REFLECT

1/15

A modern direct restorative technique

Tetric EvoCeram Bulk Fill: a case presentation

The combination for optimized esthetic success

All-ceramics and CAD/CAM technology

Easy, fast and precise

Implant-prosthetic restoration of an edentulous maxilla

Dear Readers

It is no coincidence that the current issue of Reflect reaches you in perfect time for the International Dental Show (IDS) 2015 in Cologne/Germany. IDS is the world's largest and most important trade fair for the dental industry. This year more than 2,100 exhibitors from all the five continents will showcase their range of products to an international audience of dental professionals. Ivoclar Vivadent will again take advantage of this unique platform to introduce its own innovations in the three product areas Direct Restoratives, Fixed Prosthetics and Removable Prosthetics.

In 2015 Ivoclar Vivadent will continue to present new and innovative strategies and consistently continue on its path of success. Our customers place high expectations on us. To meet these expectations, we invest not only in new products and technologies but also in the expansion of our global distribution network. A company that aims to provide its customers with the highest standards of customer care and services needs to have a local presence and an understanding of the market. Consistent with this objective, we launched a new Marketing Office and International Center for Education in Vienna/Austria and in Jakarta/Indonesia in 2014.

In this issue of Reflect, you will find again a selection of fascinating case presentations and topics. Dive in and find out how you can adjust the occlusal height and restore the esthetic and functional properties of a dental arch in a single day using lithium disilicate ceramics (IPS e.max CAD) and CAD/CAM technology. Read about the edentulous patient who was given a new smile, and discover a wealth of valuable new information.

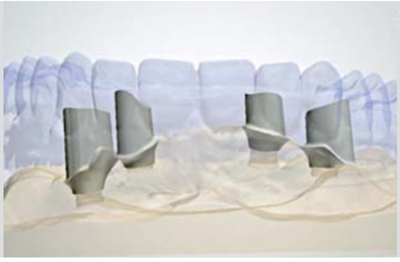
I hope you will enjoy reading this issue and I wish you much joy in your daily work.

Yours

Josef Richter
Chief Sales Officer
Ivoclar Vivadent AG, Liechtenstein

Page 5

Page 10



Page 18

Take advantage of the versatile options offered by digital magazines for tablets and experience the iPad edition of the article: "An ideal combination for optimized esthetic success" by Marko Jakovac, DMD, MSc, PhD, and Michele Temperani (pp. 8-11). Benefit from the interactive photo sequences with additional pictures, and learn more about the products used and the authors.

The availability of certain products can vary from country to country.

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A modern direct restorative technique for posterior restorations

Tetric EvoCeram Bulk Fill: a case presentation

Prof. Dr Jürgen Manhart, Munich/Germany

Bulk-fill composites are the result of the consistent further development and optimization of direct adhesive restorative materials. These composites offer an excellent depth of cure and enable a fast and straightforward restorative placement technique for posterior teeth.

Introduction

Until recently, the incremental layering technique has been considered the gold standard for the application of light-curing composites [1]. Conventional composites are normally applied in individual increments of a maximum of no more than 2 mm due to their polymerization properties and limits on curing depth. The individual increments are polymerized separately. Curing times can vary between 10 and 40 seconds, depending on the light performance of the curing light as well as the shade and degree of translucency of the composite [2]. The composite materials that have been available to date cannot be applied in thicker increments because this would prevent them from polymerizing sufficiently and their mechanical and biological properties would be weakened as a result of the insufficient cure [3,4,5]. Particularly when restoring large posterior cavities, the conventional incremental layering technique can be very time-consuming and technique sensitive. For this reason, many dentists have been looking for an alternative to this complex and time-consuming multi-step regimen. They want to use a procedure that is less time-consuming and therefore more economical and offers increased reliability and safety [6,7,8]. In response to this demand, bulk-fill composites have been developed in recent years. These composites can be applied in increments of 4 to 5 mm and light-cured in short exposure times per increment (10 to 20 seconds) if a curing light capable of emitting an appropriately high light intensity is employed. The result is a more rapid restorative placement technique for posterior cavities [7,9,10,11].

Bulk-fill composites

As regards their chemical composition, bulk-fill composites are very similar to hybrid composites and therefore do not form a new category of materials. They comprise an organic matrix, consisting of proven monomer systems, and inorganic fillers [2,12].

Fig. 1: Preoperative situation: upper first molar after endodontic treatment and temporary sealing of the endodontic cavity

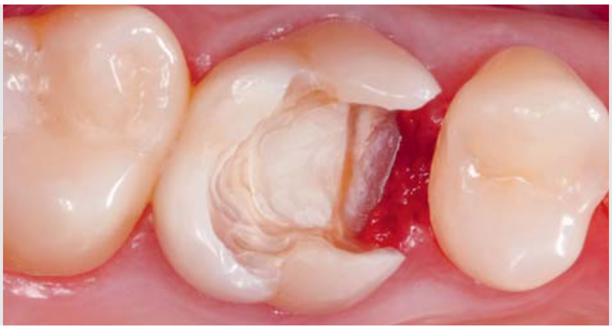

Fig. 2: Situation after removing the existing restorative material and covering the canal openings with glass ionomer cement

Fig. 3: Conditioning with Adhese Universal using the self-etch technique (reaction time: 20 seconds) after having placed a rubber dam and a sectional matrix band

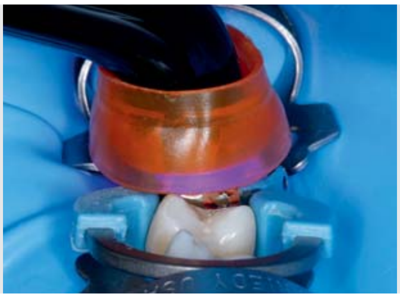

Fig. 4: Light-curing the adhesive for 10 seconds with a Bluephase Style

Fig. 5: First increment of Tetric EvoCeram Bulk Fill: filling up the mesial box

Bulk-fill composites are available in two degrees of viscosity. Both of these viscosities require a different application technique:

1. Low-viscosity, flowable composites. These bulk-fill composites require the application of a final covering layer of conventional posterior hybrid composite to protect the restoration surface because they contain comparatively large filler particles and feature low filler content. This also causes the mechanical properties of flowable bulk-fill composites to be less advantageous, which is reflected in their susceptibility to wear, increased surface roughness and diminished polishing properties [2,13,14,15]. Additionally, the covering layer assists in creating functional occlusal contours, which would be difficult to achieve with a flowable material.
2. Regular to high-viscosity variants featuring a stable and mouldable consistency. These bulk-fill composites can be used up to the occlusal surface. They do not require a covering layer and therefore do not require an additional composite material.

For both versions, their maximum layer thickness is restricted to 4 to 5 mm because of the limits on the depth of cure. This means that only the high-viscosity representatives applied in cavity depths that do not exceed their maximum depth of cure can be considered bulk-fill materials in the true meaning of the word. If a defect is deeper than the maximum curing depth or if a flowable variant is used, an additional layer of material will always be required.

In 2011, Ivoclar Vivadent launched the high-viscosity composite Tetric EvoCeram® Bulk Fill. In terms of materials technology, this product is closely related to the hybrid composite Tetric EvoCeram, which has been successfully competing in the market for more than ten years. Tetric EvoCeram Bulk Fill is based on the monomer formulation and filler technology of Tetric EvoCeram.

Tetric EvoCeram additionally contains the highly reactive and optimized Ivocerin® light initiator.

Based on a dibenzoyl-germanium derivative, this innovative initiator system shows a similar absorption spectrum as camphorquinone, which is widely used as an initiator system in polymers. However, Ivocerin features a higher visible-light absorption rate, allowing for increased quantum efficiency and, by extension, for an enhanced light-curing performance [16, 17]. Consequently, a low quantity of light (photons) is sufficient to trigger an appropriate polymerization reaction and achieve a deep depth of cure of 4 mm with short exposure times [16,18]. The high quantum efficiency of Ivocerin is responsible for this. Due to the careful coordination of the refractive index of the fillers with the refractive index of the polymer matrix, the light initiator produces favourable optical properties that match those of the natural tooth structure (in particular those of the enamel). This results in a successful esthetic integration of the restoration [17,19]. Virtually invisible restorations can be achieved in posterior cavities free of stained dentin by using one of the three shades available (IVA, IVB, IVW).

Advantages of the bulk-fill placement technique
Rapid, time-saving restorative technique, eliminating the need for a complex layering technique ▸ increased efficiency [20]
Easier handling [21]
Fewer increments ▸ no/fewer increment interfaces ▸ fewer problems with interface imperfections (voids, gaps) between individual composite increments [22] and generally less risk of air entrapments
No need for time-consuming shade selection procedures
Streamlined logistics ▸ fewer materials to store

Case presentation

Following successful endodontic treatment, the patient expressed a wish to have the restoration on his upper first molar replaced (Fig. 1). After the patient had been informed about the treatment options and the corresponding costs, he decided in favour of a bulk-filled restoration made of the mouldable composite Tetric EvoCeram Bulk Fill.

Tetric EvoCeram Bulk Fill is a hybrid composite featuring a typical dimethacrylate monomer matrix and inorganic filler particles with a smooth mouldable consistency. The composite can be applied in increments of up to 4 mm and each increment can be cured in 10 seconds (intensity of the curing light ≥ 1,000 mW/cm^2). Given its mouldable consistency and material properties, this composite enables dentists to restore cavities with a single restorative using the bulk-fill technique. Applying a different material to cover the occlusal surface is unnecessary – a step that is normally needed if a flowable bulk-fill composite is employed. Since Tetric EvoCeram Bulk Fill is available in three universal shades (IVA, IVB, IVW), the need for a detailed shade selection procedure is eliminated.

Fig. 6: Contouring the composite and adapting the mesial wall to the height of the marginal ridge with a microbrush

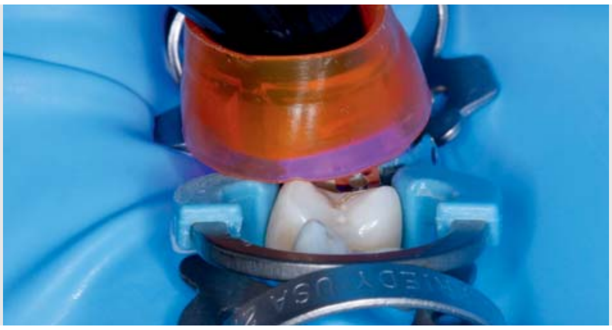

Fig. 7: Light-curing the composite for 10 seconds with a Bluephase Style

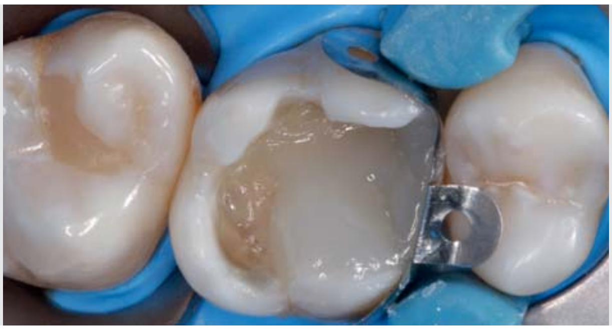

Fig. 8: Shaping the mesio-palatal cusp

Fig. 9: Shaping the mesio-buccal cusp

Fig. 10: Shaping the disto-buccal cusp

Fig. 11: Shaping the disto-palatal cusp

After the tooth had been cleansed, the existing composite material was completely removed. Following excavation, the openings of the obturated root canal system were covered with glass ionomer cement and preparation of the cavity was finished with fine diamonds (Fig. 2). Next, the operating field was isolated with a rubber dam and a sectional metal matrix band was placed around the cavity. Then, the preparation was conditioned using Adhese® Universal in the self-etch technique according to the manufacturer's instructions. Adhese Universal is an advanced single-component adhesive that is compatible with all etching techniques: self-etch and etch techniques based on phosphoric acid (selective enamel etch and total etch & rinse techniques involving the enamel and dentin). Figure 3 shows the direct application of a generous amount of Adhese Universal adhesive onto the enamel and dentin. The material was gently scrubbed into the tooth surface for at least 20 seconds using the brush cannula of the VivaPen® delivery form. Next, the solvent was dispersed with a gentle stream of compressed air until a glossy, immobile adhesive film resulted. Then, the bonding agent was light-cured for 10 seconds using a Bluephase® Style curing light (Fig. 4). A glossy layer evenly covering the entire cavity surface was now visible.

At the next step, Tetric EvoCeram Bulk Fill in shade IVB was applied to the mesial box until the remaining depth was no more than 4 mm in the entire cavity (Fig. 5). At the same time, the mesial wall was built up to the height of the marginal ridge (Fig. 6). Next, the composite was light-cured for 10 seconds with a Bluephase Style LED curing light (Fig. 7). Given the high light intensity of the curing light (1,100 mW/cm²), suitable composites can be reliably polymerized with a short exposure time.

The shortened light probe head facilitates access to posterior cavities and the filling material can be illuminated at an ideal angle to ensure reliable polymerization. With the subsequent increments of Tetric EvoCeram Bulk Fill, the occlusal morphology of the tooth was reconstructed cusp by cusp (Figs 8 to 11). We were able to light-cure the restorative material

Fig. 12: Given the large diameter of the Bluephase Style light probe, all occlusal increments can be light-cured in one go for 10 seconds.

Fig. 13: After the matrix band has been removed, the restoration is checked for imperfections.

Fig. 14:
Completed restoration polished to a high gloss: successfully restored function and esthetic appearance

with a single exposure of 10 seconds due to the large diameter of the Bluephase Style light probe (Fig. 12). Following the removal of the metal matrix band, the restoration was checked for any imperfections. Finally, the rubber dam was removed (Fig. 13).

The restoration was carefully finished and the static and dynamic occlusion adjusted. Subsequently, the restoration was polished to a shiny smooth surface using diamond-impregnated silicone polishers (OptraPol®) and Astrobrush® silicon carbide brushes. Figure 14 shows the completed direct composite restoration, restoring the original tooth shape with an anatomical and functional occlusal surface, a physiological proximal contact point and a favourable esthetic appearance. To complete the treatment, a fluoride varnish was applied to the teeth using foam pellets.

Conclusion

The advent of bulk-fill composites featuring a large depth of cure and the subsequent acceptance of these materials among dentists presents another milestone in the continued development of the direct adhesive restorative technique. Direct adhesive procedures in posterior teeth are modernized by the possibility of using these light-curing composites to restore large cavities with fewer increments. The result is a state-of-the-art, straightforward, rapid and economically efficient restorative placement technique for posterior teeth. Given the positive clinical experience reported for Tetric EvoCeram after ten years on the market, Tetric EvoCeram Bulk Fill is expected to provide an equally successful long-term clinical performance because these two materials are closely related to each other in terms of material technology.

A literature list is available from the editors on request.

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An ideal combination for optimized esthetic success

All-ceramics and CAD/CAM technology

Marko Jakovac, DMD, MSc, PhD, Zagreb/Croatia, and Michele Temperani, Florence/Italy

CAD/CAM technology provides an efficient and reliable method to create full-contour restorations from high-quality zirconia for complex restorative needs in the posterior region.

Modern dentistry is not only concerned with oral hygiene or caries prevalence – wear from attrition, abrasion or erosion is increasingly becoming a subject of concern. These destructive oral processes are in large measure attributable to stress. Stress can trigger parafunctional habits and lead to gastric reflux and low pH values in saliva. Additional factors such as bulimia and excessive consumption of soft drinks also come into play.

Case presentation

A 30-year-old female patient presented at our practice with pain in the posterior region. She was also dissatisfied with the esthetic appearance of her anterior teeth (Fig. 1). Considerable erosive loss of tooth structure on the palatal and cervical surfaces was observed at the preliminary examination (Fig. 2). An initial interview revealed that the patient consumed large quantities of soft drinks. On the basis of the clinical findings, we concluded that the woman was suffering from stomach problems with suspected bulimia.

Treatment planning

After careful history taking and a thorough assessment including a radiographic evaluation, we began to develop a treatment plan. The plan was to rehabilitate the entire oral cavity, to restore all teeth that had been damaged by erosion or tooth decay and to protect the existing dentition from further damage. We aimed at restoring the shape and function of the teeth by raising the vertical dimension of occlusion. Interventions involving such a high level of complexity require both a comprehensive plan outlining in detail every part of the treatment and close collaboration between dentist and dental technician. Following initial examination, an impression and bite record were taken. Portray imagery and DSD technology (Digital Smile Design) have proven to be highly useful in situations where the dental technician cannot gain an impression of the patient's oral situation in person.

Fig. 1: Patient before the treatment: She wanted her esthetic appearance to be improved.

Mock-up and initial temporaries

As provided for in the treatment plan, the dental technician fabricated a diagnostic wax-up to visualize the ideal oral situation. Wax-ups are convenient to assess the feasibility of such complex prosthetic treatments. Duplicate casts were made from the contoured wax-up and silicone matrices were created (Fig. 3). In the first step, the matrices assisted in the construction of the mock-up and, further on, in the fabrication of the baseline temporaries in the patient's oral cavity. The mock-up was completed on the basis of the wax-up. It was then used to simulate the final outcome on the patient and visualize the inclination of the occlusal plane (Fig. 4). The patient agreed to the treatment plan and we proceeded to implement the necessary surgical measures – i.e. tooth extraction and crown lengthening. It is important to

Fig. 2: On examination, a substantial loss of tooth structure in the cervical and palatal region was observed.

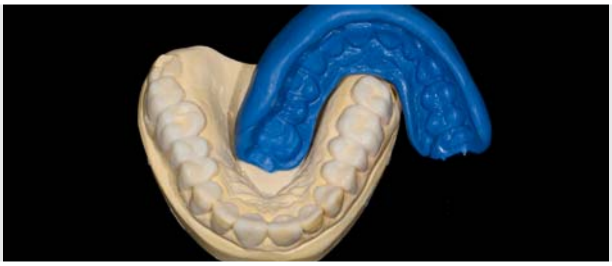

Fig. 3: Mock-up and temporaries were created using a silicone matrix of the wax-up.

Fig. 4: Mock-up placed in the patient's mouth

Fig. 5: Situation after surgical crown lengthening

Fig. 6: Long-term temporaries were instrumental in stabilizing the vertical dimension of occlusion.

Fig. 7: After long-term temporization: a bite record was taken to document the occlusal position created in the course of long-term temporization.

consider the form identified in the wax-up when performing surgical crown lengthening (Fig. 5). Subsequently, the patient underwent periodontal treatment and root canal therapy. Additionally, all existing restorations were replaced.

Preparation and temporization

The teeth were prepared in two sessions. At the first session, we prepared the teeth along the gingival margin. Impressions were taken and temporaries fabricated. Generally, temporization is essential to achieve an optimum healing result after surgical crown lengthening and tooth extraction. Since the temporaries should follow the parameters established in the wax-up, we decided to employ CAD/CAM technology for this step.

The wax-up and master models were digitized using a lab scanner (Wieland Dental) and the resulting data sets superimposed using dental design software (3Shape). This method allowed us to transfer the shape of the wax-up to the model that contained the tooth preparations. The virtual project is automatically converted into a STL data format and sent electronically to the program responsible for the CAM process. In this case, the STL data were imported into the milling program of a Zenotec® mini CAD/CAM unit (Wieland Dental) to manufacture temporaries from Telio® CAD PMMA material (Fig. 6). Occlusal and functional adjustments were repeatedly performed over the three-month healing period (Fig. 7). After successful healing, the second stage of the preparation process was implemented. When carrying out this step, visual aids (loupes, dental microscope) are recommended to achieve accurate results. After completion of the preparation procedure, an impression of the oral situation was taken (Fig. 8). Jaw relations were established with the help of a bite record. The jaw position was "test driven" during the healing phase when the patient was wearing the temporaries. A special procedure (cross-mounting method) enables the clinician to communicate the jaw relations to the technician without loss of information.

Creating the final restorations

We used the Zenotec CAD/CAM system and Zenostar® zirconia materials (Wieland Dental) to fabricate full-contour crowns and bridges for the premolar and molar region. The plan was to customize the premolar restorations with IPS e.max® Ceram veneering ceramic using the layering technique. The anterior restorations were manufactured using the press technique with IPS e.max Press lithium disilicate glass-ceramics. These restorations were also customized using IPS e.max Ceram.

On the one hand, the final restorations had to be manufactured in such a way that they were faithful to the parameters established in the simulation models. On the other hand, the final restorations should reproduce the shape and occlusal dimension of the temporaries, which had been consistently optimized during the long-term temporization stage. To achieve

Fig. 8: Anterior teeth prepared for the final restoration

Fig. 9: The master models were digitized to create the final restorations.

Fig. 10: Virtual construction based on the situation created by the long-term temporaries

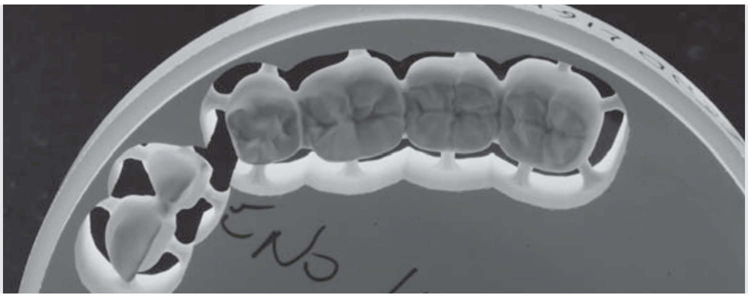

Fig. 11: Restorations after having been milled from pre-shaded Zenostar T1 zirconia material (Wieland Dental)

Fig. 12: Molars were created in full contour and the vestibular aspects of the premolars were layered over.

Fig. 13: Frontal view of the completed restorations on the model

an ideal outcome, the laboratory was provided with a range of useful data to allow the technician to mount the models on the articulator and to interchange them with one another:

- Impressions for master models
- Impressions of the temporaries after functional and occlusal adjustments
- Occlusal record
- Facebow

The master models and the models of the most recently modified temporaries were scanned and uploaded to the 3Shape software program using the "cross-mounting" method (Figs 9 and 10). Given the level of complexity involved in this case, we preferred to mill the components first from wax to be able to assess the quality of the virtual construction in a conventional fashion. With this inexpensive method, we were able to assess the shape and function of the structures in "real life". In the present case, we noticed that a few areas had not been properly contoured in the wax. These areas were corrected accordingly.

> Herein lies one of the advantage of CAD/CAM technology: a project can be designed, evaluated, modified and duplicated for an indefinite number of times.

The corrected STL data were processed in the CAM module and the data required for the milling process imported into the program of the Zenotec mini milling unit. The restoration was then milled from a pre-shaded Zenostar zirconia disc (shade T1) (Fig. 11). It is an advantage of this material that it is supplied in discs that are pre-shaded. Normally, framework shading requires a separate working step to apply metal-oxide based colouring liquids either by an immersion or brush-on technique prior to sintering. In pre-shaded discs, the shades are added to the zirconia powder and homogenised during the industrial production process. The result is a material that demonstrates a highly homogeneous shade. As the need for manual shading is eliminated, time savings can be gained in the fabrication of restorations, providing an additional advan-

Fig. 14:
Two weeks after the restorations had been seated: optimal situation with successful pink and white esthetics

Figs 15 to 17:
All-ceramic restorations: integrated harmoniously and unobtrusively into the dentition and facial appearance of the patient

tage. Colour consistency is another advantage that should not be underestimated. A consistent colour is achieved, irrespective of the skills and experience of the technician.

To ensure an optimum integration of the posterior restorations made of zirconia and the anterior restorations made of lithium disilicate, the vestibular areas of the premolars were layered over with a veneering ceramic (IPS e.max Ceram) (Fig. 12). We used a conventional press technique in conjunction with IPS e.max Press ingots (shade LT A1) to fabricate the anterior lithium disilicate restorations and then completed the pressed crowns individually using the cut-back technique (Fig. 13).

Seating the restorations

CAD/CAM technology was used to fabricate the posterior crowns and bridges from monolithic zirconia. The occlusal conditions established in the long-term temporaries were accurately taken into account. Prior to seating the final restorations, we checked their accuracy of fit and shade match intraorally using glycerine-based try-in pastes (Variolink® Esthetic Try-In). The crowns and bridges were permanently cemented using the dual-curing luting composite Variolink Esthetic DC. In the mandible, the veneers were luted using the light-curing variant of the same luting composite (Variolink Esthetic LC) in a neutral colour. This luting composite is easy to apply and excess material can be effortlessly removed during the cementation process.

Two weeks after the restorations had been placed, the patient came for another visit to our practice. Pink and white esthetics was harmoniously balanced (Figs 14 to 17). This outcome was possible due to the careful adaptation of the treatment to the needs of the patient and the smooth communication between practice and lab.

Conclusion

Successful treatment of young patients with complex treatment needs requires a high degree of accuracy and minimally invasive preparation methods. Full-contour zirconia restorations milled using CAD/CAM strategies provide a straightforward method to achieve accurate restorations, particularly for the posterior region. The success of anterior restorations continues to depend largely on the skills of the technician and on the use of materials with optimum properties, such as the IPS e.max lithium disilicate glass-ceramics.

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Five patient cases – One concept

All-ceramic restorations with IPS e.max

Dr Masayuki Okawa, Tokyo, and Shigeo Kataoka, Osaka/Japan

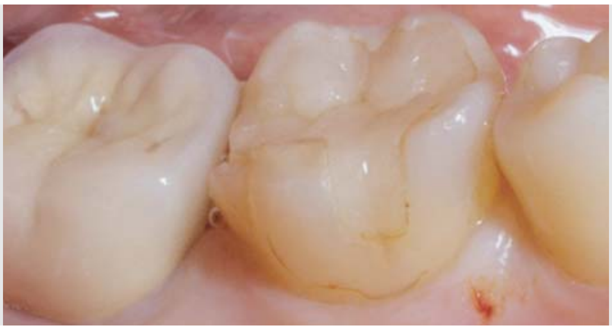
As Aristoteles already said, beauty is sensed within symmetry. This is also the guiding principle of the authors, who describe minimally invasive methods to achieve harmony between pink and white esthetics.

Minimally invasive restorations have long become a reality due to the improvements in bonding materials and the enhanced strength of ceramic restoratives. The invasiveness of the treatment is minimized. A solid understanding of the material properties and clinical steps is essential to be able to benefit from these advances. We believe that the main cause of ineffective all-ceramic restorations can be largely attributed to human error caused by a lack of familiarity with the materials or by incorrect tooth preparation and bonding procedures. Five case studies are presented below to discuss the flow of treatment from initial examination and diagnosis to final cementation.

Selecting the materials

The teeth of this patient were badly stained (Fig. 1). Even after repeated bleaching, the appearance was still not satisfactory. The patient then presented to the practice wishing to have his teeth restored with veneers. Until a few years ago, all-ceramic crowns on metal or zirconia frameworks would have been the method of choice to treat such severely discoloured teeth. Now, we favour a minimally invasive approach with lithium disilicate LS_2 (IPS e.max® Press). Given its high strength (400 MPa), this material is even suited for veneers with a layer thickness of as little as 0,3 mm (Fig. 2). From a wide range of shades and different levels of translucency and opacity, users can select the ideal ingot for every patient situation. Further convincing features include high accuracy of fit and excellent esthetics. Harmony and beauty are inherent in natural teeth. We must reproduce this effect with artificial materials. IPS e.max Press has enabled us to emulate the nuanced colour effects of natural teeth.

Figs 1 and 2: First case: severely discoloured teeth restored with ceramic veneers (IPS e.max Press)




Figs 3 and 4: Second case: Following a distal cusp fracture, the tooth was restored using ceramic materials. Considering the occlusal masticatory forces, we decided to use high-strength IPS e.max Press LS_2 ceramics in conjunction with the staining technique. (Fabrication of restoration: DT Takahiro Aoki)

Diagnosis and treatment planning

First, the patient's oral health state is assessed and the information gathered in the process forms the basis for the subsequent treatment planning. The key to success is to involve the dental lab already at this stage and to share the information gathered in the assessment process with the technician. In addition to taking the usual oral and facial images, radiographs and impressions, we also perform cephalometric analyses and jaw function tests, depending on the indication to be treated. In addition, we evaluate the esthetic characteristics. By consulting with the treatment partners, we are trying to gather as much information as possible with the aim to use this data to prepare a treatment plan in which we consider not only the tooth to be restored but the overall balance between the facial configuration and oral cavity.

Staining technique vs cut-back technique

Although the staining technique has a favourable effect on strength, it poses limits on the esthetic design of the restoration. When we treat patients who require restorations in the anterior region, we prefer to use the refractory die method (IPS e.max Ceram) or the cut-back technique (IPS e.max Press). In the posterior region, however, we often opt for the staining technique. The result of a study conducted at New York University [Guess et al. 2010] demonstrates the high strength of monolithic lithium disilicate restorations manufactured in conjunction with the staining technique. Against such a background, we only occasionally use the layering or cut-back technique for full-coverage crowns and often choose to design the occlusal surface with IPS e.max Press because of its high strength (Figs 3 and 4).

> It is important to decide on the technique to be used prior to beginning the actual treatment to ensure that only as much tooth structure as required is removed during tooth preparation.

Preparation

Minimizing invasiveness is one of the goals of esthetic dentistry. While the work of the dental technician may be helped by removing large amounts of tooth structure, this is not an acceptable reason for creating an unnecessarily high level of invasiveness. On the other hand, if a tooth has been prepared insufficiently, the technician may find it difficult to achieve an esthetically satisfactory restoration in the correct shade.

Veneer restorations are incorporated by bonding the restoration material to the tooth structure using an adhesive technique. Although the materials for adhesive bonding have been improved to enhance the bond strength to dentin, the preparation borders should nonetheless be limited to the enamel to attain reliable adhesion. Generally, the shape of the preparation is designed by taking both esthetic and biomechanical aspects into account. For this purpose, a silicone key may be created on the basis of the diagnostic wax-up. Indexing the tooth horizontally into three areas (cervical, coronal and incisal) allows the amount of tooth structure that is being removed during preparation to be checked. Additionally, a guide in the shape of the final tooth preparation may be used as a reference in complex micro-veneer preparations. Preparation is performed under a microscope. Using a microscope results in clearly defined margins and, as a result, facilitates the work of the technician and enhances the accuracy of fit.

Shade selection

Esthetic restorations of discoloured teeth usually require the removal of larger amounts of tooth structure than usual. Since we began to use lithium disilicate, however, we have been able to achieve shade adjustments with minimal reduction of tooth structure. To this end, communicating the colour of the tooth preparation to the technician is essential. Photographs including shade tabs and digital shade measuring devices are examples of instruments that can be used for shade communication. While shade measuring devices are suited for objective shade evaluations, they only provide information on a limited gamut of colours. They cannot convey subtle nuances. Photographs of the teeth with the shade tabs placed next to them are better suited for this purpose. Using tooth-coloured IPS Natural Die material is particularly useful for the fabrication of veneers on discoloured teeth.

**"Transparency" –
the key to esthetic restorations**

When restoring discoloured teeth, we tend to select an ingot with high opacity. However, using an opaque ingot entails the risk of obtaining a "white" restoration that looks too light. Veneers should be of a similar translucency as the natural teeth. If severe discoloration is present, an appropriate translucency can be achieved by selecting an ingot in a translucent bleach shade. A masking effect is then achieved if the base material, i.e. framework, is of a certain thickness, capable of "blocking out" the severely discoloured areas while the shade of the restoration is reproduced with the veneering ceramic (IPS e.max Ceram). This approach allows the technician to achieve a sufficiently powerful masking effect whilst maintaining the translucency of the restoration.

Try-in

Accuracy of fit is one of the success factors for an esthetic restoration. Since we started using IPS e.max Press, we have been able to try in the frameworks. This is not possible with veneers fabricated using the refractory die method. At the try-in, the shape, shade and marginal fit are checked.

Checking the shape

White wax is used to contour the planned tooth shape on the framework and then the restoration is inserted in the patient's mouth for a try-in. Adjustments, such as modifications of the crown length and shape, can now be applied.

Checking the marginal fit

Veneers may be tried in with try-in pastes. However, we use water for this purpose because water has a better fluidity. After a drop of water has been applied to the inside surface of the veneer, the veneer is placed on the tooth preparation (Fig. 5). This requires a meticulous working method under the microscope. At first, a white line appears between the preparation margin and the framework. If the marginal fit is accurate, the water penetrates and the line disappears.

Shade adjustment by layering

In the past, if several adjacent teeth had to be restored for different indications, the restoration which allowed only little variation in shade had to be fabricated first (e.g. veneers first and then crowns fabricated to match the shade of the veneers). Given its excellent light scattering properties, IPS e.max Press allows users to fabricate all restorations simultaneously (Figs 6 and 7). We try not to change the shade of the ingot even when working with several tooth preparations showing inconsistent shades. A minute change in thickness is all that is required to control the base shade. In this way, "shade interpretation" can be simplified for shade adaptation by layering. One of the characteristics of the IPS e.max lithium disilicate ceramic is that it maintains its translucency.

If all teeth have been reduced by the same amount of tooth structure, the challenge consists in matching the shade of the restorations that require varying build-up layer thicknesses. If the thickness of the frameworks has been maintained to match the shade by means of the framework, the amount of layering ceramic must be reduced accordingly. In this case, the luminosity of the dentin may be increased by using bleach shades and saturation may be intensified by internal staining. This method is often applied in adjacent teeth where one is vital and the other is non-vital. Preparations with varying amounts of tooth structure removal also often show inconsistent layering thicknesses and, as a result, shade matching becomes more difficult. Since IPS e.max Press is available in several levels of brightness, translucency and intensity, a satisfactory result can be achieved in such challenging situations by selecting an appropriate ingot and combining it with IPS e.max Ceram.

Cementation

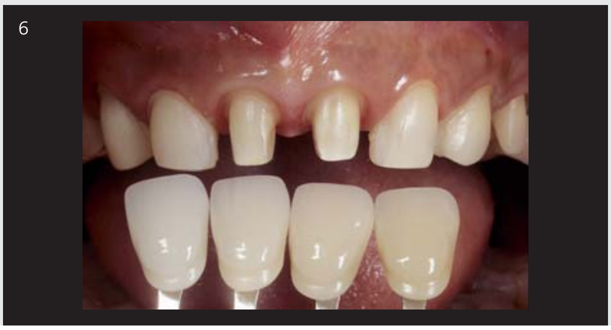
Adhesive bonding is essential to minimally invasive dentistry. In veneers in particular, adhesion by bonding plays a more important role than mechanical retention. If a veneer fails, it is often because a faulty bonding procedure has been applied.

Placing the temporary

A temporary restoration is not simply a short-term tooth replacement. It is a therapeutic step that requires full attention. We use a transparent luting composite (Telio® CS Link) for the placement of temporaries. First, small spots of the prepared

Fig. 5:
Third case: Tooth 21 during the try-in of the framework with a water droplet

Figs 6 and 7:
Fourth case: If varying amounts of tooth structure have been removed, controlling the shade of the tooth preparation is tricky. In this case, teeth 11 and 21 were restored with full-coverage crowns and teeth 12 and 22 with veneers.



Figs 8 and 9: Fifth case: Spot etching prior to attaching the temporary restoration

Fig. 10: Removal of temporary luting composite

Fig. 11: Tooth surface cleaning prior to the final cementation of the veneers

Fig. 12: Completed veneer restoration

surface are etched using the spot etching technique (Fig. 8) and then a touch of bonding composite is applied to attach the temporary restoration (Fig. 9).

Pre-treating the tooth surface in preparation for final cementation

Since semi-translucent luting composite is hard to detect, caution should be taken to ensure that no residue is left on the tooth prior to final cementation (Fig. 10). Working under a microscope is recommended. The tooth is cleaned thoroughly to create a clean environment. Fluoride-free and peroxide-free cleaning procedures using a soft brush are suitable for this step (Fig. 11).

Cementing the final restorations

For veneer cementation, we use light-curing Variolink® Veneer composite, which offers a high degree of shade stability. The sequence of steps is as follows: placement of retraction cord, cleaning of the inner restoration surface with Ivoclean, silanization and finally cementation. A rubber dam is applied to create a dry environment for the application of the bonding material. Adjacent teeth are separated with strips. The restorations can now be seated (Fig. 12). It is important to use Liquid Strip to prevent the formation of an oxygen-inhibited layer.

Discussion

IPS e.max Press lithium disilicate glass ceramics are compatible with minimally invasive procedures. Until recently, esthetic dentistry has been associated with the unfavourable image of reducing healthy tooth structure. However, we would like to reverse this image by pointing out that IPS e.max is a material that allows for minimally invasive methods to achieve esthetic restorations.

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Easy, fast and precise

Implant-prosthetic restoration of an edentulous maxilla

Cristian Petri, CDT, Cluj-Napoca/Romania

Creating an esthetically pleasing smile in an edentulous patient is no easy task. Effective collaboration, combined with suitable materials and procedures, empowers dental professionals to address this challenge effectively.

Rehabilitation of the edentulous jaw can be achieved with various treatment modalities. Removable implant-supported overdentures can provide a comfortable, esthetic and functional option even in circumstances where only a reduced number of implants can be used. This treatment option is frequently practised due to the fact that the number of patients wishing to find an alternative to complete dentures is rising. The patients' expectations regarding their prosthetic tooth replacements are similarly high as for fixed ceramic veneered restorations. With the emergence of new materials and their combination with CAD/CAM technology, outstanding outcomes can be achieved for this indication. An adequate solution can be found for almost every patient and budget. Generally, overdentures offer several advantages over conventional removable prosthodontics. These advantages include stability, functionality, comfort, confidence in the ability to interact socially, straightforward rehabilitation and easy maintenance for the patient, or, simply put: a significant improvement in quality of life.

Clinical case

A 58-year-old patient presented at the practice with discomfort caused by her complete upper denture. At history taking, we found a prosthetic restoration retained on six implants in the lower jaw and a complete maxillary denture that was esthetically and functionally inadequate (Fig. 1).

An initial esthetic evaluation revealed that the shape and shade of the teeth were inappropriate. In addition, the midline was misaligned and the curvature of the maxillary anterior group was shaped incorrectly. The poor stability of the denture was caused by insufficient prosthetic support and by the method of manufacture. Taking into account the patient's requirements, financial possibilities and clinical condition of the maxillary prosthetic field, we decided in favour of an implant-supported pros-

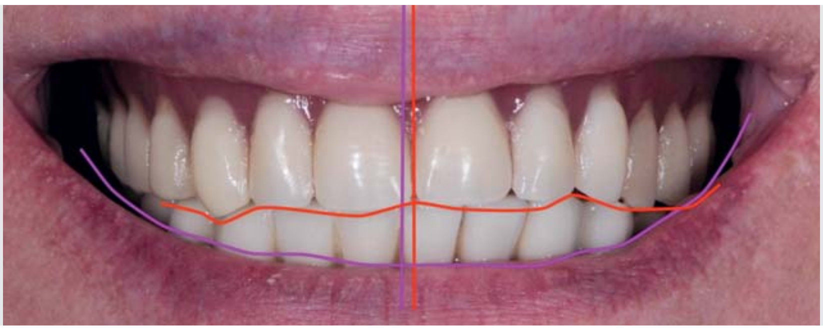
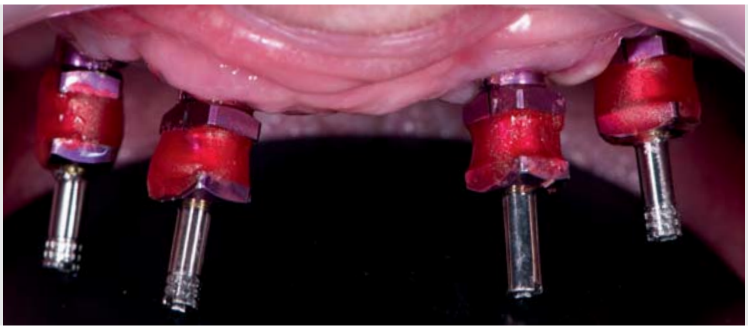
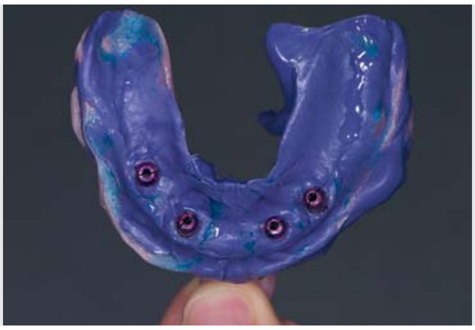


Fig. 1:
Esthetic evaluation prior to commencing the treatment: an edentulous upper jaw had been provided with a conventional complete denture.





Figs 2 and 3: Following the healing and osseointegration process of four implants, an impression of the oral situation was taken. The impression posts were splinted together prior to impression taking.

Fig. 4: Implant model for the reconstruction of the overdenture

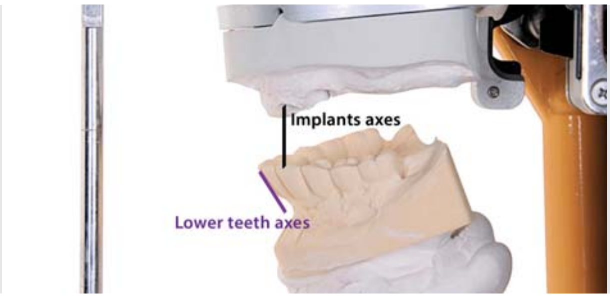


Fig. 5: The models mounted on the articulator clearly demonstrate the challenges involved in this clinical case.

thetic treatment modality. The plan was to insert four maxillary implants to retain an overdenture prosthesis using the double-crown method. This procedure is frequently practised in such cases and has been improved with the emergence of new technologies and materials. Our protocol required primary telescope crowns milled from zirconia at an incline of 2° and secondary copings obtained by galvanoforming. This approach combines the advantages of zirconia (primary telescopes) with the advantages of hydraulic retention (galvanic copings).

The tertiary structure provides the removable prosthesis with the stability required. All three structures together form a tension-free implant-supported prosthetic restoration.

Following a complication-free period of healing and osseointegration, the four implants were uncovered and a preliminary impression was taken. From the resulting model, a customized tray was created. Next, a functional impression that would transfer the exact position of the implants was required to proceed to the next stage of the treatment. The four impression posts were splinted together on the custom tray using composite material (Figs 2 and 3). After creating the working models (Fig. 4), we determined the patient's vertical dimension of occlusion (VDO), length of future teeth and gingival smile line by means of an occlusal plate (bite rim). In the upper jaw, the occlusal rim was shaped in such a way that two millimetres of the edge were visible when the upper lip was in rest position. The lower edge of the rim was aligned in parallel to the bipupillary plane and smoothly followed the curve of the lower lip when the patient smiled. On the maxillary rim, the midline, the smile line and the line of the canines were outlined. A facebow was used for the transfer of the maxillary position in relation to the base of the skull.

Once the relevant ratios had been obtained, the models were mounted on the articulator (Fig. 5). The difficulty of this case was that we had to make allowance for the existing mandibular restoration in the design of the maxillary rehabilitation. The implant axes of the mandibular prosthesis in particular posed some problems. Shade selection was dictated by the mandibular restoration and, consequently, our room for decision-making was reduced to deciding on the shape of the teeth. To this end, a photo of the patient as a young adult came in handy, as it was her wish that the shape and size of her teeth as they were when she was young should be maintained in the prosthetic reconstruction. With the aim to attain as perfect a prosthesis as possible and to make the most of the available space, we created a wax setup using prefabricated denture teeth (SR Phonares® II).

Fig. 6: Try-in of the wax setup and evaluation of the esthetic parameters

Primary structure

A try-in of the setup was performed to check the phonetics, esthetics and occlusion (Fig. 6) and then a silicone key was

Fig. 7: Customized titanium abutments

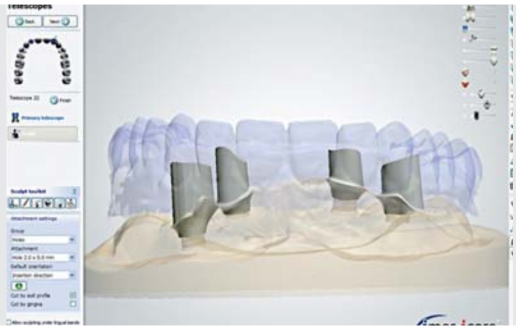


Fig. 8: Reconstruction of the primary structure after scanning the model, abutments and setup

Figs 9 and 10: Grinding and smoothing of the primary structure made from zirconia in a milling unit using CAD/CAM technology

created over the setup. The silicone key acted as a guide in the subsequent working steps. To manufacture the primary structure, the four titanium abutments were customized (Fig. 7), the resulting abutments were scanned together with the model and setup (double scan) and these data sets were imported into the design software. The CAD program proceeded to suggest the shape, height and angulation of the telescope crowns, which we adjusted and optimized as required (Fig. 8). The primary telescopes were milled from zirconia and sintered to their final density at 1500°C. After checking the accuracy of fit, the zirconia crowns were permanently bonded to the titanium abutments (Multilink® Hybrid Abutment). Next, the zirconia telescopes were adjusted using a lab turbine and parallelograph. The walls of the telescopes were given a 2° incline and smoothed out using appropriate diamond grinding tools and sufficient water cooling (Figs 9 and 10).

Secondary structure

The primary crowns could now be prepared for the manufacture of the secondary crowns by means of the galvanoforming technique. For this purpose, the zirconia surfaces were covered in a thin coating of conductive silver using the airbrush method and the galvanoforming process was commenced. Upon completion of the galvanoforming process, the galvanized gold crowns were detached from the telescopes and the conductive silver coating was removed with a nitric acid containing solution. In the process, a highly accurate secondary structure was obtained.

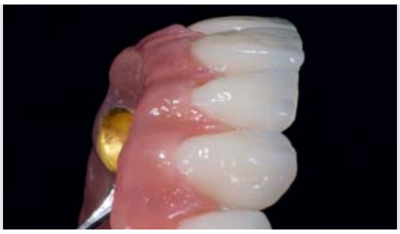
Tertiary structure

All the components were repositioned onto the working model. Before the tertiary structure was fabricated, the galvanoformed crowns were covered in a thin layer of wax to create the space necessary for the cement that would later be used. The tertiary structure was invested, cast in CoCr alloy using induction casting technology and then finished. The tertiary structure was intraorally cemented onto the galvanoformed telescopes (Multilink Hybrid Abutment, Monobond®) in order to obtain a tension-free restoration (Fig. 11).

Esthetic design

The structure thus obtained was covered in opaque light-curing lab composite (SR Nexco®) in pink and white prior to finishing the prosthesis. The silicone key was again used as a guide: the Phonares II teeth were repositioned from the wax setup to the framework. The occlusal parameters were again checked and then we proceeded to complete the restoration. To reconstruct the pink gingival portion, we used the IvoBase® injection system. First, the denture was invested in two especially designed flask halves using type III and IV plaster. After removing the wax and isolating the plaster surfaces, we pre-

Fig. 11: Intraoral bonding of the galvanoformed secondary structure with the tertiary structure



Figs 12 and 13: Detailed view of the completed denture: customized prefabricated teeth and soft tissue parts

Fig. 14: The macro-texture and shade effect of the denture were individualized in a straightforward manner to achieve a result that is true to nature.

Fig. 15: Implant-retained overdenture inserted in the patient's mouth

pared an IvoBase capsule and placed it together with the flask into the polymerization chamber. The IvoBase injection and polymerization process is fully automated and takes about 60 minutes. Users can choose between two program options: Running the standard program takes about 40 minutes. If the RMR program is additionally activated, the pressing time increases, as a result of which the monomer concentration is reduced to less than one per cent. This aspect is beneficial to patients because the risk for allergies and irritations of the mucous membrane is virtually eliminated.

Upon completion of the injection program, the flask halves were opened, the denture divested from the stone core and processed with milling and polishing instruments. In an effort to create a tooth replacement that closely meets the expectations of the patient, we decided to customize the visible areas of the denture by applying additional material (SR Nexco). To this end, the vestibular surfaces of the anterior teeth and the corresponding pink parts were sandblasted. SR® Connect was applied and the teeth and prosthetic gingiva were characterized with SR Nexco and the shape adjusted according to the requirements of the patient. Final polishing was carried out with biaxial brushes and pads. This procedure yielded a result that was true to nature and adjusted to the specific requirements of the patient (Figs 12 to 15).

Conclusion

Many patients respond with reluctance to the idea of being given removable dentures. If dentures are optimized by adding the stability of implants and the effectiveness of telescopes, dental professionals will be able to dispel the initial reservations of their patients and offer them a tooth replacement that provides the expected level of comfort. Completely edentulous patients have the same high esthetic expectations as patients requiring fixed restorations. However, some of these requirements are more difficult to satisfy in the edentulous patient, because we are forced to replace not only missing teeth but often also soft tissues. To achieve this, we need to find a way of creating harmony between the pink and white aspects of the denture. Today's patients tend to be well informed. They place ever higher expectations on the esthetic and functional aspects of tooth replacements. Against such a background, we need to be well trained and know which materials and technologies can ease our job and increase our efficiency. This will enable us to solve any clinical case, regardless of its difficulty.

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Monolithic brothers

Fabricating individualized monolithic restorations using IPS e.max CAD LS_2 and Zenostar ZrO_2
MUDr Petr Hajný, Prague/Czech Republic

Patients who visit the dentist with the wish to have their smile enhanced would like this to happen in a fast, efficient and complication-free manner.

Esthetic and functional rehabilitation of the anterior dental arch and occlusal height can be completed in a single day using IPS e.max® CAD lithium disilicate ceramics (LS_2) in combination with CAD/CAM technology (the CEREC® system by Sirona, Germany, was used here). We use T-Scan® technology (Tekscan, USA) to assess the articulation and this method has enabled us to achieve excellent results.

Until recently, closing lateral gaps in patients refusing to undergo implant treatment posed a problem with timescales for us. Zirconia bridges have become the solution for these cases. To be able to treat our patients within a few hours, but at the longest within 48 hours, we were looking for possibilities of speeding up, or simplifying, this treatment modality. After considering the results of scientific studies investigating the surface properties and wear of various polished monolithic ZrO_2 restorations, we decided that the Zenotec® CAD/CAM system from Wieland would be appropriate for this purpose. This system allows us to mill even extensive bridges from zirconia.

Fig. 1: Before: view of the lips

Fig. 2: Before: with OptraGate®

Fig. 3: Before: lateral view with OptraGate

Fig. 4: Clinical situation after removal of maxillary crowns

Case presentation

The patient in this case was a 60-year-old lady whose dentition had been restored with metal ceramic crowns in the anterior and bridges in the posterior region. Her main complaint was the colour and length of the teeth. Her teeth were completely invisible during both speaking and smiling (Figs 1 to 3). She wished to have a bright smile that was the colour of "Hollywood white". She refused to have any implant therapy to close the gaps in the posterior region. For this reason, we chose to use all-ceramic bridges. The plan was to manufacture a bridge spanning from tooth 23 to 26, a cantilever bridge from tooth 33 to 35 with a pontic at 36 and a bridge from tooth 45 to 47.

> This is a rather unusual treatment plan, particularly in view of the fact that implant therapy usually presents the method of choice to treat such cases nowadays.

The gingival tissues were in poor condition and this was mainly attributed to the impact of the metal ceramic restorations. Figure 4 shows the need for increasing the vertical dimension.

Material selection

On the basis of a bleach shade guide, the patient decided in favour of the BL2 bleach shade and did not want this shade to be tuned down with materials of a darker hue. We therefore decided to use the unstained, or pure, shade variant for the fabrication of the Zenostar® bridges and IPS e.max CAD LT blocks in the BL2 bleach shade (Fig. 5). Usually, we use IPS e.max CAD for the fabrication of three-unit bridges up to the second premolar. The present case, however, required four-unit bridges and a cantilever bridge in the posterior region; IPS e.max CAD does not cover these indications.

Clinical procedure

After the existing restorations had been removed, FRC Postec® glass-fibre reinforced composite root canal posts were inserted into teeth 21, 23, 35, 44 and 45, followed by the placement of MultiCore® Flow core build-up composite.

Fig. 5: Wieland work station and ZrO_2 block

Next, we replaced all existing single restorations with crowns made of IPS e.max CAD using the CEREC MCXL CAD/CAM system and IPS e.max CAD LT blocks in shade BL2 (staining technique). The occlusal height was raised at the same day and temporarily stabilized with Telio® CAD bridges. The lower anterior teeth were restored with laminate veneers made of IPS e.max CAD (staining technique). Prior to placing the Telio CAD bridges with Telio CS Link, impressions were taken (Virtual® 380). A bite record of the new vertical dimension was taken using Virtual CADbite silicone material. The bridges were manufactured using a Wieland® scanner and a Zenotec mini milling unit. The restorations were designed with 3Shape® software (Figs 6 to 8). To reconstruct the bridge from tooth 23 to 26, the canine, the first premolar and the second premolar of the first quadrant were mirrored while the first molar was reconstructed on the basis of data retrieved from the 3Shape library. The contours of the molar were from the beginning very clear and detailed. There was no need for additional manual fissure adjustment. The restorations were milled, sintered in a Programat® S1 furnace and then customized applying stains from the Zenostar Art Module in the staining technique. Finally, the occlusal contact points were polished (Fig. 9).

Final seating

On the second day, the temporary Telio CAD bridges were removed and the teeth were cleaned with chlorhexidine-containing Cervitec® Liquid mouth rinse. Try-in was carried out without any problems; additional adjustments were not required. The restorations were cleaned with Ivoclean® and then silanized with Monobond® Plus.

The preparations were pretreated with Multilink® Automix Primer A + B and then seated using Multilink Automix luting composite (yellow shade). After the luting composite had been pre-cured with a Bluephase® curing light and excess material removed, the restorations were permanently cemented in place activating the Turbo mode of the curing light a number of times. Articulation and occlusal contact points were assessed with a T-Scan device and then the occlusal surfaces were polished (Figs 10 and 11).

Conclusion

A slight difference in brightness between the Zenostar zirconia bridges and the IPS e.max CAD crowns can be noted. With hindsight, we would adjust the shade of the Zenostar framework with Zenostar Color Zr colouring solution before conducting the sintering process to adapt the brightness level in such cases. As an alternative, a pre-shaded block could be used instead of adjusting the shade later on by means of the staining technique.

For the patient, her new bright smile was simply a wish fulfilled (Figs 12 and 13). From our point of view, the 3Shape software enabled us to complete this rehabilitation in an efficient manner. The tooth shapes were easy to copy. An initial proposal for the design of the occlusal surface of the posterior teeth was immediately available and could be quickly and predictably adjusted. The restorations showed a smooth surface and clearly contoured fissures both on the screen and after milling in the 4-axis milling unit. We were able to seat the restorations straightaway as further adjustments were not necessary. Monolithic zirconia restorations have shown similar, if

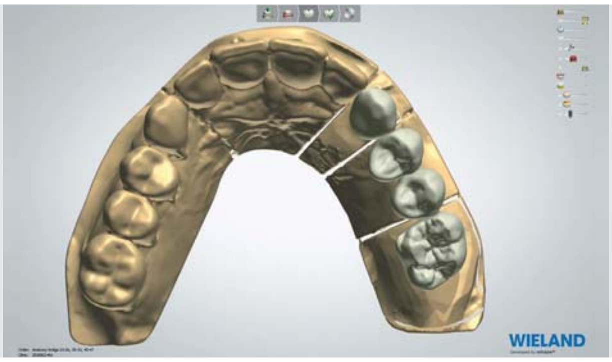

Fig. 6: Design of the bridge 23 to 26 in the 3Shape software

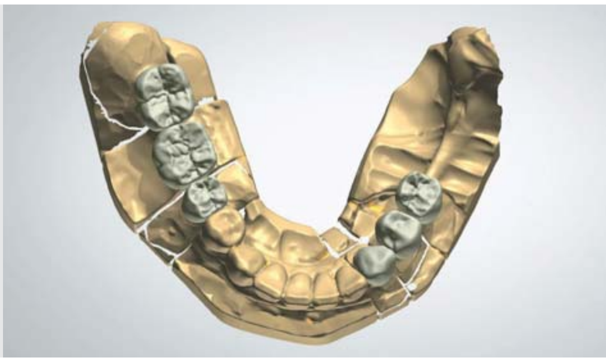

Fig. 7: Design of the cantilever bridge from tooth 33 to 35 with a pontic at 36 and a bridge from tooth 45 to 47

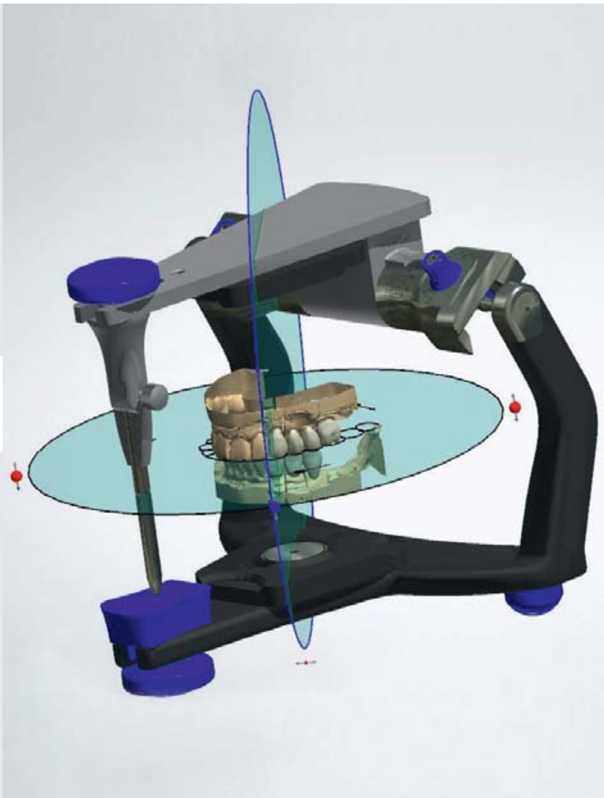

Fig. 8: Virtual articulation to establish the functional characteristics

Fig. 9: Monolithic zirconia bridges before cementation

Fig. 10: Monolithic restorations after eleven months: IPS e.max CAD restorations and Zenostar Zr

Fig. 11: Anterior view of the rehabilitation

Fig. 12: View of the lips: The patient is pleased with the outcome. Her wish has been fulfilled.

Fig. 13: Close-up of the monolithic IPS e.max CAD crowns fabricated using the staining technique

not lower, levels of enamel wear on antagonists as other ceramic restorations in clinical applications. By using monolithic restorations, we are able to complete certain cases in a single day. If we look at recent investigations that evaluated the enamel wear caused by monolithic zirconia crowns and other ceramic materials and compared these results with the enamel wear caused by natural antagonists, we may conclude that we chose a functional and sensible solution [Enamel wear caused by monolithic zirconia crowns after 6 months of clinical use – T. Stober, J.L. Bermejo, P. Rammelsberg, M. Schmitter].

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