Minimally invasive reconstruction of anterior teeth - A combination of 3D printing, press technique and adhesive bonding

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Introduction

Ceramic veneers present a popular minimally invasive treatment option to restore a person's smile. Dental materials and techniques are being enhanced all the !ime. As a result, the fabrication processes are also changing. The successful adhesive bonding technique is consistently being optimized, for example, in terms of its handling.

A growing number of patients are consulting their dentists with the request for an even-looking smile and the realignment of their teeth. In addition to this cosmetic wish, they usually ask that as little as possible of the healthy tooth structure be removed. As a result, the teeth should be prepared according to tooth-preserving principles, without having to make any compromises in terms of the esthetic properties. This balancing act can be achieved with the help of modern ceramic materials - in conjunction with the adhesive bonding technique. Therefore, it is important for the dental team to choose a material that optimally fulfils their functional and esthetic planning requirements. The teeth have to be prepared very carefully. The restorations are adjusted to the smile with artistic flair, while taking into account the principles of proportion. Finally the restorations are seated in accordance with the guidelines of the adhesive bonding technique. The challenge is to find a way of fabricating ultra-thin ceramic veneers that demonstrate adequate strength and stability. Furthermore, it is important to establish a sound bond between the restorations and the tooth structure by means of the sensitive adhesive bonding technique. In order to ensure long-lasting, successful outcomes, it is recommendable to use products that are optimally coordinated.

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The materials

The optical properties of a modern ceramic material (e.g. IPS e.max® Press) are very similar to those of natural dental enamel. Therefore, veneer restorations are capable of imitating the translucent properties of natural teeth and ensuring optimum light transmission. Furthermore, very thin restorations with a minimum thickness of 0.3 mm can be produced due to the excellent mechanical properties of IPS e.max Press. As a result, the demand for minimally invasive treatments can be met, since only very little of the healthy tooth structure needs to be removed. Veneers obtain their final strength from the strong bond with the tooth structure (adhesive cementation). The decisive factor at this stage is the procedure used for seating the veneers (luting protocol). The products of the silicate ceramic materials portfolio within the IPS e.max system are coordinated with the Variolink® Esthetic luting composite. The single component ceramic primer Monobond® Etch & Prime, which is contained in the system, etches and silanates glass-ceramic surfaces in one easy step. Moreover, the etchant is much gentler than hydrofluoric acid.

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Figure 1: Preoperative view. The patient wanted more attractive upper anterior teeth.

Figures 2 and 3: Slight preparation of the cervical margin with Arkansas stones.

Figure 4: The teeth prepared for the veneers.

Case study

The female patient wished to have more attractive upper anterior teeth (Fig. 1). She had a well-groomed appearance and healthy teeth. However, the young woman was dissatisfied with the shape of her teeth. She felt that they were too narrow. She requested strong-looking, bold tooth shapes that would give her a harmonious smile. After one consultation, she chose the veneer option. This case presented quite a challenge. On the one hand, the healthy teeth would have to be ground as little as possible. On the other hand, the patient's wishes had to be fulfilled, without making the teeth look too bulky. As a result, we decided to use ultra-thin ceramic veneers.

Clinical preparation

First, an esthetic and functional plan was established with the help of a wax-up of the vestibular region of the ULS to the URS. Then the esthetic treatment phase started. The main aim of the preparation was to achieve an even thickness of the ceramic veneers in relation to the envisaged result. Since the teeth had to be slightly enlarged in the present case, only minimal removal of tooth structure in the vestibular region was necessary. In order to prevent over-contouring of the margins and the risk of gingival inflammation, a shoulder was carefully created at the cervical margin using Arkansas stones (Figs 2 to 4).

Fabrication of the veneers in the laboratory

IPS e.max Press is an excellent material for fabricating veneers. In the first fabrication phase, digital technologies were used. The master cast was digitalized . Then, the ultra-thin veneers were designed using CAD software. They were produced with a synthetic resin that fires without leaving any residue (3D printing). The printed veneers demonstrating a

Figure 5: Printed veneers made of synthetic resin.

Figures 6 and 7: Manual adjustment of the printed veneers with wax.

Figure 8: Att achment of the sprues.

Figure 9: Spruing of the restorations for the press procedure.

Figure 10: Finishing of the ceramic veneers on the model.

minimal thickness of 0.3mm offered an ideal basis for manually shaping the actual veneers (Fig. 5). Only very little wax had to be applied to achieve the ideal proportions. The shape of the teeth was adjusted with wax in the incisal and proximal areas in particular. The aim was to create an even appearance of the vestibular surfaces from the UL5 to the URS (Figs 6 and 7).

In the course of the preparation of the restorations for the press procedure, the advantages of printed veneers became evident: They are comparatively stable, which greatly facilitates the spruing process. The restorations were invested, pressed (IPS e.max Press) and divested in the conventional way (Figs 8 and 9). Finishing of the delicate veneers was reduced to only a few steps. The veneers were polished and then sent to the dental office (Fig.10) .

Adhesive cementation

In the dental practice, the restorations first had to be tried in and evaluated in terms of their shade and translucency. Water-soluble try-in pastes are recommended for this purpose. Their shade corresponds to that of the cured luting composite. As a result, they allow a reliable esthetic assessment to be made. Following the cleaning of the teeth and the veneers, the restorations were tried in - at first, each veneer was tried in separately and then all the veneers were tried in together.

The adhesive cementation of ceramic restorations is a technique-sensitive procedure. In order to achieve a long-lasting bond, it is of utmost importance to prepare this step carefully and to observe the cementation protocol. The single-component ceramic primer Monobond Etch & Prime was used to condition the ceramic restorations. The primer was scrubbed into the contact surface with a microbrush for 20 seconds in order to remove any saliva and silicone residue (Fig. 11) . During the 40-second reaction time, the etchant enlarged (roughened) the surface and produced an etching pattern. Next, the primer was rinsed off and the restoration was dried with a stream of air for 10 seconds. Then the reaction between the silane and the activated glass-ceramic

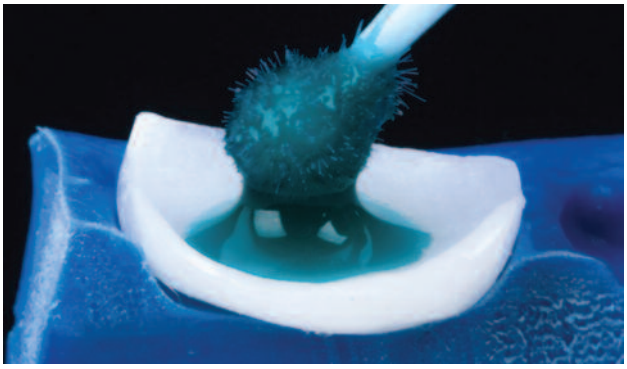

Figure 11: Application of Monobond Etch & Prime.

started. This resulted in the development of a thin layer of chemically bound silane, which ensures a strong and reliable bond to the teeth. An additional benefit offered by Monobond Etch & Prime is the fact that the product etches and silanates in one step. This simplifies the sensitive placement procedure and heightens its efficiency.

After the preparation of the tooth surfaces in accordance with the requirements of the adhesive technique, the veneers were cemented with a light-curing luting composite (Variolink Esthetic LC, shade: light) (Figs 2 and 13). The material offers a balanced combination of flowable and stable properties, which facilitates handling. Therefore, the veneers can be bonded with comparatively little effort. Next, all residues were removed and final light curing took place. The cement joint was covered with glycerine gel (Liquid Strip). In the last step of the seating procedure, the margins were finished.

Result

The planned goal was achieved with the ceramic veneers (Fig. 14). The upper anterior teeth look much bolder - as desired - and also some what lighter. They harmonize with the oral environment and the facial features of the young patient. Furthermore, the soft tissue adapted very well to the new situation. The wishes of the patient were fulfilled: Her new smile was achieved without any substantial loss of tooth structure (Fig. 15).

Conclusion

Modern ceramic materials such as IPS e.max Press allow teeth to be restored with minimally invasive techniques. Even ultra-thin veneers (minimum thickness of 0.3 mm) can be produced. The ceramic restorations are cemented with the matching Variolink Esthetic luting composite. The single-component glass-ceramic primer offers the possibility of etching and priming the glass-ceramic surfaces in one step. As a result, only one protocol is needed for the different types of ceramics. This significantly facilitates day-to-day procedures and heightens the efficiency of the dental office.

Figures 12 and 13: Placement of a veneer.

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Figure 14 : Situation following insertion . All the veneers have been cemented in the mouth.

Figure 15: The satisfied patient. Her wishes have been.fulfilled with minimally invasive restorations.