REFLECT

dental people for dental people 03/11

Direct reconstruction
Minimally invasive restoration of worn teeth

Not your regular patient case
Esthetic reconstruction of a transplanted premolar tooth

Shining results
Minimally invasive and esthetic restorative treatment

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passion vision innovation

Editorial

Dear Reader

The present issue of our international customer magazine Reflect once again bears testimony to the innovative power of Ivoclar Vivadent AG. Even in economically difficult times, innovative product systems and techniques are indispensable for dental practices and laboratories striving to deliver quality dental care. In this issue of Reflect, you will find specialized articles written by dental professionals for dental professionals. At Ivoclar Vivadent, we are proud to provide our customers with a continuous supply of outstanding products for high-quality, esthetic dental restorations that benefit the patient.

Ensuring that customers receive the goods they order at the right time and in the right quality is part of my task as the person in charge of production and logistics. To this end we have again made substantial investments in the field of production this year. Innovation also plays a decisive role in this respect. All our strategically important production plants are designed and built by an internal team of engineers on the basis of state-of-the-art technology – just one of several aspects that help ensure the high quality of our products. The technological know-how acquired is an important prerequisite in the creation of new manufacturing processes, and as such plays an important part in the development of new products. It is the innovative spirit of the people working at Ivoclar Vivadent that has allowed the company to achieve and maintain its current position at the forefront of the marketplace.

As you can see, we are committed to driving innovation in all areas. As a result customers can fully depend on our products and systems solutions in terms of reliability, cost-effectiveness and high esthetics, now and in the future.

I hope you will enjoy reading Reflect and that the articles contained in this issue will offer useful hints and tips for your daily work.

Best wishes

Wolfgang Vogrin
Chief Production Officer
Ivoclar Vivadent AG

The cover picture shows an artistic representation of upper anterior teeth restored with IPS e.max® materials (photo: Szabolcs Hant, MDT).

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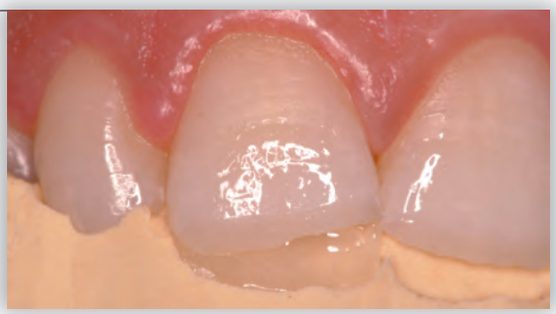
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Direct reconstruction

Minimally invasive restoration of worn teeth

Juan Manuel Liñares Sixto, DDS, MD, PhD, La Coruña/Spain

Composites were first used as restorative materials in the 1960s. In the meantime, the field of application has been significantly expanded to include indications in both the anterior and posterior region. Today's materials allow the fabrication of highly esthetic restorations with minimal loss of tooth structure. This presents a clear advantage, because it has become an overriding objective for many dentists to keep the biological cost of restorations as minimal as possible.

Composite materials are successfully used for anterior restorations to reconstruct lost tooth structure caused by carious lesions, fractures or wear processes. Composites are also suited for complex rehabilitations which have to meet exacting esthetic requirements, such as the closure of diastemas or the realignment of teeth. Dental professionals can choose from a wealth of composite material systems offered by various manufacturers. Ideally, the physico-chemical properties of the material should ensure easy handling and provide optical characteristics that allow the healthy natural teeth to be accurately mimicked. Detailed knowledge of the material properties and strict adherence to the instructions for use and the adhesive protocol are essential to achieve predictable and durable results that satisfy both the patient and the dentist.

Tooth wear – ie the progressive loss of tooth structure – is a frequently occurring problem among today's population. The reasons for tooth wear vary; it is difficult to determine how widespread bruxism is. Increasingly, dental professionals are faced with the challenge to find a minimally invasive treatment option for patients who suffer from this condition.

Clinical case – initial situation

A 27-year-old female patient came to our practice with her upper anterior teeth showing signs of severe attrition (Fig 1). She told us that her central incisors had been getting smaller over the past two years and their shape had been changing. Teeth grinding during sleep was responsible for the attrition. The patient wanted the progressive tooth wear to be stopped and the original shape of her teeth restored.

At the beginning of the treatment, a clinical and a radiological examination were carried out and the initial situation was documented with photographs. Subsequently, study models were fabricated and mounted on a semi-adjustable articulator. As the canine guidance and lateral movements of the teeth were found to work perfectly and the patient was of a relatively young age, we opted for a minimally invasive treatment option. Only the incisal third of the upper anterior teeth should be restored with composite.

The function and anatomy of the teeth were evaluated using a diagnostic wax-up (Fig 2). The envisaged result was simulated in the oral cavity with a silicone key. This allowed the patient to critique the esthetic and functional characteristics before the beginning of the restorative treatment. Silicone keys are generally useful as a reference to reproduce the shape of the tooth as determined at the beginning of the treatment. After the patient had been appropriately informed of the treatment, the restorative procedure was commenced.

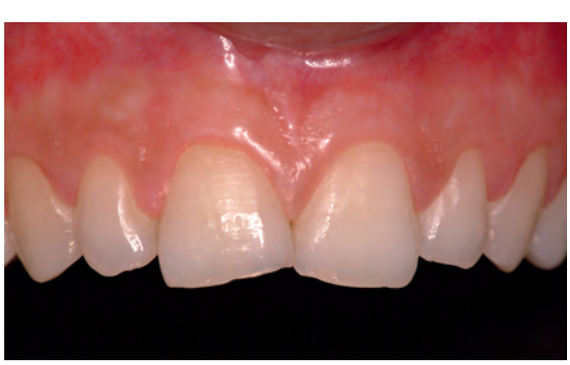

Fig 1 Initial situation: severe attrition of upper anterior teeth caused by bruxism.

Fig 2 Diagnostic wax-up

Fig 3 Adhesive is applied to the slightly bevelled enamel edges.

Fig 4 Composite material is applied in layers using the silicone key as a reference.

Fig 5 The surface is provided with appropriate characteristics before the composite is polymerized.

Fig 6 The high-gloss restorations on teeth 21 and 11 are virtually indistinguishable from the natural tooth structure.

Treatment procedure

As the first step, the incisal edge was given a slight bevel. Care was taken to remove as little tooth structure as possible and yet to achieve optimum retention and ensure an accurate fit of the restoration. Next, the enamel areas were etched with phosphoric acid and ExciTE® F adhesive was applied (Fig 3).

In the present case we decided to utilize the IPS Empress Direct® composite system. The materials were applied in layers using the silicone key fabricated beforehand. The silicone key enabled us to reproduce the anatomical characteristics of the tooth as true to nature as possible (Fig 4). To build up the tooth shade, we decided to use A1 Enamel to achieve an increased degree of brightness and halo effect in the incisal third and create intensely translucent areas. Shades A2 and A1 Dentin were selected to simulate the mamelons. Some of the material extended into the bevelled enamel edges to mask the transition between the tooth and restoration. The deepenings between the mamelons were filled with Trans Opal. Finally, the restoration was covered with a thin coating of Trans 30. This layer also extended into the bevelling (Fig 5). Each individual composite layer was polymerized with a bluephase® curing light for ten seconds using the High Power program. Upon completion of the layering procedure, the restoration was finished using multi-blade burs and aluminium oxide discs.

Finally, the restoration was carefully polished using the three-step Astropol® polishing system, felt discs and aluminium paste until the desired high-gloss surface was attained (Fig 6).

Figs 7 and 8 The lateral incisors are restored using the same procedure.

Figs 9 and 10
A night guard enhances the durability and long-term prognosis of the optically pleasing result.

The incisal third of the upper lateral incisors was built up using the same procedure to achieve the appropriate anatomical and functional characteristics (Figs 7 and 8).

Aftercare

Although the anterior guidance had been re-established, parafunctional activity may still occur. Therefore, the patient received a night guard. Bruxism may compromise the outcome and durability of any restoration, no matter how well designed.

Conclusion

Increasingly, composites are used for standard rehabilitations of the anterior region. Detailed knowledge of the material in use, the tooth anatomy, shade design and occlusion were, among other things, instrumental in achieving the optically pleasing result in the present case (Figs 9 and 10). The continuing development of appropriate technologies and improved understanding of adhesive cementation, layering, polymerization and polishing enable dental professionals to use composites in a more targeted fashion and predict the results more reliably. ❑

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Perfectly natural

Restoring damaged posterior teeth efficiently and esthetically

Dr Jason Olitsky, DMD, AAACD, Ponte Vedra Beach, Florida/USA

Direct composite restorations are advantageous for both the clinician and the patient in many respects. The article below gives a detailed account of the restoration of posterior teeth with a composite resin that provides ease of use and yields natural results.

Dentists and patients prefer the esthetics and biocompatibility of direct composite restorations. Unfortunately, material and handling characteristics of some restoratives can lead to time-consuming placement challenges that ultimately can lead to clinical problems. These include premature polymerization, increased risk of staining, bacterial accumulation, marginal leakage and secondary caries. What dentistry has needed is a highly esthetic, durable direct composite that enables efficient and predictable placement in any situation.

Tetric EvoCeram® is a universal nano-hybrid composite that demonstrates industry-leading working times as a result of the material's special photoinitiator system. Featuring "Polymerization on Demand", Tetric EvoCeram is less reactive to ambient light, though it remains highly reactive to curing lights within the wavelength range of 400-500 nm. As a result, Tetric EvoCeram is a viable solution to premature curing that allows the clinician to control polymerization in every situation. Tetric EvoCeram supports greater ease of use, and low polymerization shrinkage rates reduce the risk of marginal leakage and secondary caries. Restorations can be brought to full-contour efficiently and predictably.

Fig 1 The patient presented with a failing amalgam restoration on tooth 36.

Material properties

The fillers in Tetric EvoCeram demonstrate an average size of less than 550 nm, which is similar to those in pure nano-filled materials. Therefore, Tetric EvoCeram restorations can be easily polished to a high level of gloss in a short period of time. With a unique refractive index, the nano-fillers and nano-colour pigments in Tetric EvoCeram blend to create a chameleon effect with natural teeth to produce lifelike results in even the most challenging cases. Tetric EvoCeram also demonstrates balanced translucency to enhance shade adaptation and shade matching.

Tetric EvoCeram is indicated for use in all anterior and posterior restorations. Available in 22 shades, Tetric EvoCeram can be dispensed from syringes or Cavifils to meet the clinical requirements and esthetic demands of any case.

Case presentation

A 40-year-old woman in excellent health presented with a failing amalgam restoration on tooth 36 (Fig 1). After a thorough initial examination and consultation, the patient said she wanted an esthetic, tooth-coloured posterior restoration. We decided to use the nano-hybrid composite Tetric EvoCeram in this case. Under rubber dam isolation, the amalgam was removed in its entirety using a carbide bur. The walls

Fig 2 The tooth was etched with 35% phosphoric acid, beginning with the enamel.

Fig 3 The dentin surface was etched for 15 seconds.

Fig 4 The tooth was treated with Telio CS Desensitizer and lightly air dried.

Fig 5 A coat of ExciTE F adhesive was applied to the preparation and cured for ten seconds with the bluephase 20i curing light.

Fig 6 A dentin shade was placed and softly condensed into place using an applicator brush.

and cavosurface margins were smoothed with a fine-grit diamond bur. The tooth was then etched with 35% phosphoric acid beginning with the enamel to prevent over etching the dentin surface, then proceeding to the dentin for 15 seconds (Figs 2 and 3). Subsequently, the preparation was rinsed and lightly dried with a warm air drier (A-dec) to prevent moisture and oil contamination. Next, the tooth was treated with a desensitizer (Telio CS) per the manufacturer's recommendations and lightly dried with the air drier (Fig 4). The preparation was then coated with a coat of a fluoride-releasing, single-component total-etch adhesive (ExciTE® F Soft Touch Single Dose) per the manufacturer's recommendations and cured for ten seconds with an LED curing light (bluephase® 20i) using the low-power mode (Fig 5). A translucent liner (Tetric EvoFlow®) was placed using a Cavifil, instrumented into place with an explorer and cured for ten seconds using the high-power mode. A dentin shade (A3.5) of a nanohybrid composite (Tetric EvoCeram) was placed in an approximately 1.5 mm increment and softly condensed into place using a Soft Touch applicator brush that was slightly moistened with the adhesive (Fig 6). Dentin contours were placed with a thin IPC instrument and cured for ten seconds with the bluephase 20i curing light using the high-power mode. Note that a simplified technique is to proceed directly to the enamel layer without internal staining at dentin level. Next, Tetric EvoCeram enamel shade A3 was placed in one increment using a composite instrument. Gross excess was removed, and primary and secondary anatomy was placed with an IPC-TTN instrument (Fig 7). Due to the photoinitiator complex added during material processing, Tetric EvoCeram allows an extended working time. Its handling properties are ideal for sculpting deep posterior anatomy, since the material demonstrates a non-tacky, slump-free consistency.

Before curing the enamel layer, dark brown tint (Tetric® Color) was added to simulate discoloured fissures. The tint was added with a sharp explorer that was punched through the enamel into the dentin layer at the location of fissure pitting to create a layering effect (Fig 8). Naturally occurring fissure stains at the cavosurface margin were combined with artificial stain of the same colour to create a chameleon effect. White opaque tint was used to create a "pop"



Figs 7 to 9 After having applied the enamel shade, primary and secondary anatomy was placed. Dark brown tint was added to simulate discoloured fissures and white opaque tint was applied on the buccal and lingual cusps.

Fig 10 The restoration was polished with Astropol rubber polishing points for 30 seconds.

Fig 11 The completed Tetric EvoCeram posterior restoration blended seamlessly into the natural oral environment.

effect in the cusps by using an explorer to place the tint on the lingual inclines of the buccal cusps and buccal inclines of lingual cusps (Fig 9). The enamel, tints and stains were then cured for 20 seconds using the high-power mode. To further enhance the surface characteristics of the restoration, dark brown tint was traced in the fissures with an explorer. The restoration was then cured with the bluephase 20i curing light for an additional 20 seconds.

With the rubber dam removed, the occlusion was checked with 40 micron articulating paper and adjusted using an OS1 carbide bur until contacts were correct. Finally, the restoration was polished with Astropol® diamond impregnated rubber polishing points for 30 seconds to achieve a natural-looking polished restoration (Fig 10).

Conclusion

Utilizing Tetric EvoCeram enables dentists to place posterior composite restorations simply and efficiently, and still provide patients with the function and esthetics they demand (Fig 11). In this case, the dentist had ample working time to create the necessary cusp characteristics without worrying about premature polymerization or the need for specialized light-curing techniques and additives that would otherwise increase cost and chair-time. Using proper materials like Tetric EvoCeram, the resulting restorations appear lifelike and natural. ❑

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The truth is three-dimensional

From the creation of the virtual mock-up to the final restoration

Dr Nihan Özlem Kuday and Hilal Kuday, CDT, both Istanbul/Turkey

A high degree of imagination is required by any dentist who strives to provide patients with bespoke restorative solutions. Before the treatment can begin, all relevant data have to be gathered, as this gives the operator an idea of the final result that can be achieved. Thus an imaginary goal is set, based on which the treatment procedure can be determined and the appropriate materials selected. This article provides a detailed description of a complex case which involved the restoration of the entire upper arch with all-ceramic crowns. It covers everything from the fabrication of the virtual prototypes to their conversion into the real restorations using an efficient procedure.

Evaluating the patient's expectations is an essential step before starting the treatment. Face-to-face conversations and photographic images provide a host of details which we can combine to form a picture of the final restoration in our mind's eye. In order to share this imaginary restoration goal with the patient and to assist him/her in the decision process, our treatment strategy usually involves the design of a digital prototype. We have found this to be a key element in the creation of outstanding, bespoke anterior restorations and crucial for a successful outcome.

Starting situation

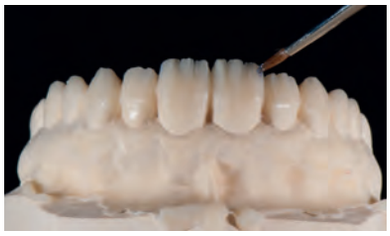
A 38-year-old female patient presented to our practice with heavily worn dentition. She suffered from the esthetic and functional problems caused by this condition. After a thorough diagnosis and an evaluation of possible treatment options, we decided to restore the entire upper arch with all-ceramic crowns. We opted for a non-invasive treatment approach, ie no tooth preparation was performed. Temporary restorations made of high-quality resin material would be worn by the patient as a transitional solution during the treatment phase.

Fig 1 By means of the digital mock-up we were able to visualize the anticipated result.

Two-dimensional, digital mock-up

As this type of treatment is very comprehensive, time-consuming and difficult for patients to understand, a considerable amount of time was reserved for the consultation appointment. Photos of the initial situation, which were taken according to an established procedure in our practice, served as the basis for the discussion with the patient. The digital technology available today enables different construction options to be displayed and compared on the computer screen. Based on the imaginary goal we set ourselves, several different mock-ups were digitally designed using a special photo editing tool (Fig 1). This allowed us to visualize the anticipated result for the patient. We also used this opportunity to answer her questions and eliminate any doubts preoperatively. By choosing such a procedure, patients are involved in the planning process at an early stage, which is crucial for a positive outcome. Apart from its psychologically valuable effect, this early involvement gives patients an opportunity to express their desires and expectations so that these can be included in the digital design. However, the problem with digital mock-ups is that they are easily "overdone" and may be difficult to convert into a real restoration later on. Even though the limitations posed by essential biological principles and the properties inherent in the material can be ignored during the design phase, they definitively need to be taken into account when the actual restoration is fabricated. Promising the patient too much at this stage may result in a high level of patient dissatisfaction once the restoration is in place. After a few small adjustments, the digitally designed mock-up was approved by all the

Fig 2 A wax-up was fabricated on the model based on the digital design.



Figs 3 and 4 The temporaries were fabricated with Telio Lab resin using the sandwich technique.

Figs 5 and 6 The temporary restorations in situ

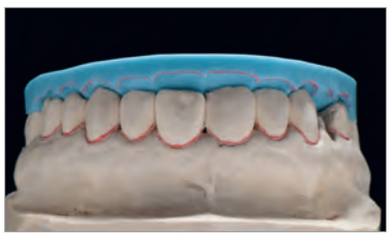


Fig 7 The silicone matrix served as a guide when the digital design was converted into the real restoration.

Fig 8 The pressed crown coping

persons involved in the case presented. It was used as a reference during the working steps that followed.

Temporization phase – Converting the 2-D digital mock-up into a 3-D wax-up

The digital construction was measured. Based on these measurements, a wax-up was fabricated on the model (Fig 2). This wax-up created the basis for the fabrication of the provisional restoration. We decided to use the sandwich technique with Telio® Lab resin for this purpose. This material is designed to stay in the mouth for a prolonged period of time, which is an asset when complex restorations such as the one presented are undertaken. Moreover, temporary restorations fabricated with Telio Lab feature a homogeneous structure and are easy to polish. Due to the excellent shade match of the materials involved, the shade guide prepared for the final all-ceramic restoration (IPS e.max®) can also be used for the temporary restoration. By using materials with different levels of translucency (similar to layering ceramics), Telio restorations are imparted with the desired translucency and customized shading. Even though Telio materials and IPS e.max ceramics feature similar shade characteristics, the shade saturation of a 0.4 mm thick resin build-up is different from that of a 0.4 mm thick ceramic build-up. However, we should not forget that the provisional is only intended to stay in the mouth for a limited period of time.

Using one main shade in combination with an additional incisal shade is usually sufficient to achieve an optimum result when fabricating temporary restorations. However, in the case presented, it was essential to meet the high esthetic expectations of the patient already at the temporization stage. This represented no problem – it just meant that some extra effort had to be put into the fabrication of the temporary. A basic mixture of materials was required to build up the crowns. Our experience has shown that a natural shade effect in combination with the desired shade saturation is best achieved with a mixture of one part Dentin material and two parts Incisal 2 material. This basic mixture was used to create the crown body. Subsequently, the restoration was cut back. Effect materials were applied and the enamel portion was rebuilt with Enamel material. For the purpose of achieving a lifelike transition, the basic mixture was diluted slightly and placed between the mamelons. To enhance this effect, an Effect material (Telio Stains orange) was applied to the respective surface areas. Low-value areas were also created with a suitable Effect material (Telio Stains white) (Fig 3). During the layering process, it is advantageous to light-cure the build-up in stages. This helps to stabilize the ceramic layers once they are placed and avoids running or bleeding. By polishing the restorations mechanically they obtained their final surface lustre (Fig 4).

The moment when the restorations were incorporated was a very exciting one for us all. Had we been successful in converting our virtual goal, the digitally designed restoration (2-D), into a three-dimensional temporary? Yes, we had. Figures 5 and 6 clearly show that we were on the right track to achieving the goal we had set ourselves. In preparation for the definitive restoration, a silicone matrix had to be fabricated based on the provisional restoration. Before that, however, occlusion, phonetics and esthetics were verified and adjusted where necessary. The silicone matrix served as the basis for the fabrication of the copings (Fig 7).

The final restoration

At this stage, the major part of the work had already been accomplished. The patient had worn the provisional restorations for a prolonged period of time and neither complained about functional nor phonetic problems, which confirmed that the preparatory work had been successful. This only left us with the task of reproducing the temporary restorations in ceramic. Since our objective was to create highly esthetic restorations, we chose to use pressed-ceramic copings in combination with a ceramic layering technique (IPS e.max).

The copings were modelled in wax and pressed using IPS e.max® Press Opal 1 ingots (Fig 8). In order to achieve an

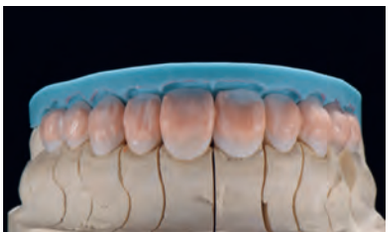


Fig 9 The crowns were layered with the help of the silicone matrix.

Fig 10 After the first firing

Fig 11 Preparations are made for the second firing cycle.

Fig 12 Surface texture was applied prior to glaze firing.

Fig 13 The crowns are ready for incorporation.

Fig 14 The frontal view of the final result proves …

optimum chameleon effect and a natural-looking result, the restorations were designed with highly translucent cervical areas. This was easy to accomplish with IPS e.max materials. However, if these materials are used arbitrarly or incorrectly, they can absorb light, which may result in a greyish tinge. As the thickness of the pressed copings was between 0.5 and 0.6 mm, they appeared very fragile. Using the silicone matrix as a guide, IPS e.max® Ceram layering ceramic was applied to the copings. For the first firing, a mixture of Dentin and Deep Dentin materials was applied (Figs 9 and 10). Using a sophisticated, well-practiced technique, internal characterizations were added using different Effect materials (Fig 11). Finally, the build-up was coated with a layer of Enamel material. Prior to glaze firing, surface texture was applied to the surface of the restoration. This working step is crucial to attaining a lifelike appearance of the final result (Fig 12). After the glazing paste had been applied, glaze firing was conducted. Then the crowns were ready to be incorporated (Fig 13).

This was another exciting moment. Had we succeeded in reproducing the shape, function and phonetics of the temporary restoration in the final ceramic restoration? Yes, we had. Figure 14 shows the crowns after final incorporation. The end result proves that the treatment can be considered a complete success (Fig 15).

Conclusion

In the case presented, we succeeded in converting the virtual goal we had set ourselves into a real restoration. Our treatment strategy involved the design of a digital mock-up based on photographs of the preoperative situation. Our patient was given a say in the treatment as she was able to contribute her ideas when the restoration was digitally designed. We would like to emphasize once again that realistic digital mock-ups should be created. Limitations posed by nature or material sciences can be ignored when digitally designing the restoration on the computer screen; however, being "overenthusiastic" at this stage can lead to problems during the realization phase. The digital mock-up was used as the basis for creating a long-term provisional via the wax-up. All the desirable functional and phonetic characteristics were already included in the provisional restorations. As the patient wore them for a fairly long period of time, they represented a reliable basis for the creation of the definitive all-ceramic restorations. ❑

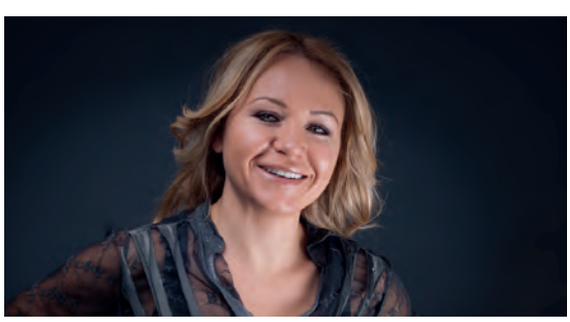


Fig 15 … that our efforts were crowned with success.

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Challenging, but far from impossible

Correcting a hypodontia of the maxillary lateral incisors

Dr Jean M Meyer and Gilles Philip, DT, both Marseille/France

If lateral incisors are missing, the classic treatment option would involve two implants placed in the position of the missing teeth. However, this is only possible if the clinical situation allows for such a procedure. In this article, the authors describe a treatment concept which can be applied if the initial situation is not optimal.

In this day and age, looking attractive is considered an indicator of social success. As a result, more and more patients want a "perfect" smile and sparkling white teeth. The media play a major role in this, by placing the images of beautiful people with flawless teeth and an air of success on the cover pages of large magazines.

Initial situation

Our patient also came to the practice with the wish to have a "perfect" smile. The clinical situation, however, was anything but perfect. The patient suffered from hypodontia, ie the lateral incisors had failed to develop (Fig 1). Furthermore, the teeth were severely stained. Another complicating factor was that tooth 13 was in a central position between teeth 14 and 11 (Fig 2). As an extended treatment time was not an option for the patient, a protracted orthodontic treatment was ruled out. Also if such an approach had been pursued, an esthetically satisfying outcome would have been very difficult to achieve without modifying the other anterior teeth.

Fig 1 Labial view of the initial situation

Fig 2 Occlusal view of the initial situation

Planning the restoration

The planning phase is an important part of the restorative process, as it allows us to achieve the desired esthetic outcome on the basis of a clear sequence of working steps. It also enables us to pursue an anticipative approach in most cases, rather than having to react to unexpected situations. Thanks to this targeted method, compromises in terms of the treatment outcome that could emerge during the restorative process are eliminated.

In the case described here, the main problem was the lack of space in the first quadrant; tooth 13 was located in the position of tooth 12 (see Fig 2). After an extensive planning stage and discussions with the patient and the dental technician, we chose to fabricate two bridges and one crown, made with the high-strength lithium disilicate (LS_2) glass-ceramic material IPS e.max® Press.

We decided to place the distal portion of the cervical preparation margin of tooth 13 below the gingiva (Fig 3), in order to reduce the size of the tooth neck and therefore to make the gap appear larger. The mesial area of tooth 14 was rather large, which is why we were able to remove some of the enamel without being too invasive. With this preparation concept, enough room was created to accommodate the restoration in the first quadrant. As an alternative, the teeth could have been slightly repositioned towards the vestibular aspect. In the second quadrant, a reverse

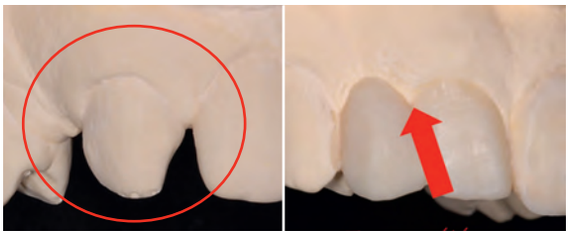

Fig 3 A wax-up provides a good opportunity to explore the given situation on the model. In this case, the cervical area of tooth 13 was critical.

Fig 4 The situation after tooth whitening

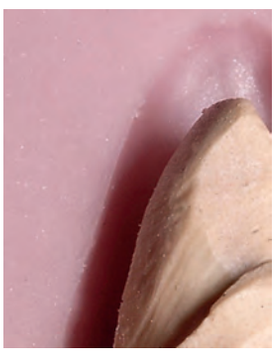

Fig 5 The silicone key was also used to check the preparations.

Fig 6 The finished preparations prior to impression-taking

Fig 7 The direct temporary restoration

Fig 8 Prior to seating the final restoration

situation was found: The gap was too spacious in order for an esthetic reconstruction of tooth 22 to be integrated. The central incisors were somewhat more prominent and straight and had a beautiful shape. This was a sound starting point for a beautiful, harmonious outcome. The wax-up was designed in accordance with the planned reconstruction. Prior to preparation, the teeth were bleached (Fig 4).

Clinical procedure

Except for tooth 13, all teeth were vital. In order to transform this tooth into a lateral incisor, pulp extirpation was performed. The root canal was filled with a glass fibre-reinforced post (FRC Postec® Plus) luted with Variolink® II composite material. After the application of a total-etch adhesive (ExciTE®), the core was built up as required with composite material (MultiCore® Flow light).

The periodontal soft tissue was protected during the subsequent preparation procedure by means of retraction cords (No. 000). First, the tooth with a straight tooth axis was ground. This preparation then served as a reference for the other teeth that were to be ground. In order to ensure even preparation, the diagnostic wax-up was used as a basis. Three silicone patterns were prepared from this wax-up: One was used for the fabrication of direct temporaries and the remaining two were cut open in a sagittal and vertical direction in order to ensure that enough space was available for the final restorations with an adequate thickness (Fig 5).

The preparation margins were created close to the gingival margin. Tooth 13 was an exception, as the preparation extended below the gingiva line. It was thanks to this measure that the canine was converted into a lateral incisor and thus sufficient space for an adequately sized bridge pontic was made available. Before an impression of the prepared teeth was taken (Fig 6), the dentin tubules were sealed with an adhesive (ExciTE) in order to avoid contamination of the dentin tissue and postoperative sensitivities.

Conventional impressions were taken. In order to provide the patient with a temporary restoration, we fabricated a provisional on the basis of the wax-up. The Telio® CS material is a self-curing composite material in paste form which can be used for the direct fabrication

Fig 9 The all-ceramic system we used (IPS e.max) offers excellent possibilities to achieve lifelike adaptation of ceramic restorations.

Fig 11 Thanks to the IPS e.max ceramic system, we were able to achieve an esthetic outcome in spite of the challenging initial situation.

of temporary restorations. After removing the impression, we applied a layer of adhesive to the tooth substance and isolated it with glycerin gel before fabricating the temporaries. Finally, the temporary restoration was seated (Fig 7). If vital teeth are treated, it is advisable to leave the temporary restoration in the patient's mouth for no longer than a month. Even if the fit of the temporaries is excellent, contamination of the dentin must be prevented. In case of decementation, the preparation has to be cleaned again and another layer of ExciTE has to be applied.

Fabrication in the dental lab

The treatment plan encompassed a bridge restoration for the teeth 14 to 12 and one for teeth 21 to 23 and a single crown for tooth 11. The restorations were fabricated with IPS e.max Press lithium disilicate all-ceramic. As the frameworks that were fabricated were to be veneered in a subsequent step, we chose IPS e.max Press LT ingots (LT = Low Translucency) in the shade A1. In order to achieve an esthetic outcome and to create a lifelike vestibular transition, the connectors of the bridge pontics were positioned more towards the lingual aspect. The importance of the connectors must not be underestimated, and the durability of a restoration must not be compromised for esthetic reasons.

Fig 10 The seated restorations made the patient smile.

Seating the restoration

After removing the temporary restoration, we conditioned the prepared teeth appropriately (Fig 8). During try-in, the ceramic restorations were checked with regard to esthetics, phonetics and function.

After the application of hydrofluoric acid to etch the inner aspect of the ceramic and the subsequent silanization with Monobond Plus, the restorations were ready for adhesive cementation. For this procedure, we used the transparent version of the dual-curing Variolink II composite system. In this way, the shade of the preparations could be optimally utilized and lifelike adaptation was achieved. Due to the translucency of the restorations and the cementation materials, the final outcome showed a vital appearance (Fig 9).

Because we used IPS e.max Press material in the "LT" (Low Translucency) level and IPS e.max® Ceram material in the shade A1, the patient obtained brilliant white teeth as requested. It was possible to give the patient his smile back after many years of having suffered because of the unattractive appearance of his teeth (Fig 10). The images of the seated restorations show their outstanding integration into the surrounding tooth structure. Thanks to IPS e.max®, all teeth feature an outstanding luminosity. This material shows exceptional biomimetic behaviour, which allows dental professionals to create lifelike restorations (Fig 11). ❑

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Not your regular patient case

Esthetic reconstruction of a transplanted premolar tooth

Prof Dr Daniel Edelhoff, Björn Maier, MDT, and Dr Hela Ihloff, all Munich/Germany

Several therapeutic approaches are available to solve cases of missing anterior teeth. The most common of these approaches involves the placement of implants or the fabrication of Maryland bridges. However, tooth transplantation is also an option. In this article you will learn how the author team – using a rather unconventional concept – managed to provide a suitable restorative solution for a young female patient who had lost an anterior tooth.

The patient had lost tooth 11 due to an endodontic complication. When this tooth was extracted, tooth 15 was transplanted into the space left by tooth 11 and the gap was preserved by means of orthodontic measures. As the healing process had been successful, we were able to grind the premolar tooth to the required shape and prepare it for a crown. To improve the overall esthetics, we decided to additionally place non-prep veneers on teeth 12, 21 and 22. Furthermore, the canines were to be built up with composite material to ensure proper function.

Time and again, restoring upper anteriors proves to be a challenging task to the dental team. Criteria such as esthetics, function and strength have to be individually assessed in each case. However, due to the developments in the field of dental materials, today's dental teams have many all-ceramic restorative options at hand. From zirconium oxide-based framework materials to press ceramics and layer ceramics for individualized layering on refractory dies, the range of materials for the fabrication of dental restorations is immense.

The lithium disilicate (LS_2)-based IPS e.max® Press ceramic is an ideal material for cases where single-tooth restorations with exacting esthetics are required. With this material, the wax model is precisely reproduced with the ceramic material and the fully anatomical restoration is characterized with stains and then fired. A more exacting option would be to use the cut-back technique, in which Impulse and Incisal materials (of the IPS e.max® Ceram range) are applied in the occlusal and incisal areas of the pressed framework. By applying small amounts of layering material, highly esthetic restorations can be achieved in just a few steps.

The same applies to the fabrication of ceramic veneers: On the basis of a wax model, partially or fully anatomical restorations are pressed with ceramic and subsequently characterized by means of stains and layering materials. The individual build-up of the veneers with layering materials of the IPS e.max Ceram range on refractory dies is a more time-consuming and demanding option. The outcome, however, makes the additional effort worthwhile.

Patient case

The 32-year-old female patient came to our clinic after the orthodontic treatment had been completed and the transplanted premolar tooth had healed in place (tooth 15 was transplanted to the gap left by tooth 11) (Fig 1). She wished to have the transplanted tooth modified to obtain an impeccable esthetic appearance.

We relied on preoperative models to understand the case and discussed the various options on the basis of a wax-up. As shown in Figure 2, the transplanted premolar has a strong vestibular inclination as a result of

***Fig 1** Initial situation: transplanted premolar in place of tooth 11.*

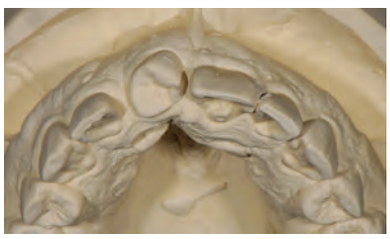

Fig 2 Incisal view of the initial situation on the stone model

Figs 3 and 4 Wax-up for the intraoral transfer to a mock-up

Fig 5 Mock-up in place in the patient's mouth

Fig 6 Fabrication of the working model with removable dies

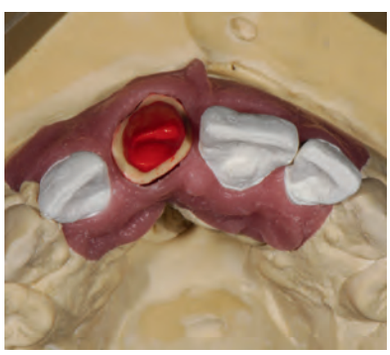

Fig 7 The refractory dies can be directly repositioned in the working model.

its specific anatomy. This was a complicating factor in achieving a harmonious outcome. When we measured the preoperative model, we noted that the width of the orthodontically modified gap was somewhat too large in relation to the width of tooth 21. The immediate solution we thought of was to build up the mesial aspect of tooth 12 with composite material to restore the harmonious relationship between the central incisors. However, this would have caused the lateral incisors to be in disharmony. Another criterion was the length/width ratio of the anterior teeth (odontometrics). In order to achieve a harmonious appearance that matched the age of the patient, the incisal areas of the anteriors would have had to be lengthened by 1 to 1.5 mm. These aspects were discussed with the patient and visualized with models and the wax-up. A goal was defined together with the patient, and we eventually decided that one crown (tooth 11) and three veneers (teeth 12, 22 and 21) were needed. The wax-up was optimized accordingly and an esthetically pleasing final goal was developed (Figs 3 and 4).

To provide a better preview of the final outcome, the finalized wax-up was transferred to a mock-up by means of a template. The patient was thus allowed to gain a more detailed impression of the outcome that was planned before the treatment commenced (Fig 5). She agreed to have the final restorations fabricated on the basis of this mock-up.

Prosthetic planning

If, as in the present case, a restoration has to be made in a largely healthy masticatory system, the question arises as to how it should be fabricated. Whenever possible, an adhesively cemented, conservative all-ceramic solution should be chosen. Veneers made of layering ceramic, such as the nano-fluorapatite glass-ceramic IPS e.max Ceram, on refractory dies can be fabricated with very thin wall thicknesses and with pleasing optical effects. If a non-invasive approach is pursued, this type of restoration allows you to exploit its full potential in terms of esthetics and function. In this case, tooth 11 was prepared according to morphological guidelines and conditioned for the placement of an all-ceramic crown, which was individually layered in the incisal area.

The working model

After preparation and impression-taking, we fabricated the restorations on the model. As we needed refractory dies to complete the individually layered veneers, we prepared a model with removable dies (Fig 6). As a result, we were able to precisely reposition the doubled dies in the model of the initial situation when the materials were fired. It is crucial, however, that the dies are fabricated with utmost precision. Undercuts had to be prevented at all cost. For an optimal fit of the dies on the model, it is advisable to create parallel surfaces which do not allow for any torsion movement of the dies. A guidance groove is therefore not necessary (Fig 7). If the work is carried out precisely, the method described herein allows a high accuracy of fit to be achieved. After the glaze firing, the completed restorations showed an accurate fit also in the vertical dimension almost at once.

Fig 8 The preparation margin was marked on the refractory dies.

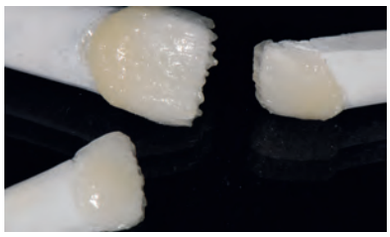

Fig 9 Firing of the ceramic materials on the refractory dies

Fig 10 Mamelon structures were created.

Figs 11 to 13 Much attention was also paid to the creation of the surface texture.

Fabrication in the dental lab

The information captured in the previously completed wax-up was transferred to the working model by means of a silicone template, which was additionally fine-tuned to the situation. Then, another silicone template was prepared, which served as a reference for the subsequent ceramic layering.

Depending on the material used, the refractory dies are left to dry for one day after fabrication without additional heat. If required, they may be degassed. It is important that the dies are immediately removed from the silicone matrix after the 45-minute setting time, as the die material may start to dissolve the silicone material after longer contact. Subsequently, the preparation margin of the veneers is marked on the dies with a refractory pencil and wash firing is conducted (Fig 8). A thin application of material ensures that the ceramic layer is even and homogeneous, which is important for the fit of the veneers. It is advisable to use a clear, transparent material for wash firing, for instance IPS e.max® Ceram Transpa clear or IPS e.max® Ceram Add-On Incisal. In order to keep the shrinkage as low or as constant as possible during the main firing cycle, it is possible to create an "isthmus" with ceramic material. In this case, this structure was created in the cervical area (Fig 9).

Layers of an even thickness were then applied. Starting in the cervical area, Dentin materials were used first. The incisal portion was created in accordance with the patient situation and supplemented with the suitable Incisal and Transpa materials (Fig 10). This procedure was used to create individual characteristics (eg mamelons, opalescent areas) against a translucent background. The intensity of the materials that were used could be precisely controlled and was not hampered by the opaque effect that is sometimes caused by an underlying layer of dentin material.

The crown on tooth 11 was fabricated in the cut-back technique. The IPS e.max Press LS_2 framework which was required for the crown was fabricated at the same time as the veneers. Subsequently, the incisal third of the framework was individually layered with IPS e.max Ceram veneering materials. With this procedure, optimum integration of the restoration into the surrounding tooth structure and a shade effect that was identical to that of the veneers was achieved.

After the Dentin firing process, in which the shade was adjusted, the crown and the veneers were fitted on the model, the proximal contacts were designed and the shape and surface structure of the restorations were created in accordance with the situation using silver powder (Figs 11 to 13). With the final glaze firing, the ceramic layering was completed. The investment material was removed using 50-µm glass polishing beads and a pressure of 0.5 bar (7.25 psi) (Fig 14).

Seating the restoration

A water-soluble gel which burns out without leaving residue was used to secure the sandblasted restorations in place on the model. This allowed us to check the laterotrusive and protrusive movements and to adjust the restorations by means of rubber instruments where necessary. Taking the functional aspects already incorporated in the wax-up into account, we built up the canines with composite material. A canine-based

Fig 14 The completed restorations prior to seating

Figs 15 and 16 In place: The outcome was precisely in line with the treatment plan and made both the patient and the treatment team happy.

dynamic occlusion that relieved the anterior restorations was thus ensured.

Prior to being seated, the veneers were etched with hydrofluoric acid, which was carefully rinsed off after 20 seconds. The restorations were then silanized and accurately seated according to the established protocol for adhesive cementation.

At the recall appointment after seven days, the teeth were rehydrated and the soft tissue had recovered from the intervention (Figs 15 and 16).

Conclusion

The case described in this article shows how complex treatment concepts can be systematically implemented by the dental team on the basis of a detailed plan. Thanks to the intensive counselling of the patient and planning of the treatment by means of the transfer of the mock-up to the patient's mouth, a high-quality, esthetically satisfactory outcome was achieved. ❑

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Shining results

Minimally invasive and esthetic restorative treatment

Monica Basile, DDS, and Michele Temperani, CDT, both Florence/Italy

With the availability of a wide range of innovative restorative materials, the esthetic demands of patients can be met efficiently and effectively by the collaborative efforts of practiced dental teams. As the technology behind these materials has become increasingly sophisticated, clinical cases that were considered to be challenging previously can now be treated without having to compromise on esthetics or remove healthy dental tissue. The authors describe their approach in cases such as these in the following article.

Immaculate teeth are associated with good health and vitality. A bright smile radiates self-confidence and heightens a person's attractiveness. State-of-the-art esthetic dentistry can achieve small wonders in this respect. The shape and colour of teeth as well as their length and position can be adjusted. Nevertheless, in all these treatments, conservation of healthy tooth structure is paramount. For this purpose, procedures have to be planned in detail by the dental team consisting of the dentist and dental lab technician.

An uncommon preoperative situation

The 30-year-old patient was dissatisfied with the appearance of his smile and requested us to correctively adjust his front teeth (Fig 1). We visually identified the problem at a speaking-distance to the patient. The overall appearance of the dentition was marred by gaps between the teeth (diastema) and the unusual shape of the upper lateral incisors (Fig 2). A panoramic scanning dental X-ray revealed the failed development of tooth 12 and 22 (Fig 3). As a result, the canines had moved into the position of the lateral incisors. In the past, the appearance of both canines had been slightly adjusted to that of the incisors. Moreover, it is important to note that the dental arch also featured two deciduous canines.

What patients want

The patient let us know exactly what he wanted and did not want. Today's patients are usually knowledgeable and well informed. They clearly express their ideas and demand tailor-made solutions. This particular patient had been searching for a suitable and non-invasive treatment for quite a long time. Previous treatment plans had incorporated the suggestion of removing the two deciduous teeth and replacing them with implants. However, the patient did not agree with this solution. He wanted to keep his natural teeth until they fell out of their own accord, even though the lifespan of these teeth was limited. Until this time, however, the patient wanted to have a gap-free and even-looking anterior dentition, in other words, an attractive smile. We were unable to predict the survival rate of the deciduous teeth on the basis of the X-rays. Nevertheless, a thorough examination showed that they were still securely in place. Furthermore, there were no signs of periodontal disease. The patient was fully aware of the limited lifespan of the deciduous teeth and asked for a "reversible" solution in order to prevent the existing tooth structure from being permanently damaged. He

Fig 1
The 30-year-old patient was dissatisfied with the appearance of his smile.

Fig 2 The gaps in the front row of teeth and the unusual shape of the upper lateral incisors bothered the patient.

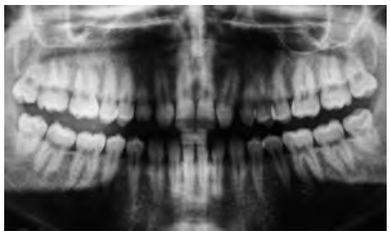

Fig 3 A panoramic scanning dental X-ray revealed that tooth 12 and 22 had failed to develop.

Fig 4 A diagnostic wax-up and a silicone matrix were fabricated.

Fig 5 The silicone matrix was used to produce a mock-up of the restoration.

Fig 6 The finished mock-up (composite resin). The patient was satisfied with the prospective result.

Fig 7 Reference patterns of the mock-up were fabricated for the permanent restoration ...

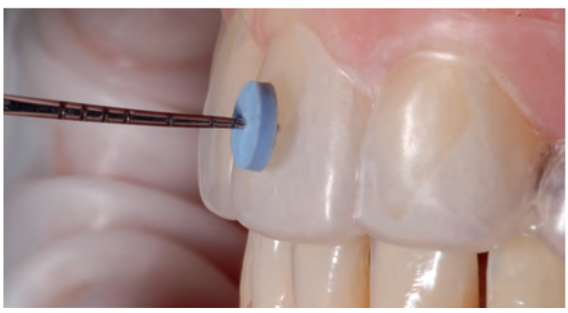

Fig 8 ... and the necessary volume and the minimal thickness were established.

wanted to make sure that further treatment in the future would be possible without having to make functional or esthetic compromises.

Planning the right way

As usual, we documented the preoperative situation with photographs. In addition, we determined the "where and how" of the restorative procedure on the basis of working models. Our aim was to produce an esthetic appearance that would meet the requirements of the patient. A diagnostic wax-up was produced and a silicone matrix was created in the dental lab, taking into account the clinical requirements and the technical limitations (Fig 4). In cases such as this one, the materials that are selected for the treatment are an important component of the treatment plan. As a result, it must be clear at the beginning of the clinical procedure what ideally should be done and what can be accomplished from a practical point of view. In this case, the corresponding information was transferred to the clinical situation by means of a direct mock-up, which was produced on the basis of the previously fabricated silicone matrix (Fig 5). Therefore, a composite resin was applied to tooth 14 and 24. The size of the two deciduous teeth was increased and the appearance of the existing canines was transformed with the composite resin to look like lateral incisors (Fig 6). Even though the proportions of the central incisors were not yet in harmony with the overall appearance, the patient was satisfied with the esthetics of the try-in results of this minimally invasive solution.

Implementation

The final restorative procedure involved ten teeth. With the mock-up as a reference, the shape, size and minimal thickness of the restorations was established. Measures were taken to ensure the predictability of the quality and the control of the technical and clinical aspects of the procedure (Figs 7 and 8). On the basis of the wax-ups fabricated on the working models, six very thin veneers (facial) were planned for tooth 14, 24, 53, 63, 11 and 21. The veneers were so thin that the teeth

Fig 9 The prepared teeth

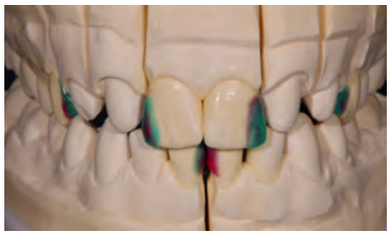

Fig 10 The restorations were modelled in the dental laboratory and ...

Fig 11 ... reproduced with pressed ceramics.

Figs 12 to 14 The material used for the film-thin veneers (IPS e.max Press) enabled utmost translucency to be achieved and the opacity to be adjusted according to the requirements.

did not require preparation. Tooth 12 and 22 were prepared for two conventional veneers. They were the only two teeth that required the removal of 0.6 mm of the dental enamel. Furthermore, mesial micropreparation of tooth 41 and 31 was planned with the aim of augmenting these teeth with the corresponding veneers. Despite the smallness of this corrective step, it served to close what the patient considered to be an unattractive gap in the lower jaw (Fig 9).

Skill and precision

This case required utmost skill and precision. The restoration involved six very thin non-prep veneers (Fig 10). Moreover, two veneers had to be fabricated for teeth with micropreparations (the deciduous canines were only ground on the distal side to remove 0.3 mm of dental enamel) as well as two veneers for teeth that had been reduced by 0.6 mm. We decided to use IPS e.max® Press lithium disilicate glass-ceramic (LS_2) to produce the ten restorations. This material is used to fabricate monolithic restorations, which are characterized by high strength (400 MPa) and exceptional esthetics. We used the new IPS e.max Press Value ingots for the veneers on the central incisors and the two deciduous teeth. The brightness of restorations can be carefully controlled with this material. As a result, smooth integration into the existing dentition is ensured (Fig 11). In the present case, the high translucency of this material enabled us to lengthen the edges of the central incisors. Therefore, the proportions of the teeth were more balanced, which enhanced the patient's smile. Instead of a Value ingot, an IPS e.max Press Opal ingot was used to construct the lower incisors. In contrast to the shades of the Value ingots, these blocks are opalescent and the level of this optical property can be adjusted as necessary (Fig 12). Furthermore, these materials are characterized by their ability to match the shade of the underlying tooth structure. As a result, certain physical properties, such as brightness and opalescence, which are often difficult to reproduce, can be faithfully imitated or even enhanced.

In order to improve the appearance of the canines and make them look like lateral incisors, we also used the press technique, but combined it with the cut-back technique. Due to the shallowness of the preparation, a very delicate framework was required. Therefore, we chose a highly translucent ingot (IPS e.max Press HT, shade BL3) for this purpose. The pressed substructure was subsequently built up with IPS e.max® Ceram using the conventional layering method (Fig 13). If the relationship between a monolithic restoration and the supporting dental tissue is incorrect in the anterior region, it may be difficult to adjust the shade satisfactorily. In other words, if little natural tooth structure is available for the shade adjustment, the restoration may lack sufficient brightness and it may fail altogether. Therefore, the aim in the case described was to remove as little tooth structure as possible.

A steady hand

It is thoroughly understandable that the dental practitioner was slightly apprehensive when she opened the packet from the laboratory, as the delicate veneers were much thinner than a fingernail (Figs 14 and 15). The subsequent challenge was to place these restorations precisely. The teeth, with the exception of the two permanent canines and the minimally prepared deciduous canines, had not been ground. As a result, no clear references were available for the placement of the veneers. Nevertheless, the OptraStick proved to be a useful placement tool. This disposable auxiliary aid

Fig 15 Some of the veneers were much thinner than a fingernail.

Fig 16 View of the restorations one week after their placement

Fig 17 Successful esthetic results were achieved with minimally invasive treatment.

allowed the individual restorations to be handled without the risk of dropping or breaking them. Another important aspect of the treatment was the fact that the dental technician was on hand to offer invaluable advice on the positioning of the restorations he had fabricated.

In addition, the cementation material selected was decisive for the successful shade adaptation of the restoration. In accordance with the recommendations for cementing restorations that are thicker than 1.5 mm, a dual-cure adhesive luting composite (Variolink® II) was used to place the faced crowns. First, a suitable cement shade was established with the help of the special try-in pastes. Next, the ceramic restorations were etched with hydrofluoric acid and the enamel areas were conventionally conditioned. Monobond Plus was used to condition the restorations, which were subsequently placed with the adhesive luting composite. Furthermore, at the try-in, the flowable composite Tetric EvoFlow® was chosen to cement the eight veneers. The flowability of the product was enhanced by warming it at 37 °C for twenty minutes before its application. Each individual veneer was placed under the watchful eyes of the dental technician and only polymerized once it was correctly in place on the tooth.

Conclusion

The subsequent working steps were carried out with the same care as cementation. Excess cement was removed completely and all the necessary checks, such as the occlusion in lateral and vertical movements, were carried out. Despite the fact that esthetics played an important part in the treatment plan, functional aspects were not ignored in any way. Even though the ceramics and cements used are by far stronger and more adaptable to natural dentition than the materials used in the past, their function has to be checked nevertheless to avoid any undesirable consequences.

The effect of the restorations immediately following cementation as well as at the one-week and one-month recall satisfied everyone involved. The materials we had selected allowed us to offer the patient minimally invasive treatment and highly esthetic results (Figs 16 and 17). ❑

A list of literature references is available from the editors on request.

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