was firmly adapted to the palatal aspect of the tooth.

Care was taken not to introduce air bubbles within the flowable composite layer (Figure 19).

With the uncured flowable composite in place the modelling instrument was rotated slightly against the adjacent incisor and subsequently light-cured for 10s.

A medium-translucent enamel layer shade B1 (IPS Empress® Direct, Ivoclar Vivadent) was applied as the final layer. The material was evenly spread on the entire bonded labial enamel surface with a brush (e.g. Uni Brush No. 4, Shofu) and feathered out for a smooth transition from the restoration to the tooth (Figure 20).

Prior to the final light-polymerization the macro-anatomical tooth morphology and emergence profile was created. The proximal vertical ridge and embrasure was shaped with a non-sticky disposable “chisel” tip.
For natural light reflections the micro-anatomical surface was created using a fine diamond finishing bur at low speed and without water spray. An additional incisal notch on tooth 11 was prepared with the fine diamond bur to reproduce a natural appearance of the restored incisal edge (Figure 22).

To create a homogeneous and smooth surface another dry finishing step was carried out with an abrasive Silicone Carbide containing rubber polisher (Astropol® F, Ivoclar Vivadent) at slow speed. At this stage a silky surface luster was emerging. Anatomical surface characteristics such as vertical grooves can be further enhanced under good visual control (Figure 23).

Subsequently all composite surfaces were wet polished at high speed in order to achieve a glossy surface luster (Astropol® P and HP, Ivoclar Vivadent; Figures 24 and 25).

**Result**
The result directly after high gloss polishing showed harmonious tooth proportions and contours. The composite restorations integrated well with seamless transitions to the natural tooth structure, with multi-directional light reflections from the glossy surface. However, the color and translucency match was not perfect due to the dehydration of the surrounding enamel which stood out in terms of its higher value and opacity (Figure 26).
The natural enamel was rehydrated 5 days later. The restorations were then also integrated harmoniously into the surrounding enamel in terms of color and translucency (Figure 27).

**Conclusion**

To close this patient’s multiple diastemata different treatment options were considered: These included orthodontics, ceramic veneers, ceramic partial veneers/edge-ups and direct composite restorations.

Given the fact that orthodontic intervention as the sole treatment option could not change the incorrect tooth proportions, restorative procedures were preferred in this case.

The patient explicitly wished to solve the problem in a minimally-invasive manner because her anterior teeth were all immaculate. Veneer preparations – either for direct composite veneers or indirect ceramic veneers - were therefore not the first choice due to their greater invasiveness. Additionally, the patient expressed financial concerns that excluded costly ceramic veneers or ceramic edge-ups.

Hence, the decision was made to improve the smile with additive direct adhesive procedures; in this case selecting the esthetic composite system “IPS Empress Direct”.

In addition to adequate material strength this composite is ideally suitable to restore missing tooth structure due to its optical properties of natural teeth, such as fluorescence and opalescence. Natural enamel is characterized by different levels of translucency that can be matched with composite layers of similar translucency. This results in a restoration that is perfectly blending with the surrounding tooth tissue. To create and maintain natural surface characteristics the material features a finely tuned filler technology which imparts favorable polishing properties, high surface gloss and low susceptibility to wear. To maintain the esthetic outcome of the restorations a proper finishing and polishing procedure is mandatory because smooth composite surfaces are much less likely to discolor over time.

For finishing and polishing esthetic anterior composite restorations best results are achieved with multi-step polishing systems.

In the present case a minimally-invasive approach resulted in a highly esthetic, yet cost-effective outcome, to the great satisfaction of the patient at the end of the treatment (Figure 28).
Disclosure
Dr Michael Dieter is Head of Professional Services, Ivoclar Vivadent AG, Liechtenstein

References
7. Scientific Documentation IPS Empress® Direct, Feb. 2010, Ivoclar Vivadent AG