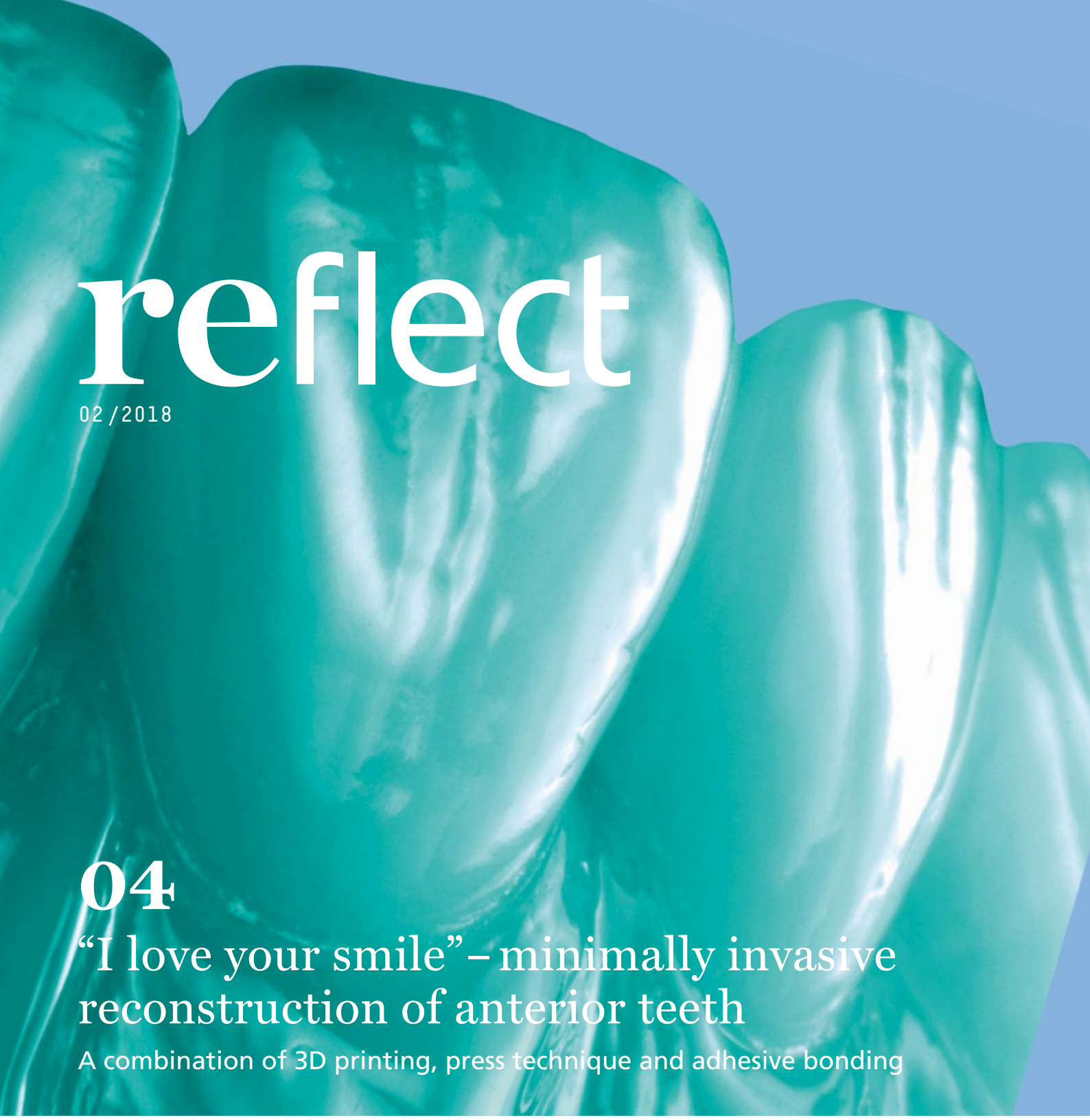

reflect

02/2018

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Editorial

Hello everyone

The quality of dental materials has improved consistently over the years. At the same time, the processing standards and procedures have also improved. As a result, the quality, esthetics, reliability and longevity of dental restorations has risen to meet the growing expectations of dental professionals and their patients.

In order to allow dentists and dental technicians to take the best advantage of the possibilities available today, they need the full support of the industry. In other words, they should be provided with not only excellent customer service and sound professional advice, but also high-quality advanced training and development opportunities.

The fourth International Expert Symposium (IES), which took place in Rome in mid-June 2018, is a case in point. On this occasion, more than 1000 dentists, dental technicians, students and dental experts from 45 different countries and five continents convened to attend the presentations of high-profile speakers and thereby obtain valuable information about the latest trends and products. The event provided the participants with ample opportunities to exchange views and experiences and establish new contacts.

My Italian team and I are proud to have had the privilege to host this prestigious symposium and we would like to encourage as many people as possible to participate in the next event, which is scheduled to take place in Paris in 2020. The symposium offers an immense opportunity to learn about major trends and new techniques and to network with other industry professionals. A series of pictures on the last page of this issue of Reflect provides an impression of the event.

I hope you enjoy reading this publication

Cordiali saluti

Paolo Castoldi
Managing Director Ivoclar Vivadent Italy

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“I love your smile”

A combination of 3D printing,
press technique and adhesive bonding

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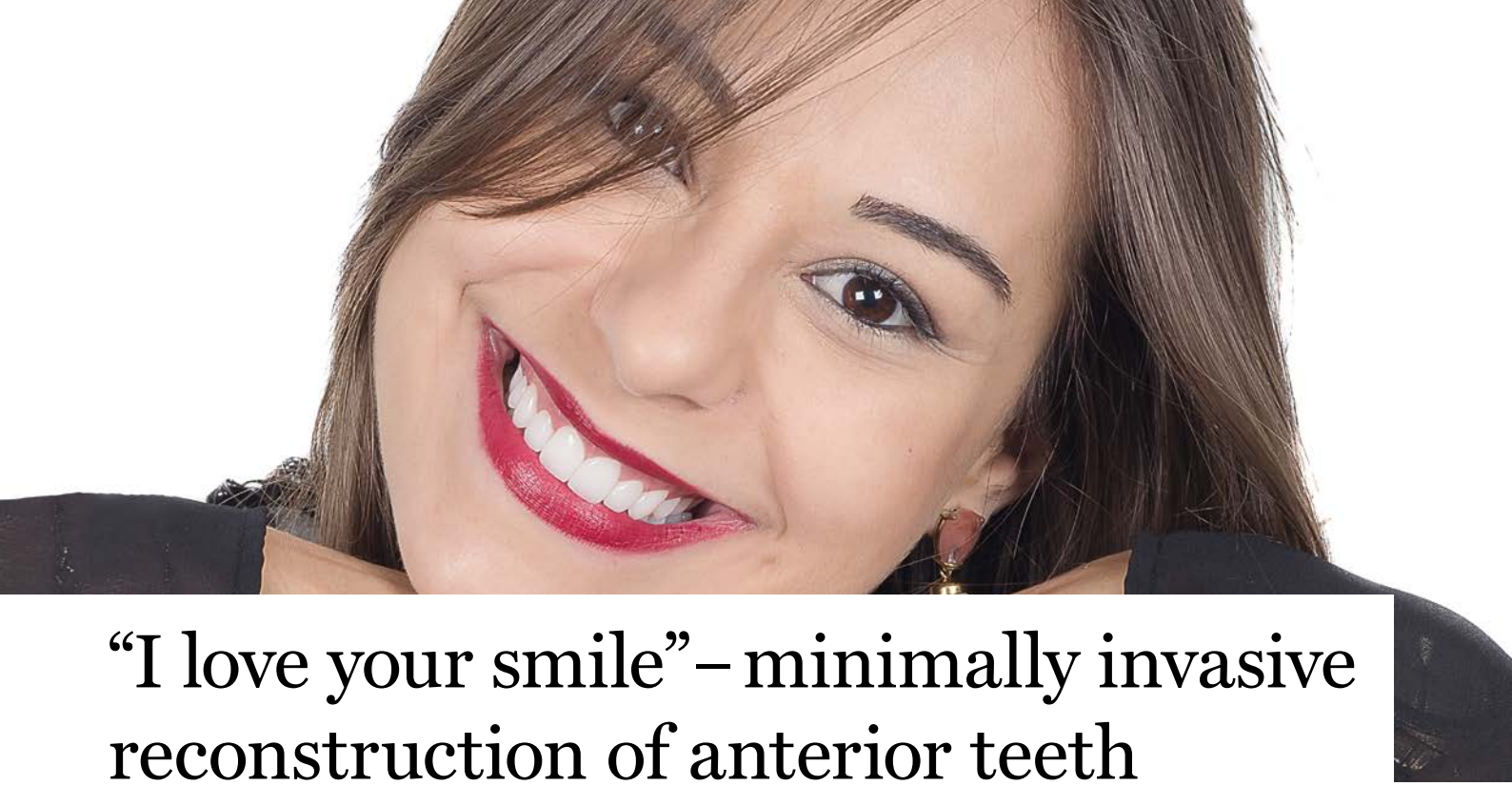

“I love your smile”– minimally invasive reconstruction of anterior teeth

A combination of 3D printing, press technique and adhesive bonding

An article by Dr Mauricio Umeno Watanabe, Birigui/Brazil

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

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

The materials

The optical properties of a modern ceramic material (e.g. IPS e.max® Press) are very similar to those of natural dental enamel. Therefore, veneer restorations are capable of imitating the translucent properties of natural teeth and ensuring optimum light transmission. Furthermore, very thin restorations with a minimum thickness of 0.3 mm can be produced due to the excellent mechanical properties of IPS e.max Press. As a result, the demand for minimally invasive treatments can be met, since only very little of the healthy tooth structure needs to be removed. Veneers obtain their final strength

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01 — Preoperative view. The patient wanted more attractive upper anterior teeth.

02 and 03 — Slight preparation of the cervical margin with Arkansas stones

04 — The teeth prepared for the veneers

from the strong bond with the tooth structure (adhesive cementation). The decisive factor at this stage is the procedure used for seating the veneers (luting protocol). The products of the silicate ceramic materials portfolio within the IPS e.max system are coordinated with the Variolink® Esthetic luting composite. The single component ceramic primer Monobond® Etch & Prime, which is contained in the system, etches and silanates glass-ceramic surfaces in one easy step. Moreover, the etchant is much gentler than hydrofluoric acid.

Case study

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

Clinical preparation

First, an esthetic and functional plan was established with the help of a wax-up of the vestibular region of the UL5 to the UR5. Then the esthetic treatment phase started. The main aim of the preparation was to achieve an even thickness of the ceramic veneers in relation to the envisaged result. Since the teeth had to be slightly enlarged in the present case, only minimal removal of tooth structure in the vestibular region was necessary. In order to prevent over-contouring of the margins and the risk of gingival inflammation, a shoulder was carefully created at the cervical margin using Arkansas stones **(Figs 2 to 4)**.

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05 — *Printed veneers made of synthetic resin*

06 and 07 — *Manual adjustment of the printed veneers with wax*

08 — *Attachment of the sprues*

09 — *Spruing of the restorations for the press procedure*

10 — *Finishing of the ceramic veneers on the model*

Fabrication of the veneers in the laboratory

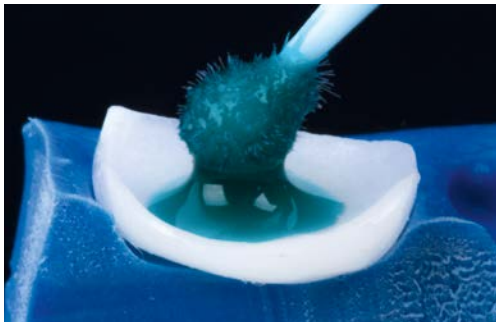
IPS e.max Press is an excellent material for fabricating veneers. In the first fabrication phase, digital technologies were used. The master cast was digitalized. Then, the ultra-thin veneers were designed using CAD software. They were produced with a synthetic resin that fires without leaving any residue (3D printing). The printed veneers demonstrating a minimal thickness of 0.3 mm offered an ideal basis for manually shaping the actual veneers **(Fig. 5)**. Only very little wax had to be applied to achieve the ideal proportions. The shape of the teeth was adjusted with wax in the incisal and proximal areas in particular. The aim was to create an even appearance of the vestibular surfaces from the UL5 to the UR5 **(Figs 6 and 7)**.

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

Adhesive cementation

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

The adhesive cementation of ceramic restorations is a technique-sensitive procedure. In order to achieve a long-lasting bond, it is of utmost importance to prepare this step carefully and to observe the cementation protocol. The single-component ceramic primer Monobond Etch & Prime was used to condition the ceramic restorations. The primer was scrubbed into the contact surface with a microbrush for 20 seconds in order to remove any saliva and silicone residue **(Fig. 11)**. During the 40-second reaction time, the etchant enlarged (roughened) the surface and produced an etching pattern. Next, the primer was rinsed off and the restoration was dried with a stream of air for 10 seconds. Then the reaction between the silane and the activated glass-ceramic started. This resulted in the development of a thin layer of chemically bound silane, which ensures a strong and reliable bond to the teeth. An additional benefit offered by Monobond Etch & Prime is the fact that the product etches and silanates in one step. This simplifies the sensitive placement procedure and heightens its efficiency.



11 — *Application of Monobond Etch & Prime*

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

The result

The planned goal was achieved with the ceramic veneers (Fig. 14). The upper anterior teeth look much bolder – as desired – and also somewhat lighter. They harmonize with the oral environment and the facial features of the young patient. Furthermore, the soft tissue adapted very well to the new situation. The wishes of the patient were fulfilled: Her new smile was achieved without any substantial loss of tooth structure (Fig. 15).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12 and 13 — *Placement of a veneer*

14 — *Situation following insertion. All the veneers have been cemented in the mouth.*

15 — *The satisfied patient. Her wishes have been fulfilled with minimally invasive restorations*

Conclusion

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

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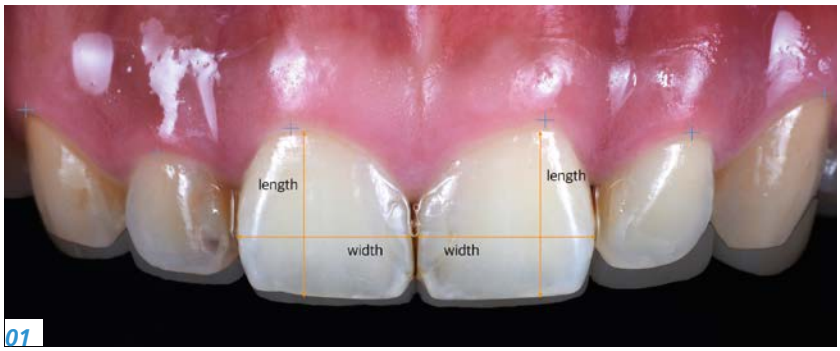
Short cut in the digital fast track

Exact reproduction of provisionals with IPS e.max Press Multi

An article by Dr Hyun-Jun Jung and Kyung-Sik Park, Seoul/South Korea

The shape of an anterior restoration significantly influences the symmetry of the gingival contours. Provisionals that have proved to be suitable both in terms of their function and esthetics allow permanent restorations to be precisely manufactured with the help of digital methods.

Unfavourably positioned teeth and/or an asymmetric contour of the soft tissue represent a considerable challenge in the already difficult anterior zone. In order to achieve a natural-looking result, the shape and shade of the restoration have to be suitably matched to the remaining teeth and furthermore the soft tissue needs to be properly conditioned. In many cases, provisional restorations are initially used by the dental team so that the special requirements of the gingiva can be effectively addressed.



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01 — *Preoperative view*

02 — *IPS e.max Press Multi ingot shade A2*

Case study

The 33-year-old patient consulted our practice about having defective dental braces removed after three years of orthodontic treatment. He asked us to treat the carious lesions in his teeth and enhance the appearance of his smile. The first esthetic analysis revealed an unfavourable length-to-width ratio of the anterior teeth **(Fig. 1)**. As a result, the patient wished to have his front teeth lengthened. The upper left canine had to be endodontically treated due to advanced necrosis of the pulp tissue.

Planning

Our plan was to reconstruct the upper anterior teeth. In choosing the most suitable material for the restorations, we had to take into account the fact that the patient enjoyed eating hard nuts. Furthermore, he reported that he had a habit of grinding his teeth at night and clenching his jaws. Consequently, the anterior crowns would have to be not only functional and esthetic, but also very strong and tough. We planned to use six all-ceramic crowns to optimize the length-to-width ratio (tooth lengthening) and even out the gingival contour.

Manufacturing technique and selection of the materials

In order to minimize the risk of fracture of the ceramic restorations, we decided to use IPS e.max® Press lithium disilicate ceramic, which demonstrates a high toughness of 470 MPa as well as excellent esthetics. In addition to the

monochrome press ingots, this ceramic system includes a polychromatic material (Fig. 2). IPS e.max Press Multi ingots are used to fabricate highly esthetic monolithic restorations that do not need any characterization. They feature a lifelike progression of the shade and translucency between the dentin and incisal areas.

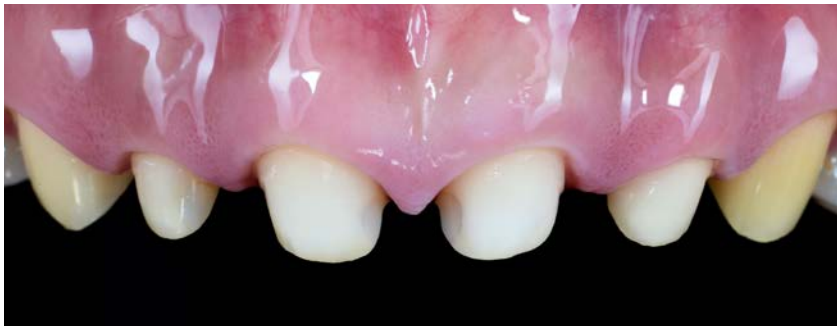
The press technique, which involves the use of a full-contour wax-up, offers a quick and uncomplicated method of manufacturing crowns. Moreover, the press technique allows us to reproduce delicate gingival contours with utmost precision. In restorations that are built up in layers, the ceramic sometimes shrinks, making it difficult to accurately replicate the gingival contours of the provisionals. In our opinion, the IPS e.max Press Multi ceramic has two decisive advantages. First of all, its true-to-nature shading imitates that of natural teeth in the cervical and in the incisal region. In contrast to the restorations pressed with monochrome ingots, the polychromatic restorations require less time and effort to fabricate, since they do not have to be customized with layering ceramics in the incisal region. Secondly, IPS e.max Press Multi has just the right translucent properties to allow the necessary transmission of light.

Clinical treatment

First, endodontic treatment was performed and the carious lesions were removed. Then the teeth were restored with composite fillings. The front teeth requiring treatment were suitably prepared (Fig. 3) and the provisional crowns were placed (Fig. 4). The right lateral incisor was lengthened. The provisional crowns helped to support the gingival contours and establish a symmetric appearance. Once the desired symmetry of the teeth and gingival tissue was attained, the teeth were prepared for the permanent restorations (Fig. 5) and impressions were taken.

03 — *Situation after the removal of caries lesions and root canal treatment*

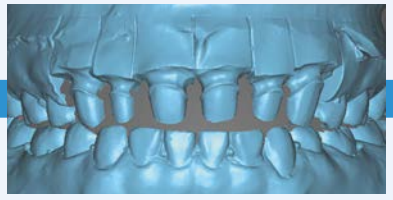
04 — *Provisional composite resin restorations for evaluating their function and esthetics*



05 — *Final preparation of the teeth*

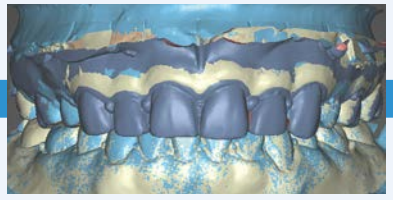
CAD/CAM processes in the fabrication of restorations

Prior to the removal of the provisional crowns, additional precision impressions were taken. In the laboratory, the data of the preparation models and the provisional crown models was captured using the double scan method. The digital data sets were superimposed on each other. The abutment teeth were separated and the margins and contours were adjusted (Figs 6 to 8).



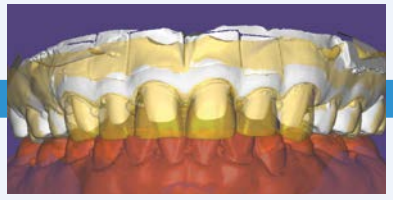
Scanning phase

06 — *Scanned data of the final preparation*



Superimposition phase

07 — *Superimposed scanned data of the prepared model and the model with the provisional crowns*



Design phase

08 — *Slight adjustments during the design phase*

This approach allowed the shape of the provisional crowns to be exactly replicated. We focused on recreating the subgingival contours, which support the oral soft tissue, so that the restorations would not have to be individually adjusted in the dental office. The crowns were milled from a dimensionally stable wax disc. ProArt CAD Wax yellow was used in the present case **(Figs 9 and 10)**. This material is specially designed for use with IPS e.max Press. The smooth surfaces of the wax ensure precision results and high accuracy of fit. The material burns out without leaving any residue. Up to this point, it was possible to reduce the manual work to a minimum.

Spruing and pressing

In the next step, the wax crowns were reproduced with a pressed ceramic (IPS e.max Press Multi). For the investment procedure, the milled wax crowns were attached to a special prefabricated precision wax component (IPS Multi Wax Pattern). At this stage, it is important to make sure that the attachment joint is not too thick and that it is aligned with the labial surface. This helps to accentuate the unique shade gradations of the material. The wax restoration attached to the Wax Pattern was subsequently secured in the slot of the IPS Multi investment ring base. The position of the sprues was checked with the help of the IPS Sprue Guide **(Fig. 11)**. The shade progression within the crown can be adjusted as required. For example, if the incisal portion should be more pronounced, the Wax Pattern is simply moved downward on the investment ring base (max. 2 mm). The preheating, pressing and divestment steps were carried in the customary way and in line with the instructions of the manufacturer.

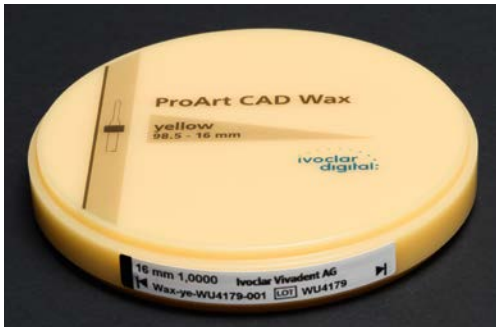
Finishing

The pressed restorations can be adjusted if desired in order to accentuate certain individual characteristics. In the present case, the unglazed restorations were tried in the patient's mouth before the stains and glaze firing. At this stage, most of the clinically important properties were clearly recognizable: tooth axes, suitable pressure on the adjacent soft tissue (e.g. papillae and gingival contour), harmony of the lip line and incisal edges as well as the symmetry of the crowns. The patient was satisfied with the optimized length-to-width ratio of the teeth. The main aim now was to reproduce this situation with utmost precision. The inter-occlusal record was sent to the laboratory in order to minimize the work involved in the adjustment of the occlusion.

The surface texture of the IPS e.max Press Multi crowns was created with suitable grinding instruments before the glaze firing cycle. The restorations were then characterized with IPS Ivocolor® stains (copper, white and anthracite) and glazed. The crowns were manually polished to the desired brilliant sheen **(Fig. 12)**.

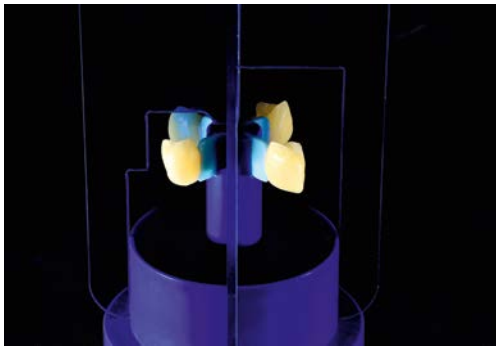
Placement

The excellent collaboration of the dentist, dental technician and the patient paid off: The restoration was swiftly placed in the practice without having to make any further adjustments. The clinical situation which was created on the model and with the help of provisional restorations could be successfully



09 *— ProArt CAD Wax yellow disc*

10 *— CAD/CAM-manufactured full-contour wax crowns*



11 *— Full-contour wax crowns attached to the IPS Multi investment ring base and verification of the position of the wax crowns with the help of the IPS Sprue Guide*

12 *— Completed crowns on the model*

13 — *IPS e.max Press Multi restorations immediately after placement*

14 and 15 — *Result after one month in situ*

reproduced in the permanent restoration (Fig. 13). The patient and the dental team were highly satisfied with the result. The entire treatment process was straightforward and efficient.

Result

One month later, the teeth and gums looked beautiful and healthy without any inflammation (Figs 14 and 15). Digital workflows minimize efforts but maximize esthetics. The possibility of replicating the subgingival contours of the provisional crowns allowed a variety of modifications to be made during the treatment process. The IPS e.max Press Multi material itself offers an impressive array of esthetic properties. If a restoration requires even more individualized characteristics, the incisal area can be built up with IPS e.max Ceram layering materials (cut-back technique). The presented process shows that the traditional press technique combined with CAD/CAM methods offers a wide variety of benefits and provides a basis for new and innovative applications. The discovery of further creative uses involving a combination of these two techniques is only a question of time.

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A skilful combination of CAD/CAM and manual work

Modern materials and manual skills skilfully combined to achieve long-lasting esthetic restorations

A report by Aiham Farah, Dubai and Anas Aloum, Abu Dhabi/both United Arab Emirates

The aim of a restorative treatment is to re-establish the esthetic properties of the tooth structure to ensure that it blends in with the shade and vitality of the natural surroundings whilst using the least invasive methods possible. Severe discolourations often aggravate the initial preoperative situation in addition to misalignments, damaged teeth and/or existing restorations. Extensive reconstructions require the combination of modern materials and technologies with manual skills. Outstanding results can be achieved by carefully selecting suitable materials, masking discoloured preparations and implementing an optimum preparation design. The success can be seen in restorations that remain stable and intact over many years.

This report describes the restorative treatment with a lithium disilicate glass-ceramic – a material that features excellent long-term clinical properties. A CAD/CAM manufacturing process was chosen to enhance the efficiency of the treatment. After a try-in in the blue (non-crystallized) state, the restoration was finalized and customized by hand in the laboratory to provide a final result with excellent esthetic properties.

Questions to explore

1. How can CAD/CAM technologies be combined with manual skills to achieve outstanding restorative results?
2. How to select suitable materials to mask discoloured substrates and take advantage of an intelligent app (SNA) to select an appropriate shade and translucency?
3. How can severely discoloured tooth preparations be masked and their shade matched to the shade of the neighbouring teeth?

Preoperative situation

A 29-year-old female patient consulted the practice with the wish to have a natural beautiful smile. She was dissatisfied with her upper anterior restorations and the appearance of the surrounding soft tissue. She wished for a functional and esthetic solution **(Fig. 1)**. Photographs of the oral situation were taken during medical history-taking and the patient's expectations were discussed. The intraoral examination revealed severe discolouration, devitalized teeth and poor esthetics. In addition to an inappropriate shade, the upper anterior crowns and veneers were out of proportion, causing an inharmonious smile line **(Fig. 2)**. An X-ray confirmed the suspicion that the endodontic fillings on the two central incisors were defective. The lateral incisors had been repaired with large composite restorations. Due to the inadequate contouring of the underlying composite, the patient showed clear signs of periodontitis in the area of all four anterior teeth.

An impression of the situation was taken. The study model provided a physical reference that was used to mark the relevant lines and planes, align the longitudinal axes, adjust the lengths and implement cosmetic optimizations in line with the digital design concept **(Fig. 3)**. A diagnostic wax-up was created. Then, a silicone key was produced from the wax-up for the fabrication of the temporaries. The silicone key also served as a guide in the preparation of the teeth.

Preliminary treatment

The existing restorations on the upper anterior teeth were removed. Teeth UR2 to UL2 were prepared with a rounded shoulder of 1 to 1.2 mm and equigingival margins, according

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01 — *Initial appearance of the smile*

02 — *Preoperative oral situation with periodontitis, discoloured restorations and devitalized teeth. Inadequate esthetic characteristics of the individual teeth and inharmonious smile line*

03 — *Smile design with newly proportioned length and width of the incisors in line with the digital smile design concept*

to the preparation guidelines for all-ceramic crowns. The depth varied slightly due to the shade of the preparation and degree of discolouration. The dark discolouration on the dentin of the right central incisor required a deeper preparation in order to be able to mask the shade of the remaining tooth structure (Fig. 4). Teeth UL3 and UR3 were prepared for veneer placement with an equigingival chamfer, 0.5-mm buccal reduction and 1-mm incisal reduction (Fig. 5). An impression of the resulting situation was taken using A-silicone and then direct temporaries were created with the help of the silicone key (Fig. 6). The periodontal situation was monitored over the following two weeks. Gingival healing was uneventful. The temporary restorations allowed the final result to be visualized. At this stage, intraoral adjustments could be made to achieve a harmonious symbiosis between the lips, smile and face.

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04 — *Crown preparations of central and lateral incisors and veneer preparation of both canines*

05 — *A deeper preparation was required in the buccal area of the upper central incisor on the right because of the pronounced dark discolouration present in that area compared with the neighbouring tooth*

06 — *Direct temporaries created on the basis of the smile design wax-up*

Shade selection

The desired tooth shade and the existing shade of the tooth preparations were determined under daylight conditions. When photos of the teeth were taken, darker and lighter shade tabs were held against the natural teeth, the flash was turned off and all photos were taken from a similar angle. These photos were also very helpful in the fabrication of the restorations in the laboratory **(Figs 7a and b)**.

Material selection in favour of clinically proven properties

The decision fell on a tried-and-tested glass-ceramic that offers long-term clinical stability along with high strength and impressive esthetics: IPS e.max® lithium disilicate. This material is suitable for both conventional press methods and CAD/CAM applications. It can be processed to provide fully anatomical restorations or restorations that can be customized with veneering ceramics. As this case had already taken us onto a digital route with the 2D smile design software, we decided to continue with the digital option. The situation was digitalized with a D2000 scanner (3Shape). The restorations were designed in the software in line with the proportions previously established and then ground from IPS e.max CAD blocks using a Zenotec select hybrid CAD/CAM machine **(Fig. 8)**. The IPS e.max blocks were processed in their crystalline intermediate stage ("blue" phase), which is optimally coordinated with the grinding process, providing highly accurate results. Subsequently, the restorations were crystallized in a conventional ceramic furnace, in the course of which they acquired their final material properties (e.g. shade). Once crystallized, the strength of the material increases up to 530 MPa (mean biaxial strength). IPS e.max CAD blocks are available in different translucency levels, ranging from medium opaque to highly translucent (MO, LT, MT, HT), and in two opalescent shades. The material can be used to create frameworks for veneering or to fabricate monolithic restorations (e.g. veneers, inlays, crowns and three-unit bridges). It is also indicated for hybrid abutment restorations. IPS e.max CAD is suitable for an unrivalled wide range of indications for CAD/CAM glass-ceramics. It is even suited for minimally invasive restorations such as thin veneers (0.4 mm) and adhesive crowns (1 mm).

Block selection with an app

In terms of colour saturation, shade 1M2 (Vita 3D-Master) was ideal and would have come closest to the A1 shade (A-D shade guide). However, the brightness in the central third was higher than that of the IPS e.max CAD LT block in shade A1. And yet, the colour saturation of a brighter block (e.g. LT BL4) would have been too high for the veneer. The IPS e.max CAD HT (High Translucency) blocks in the Bleach shades might have been a suitable choice. However, using

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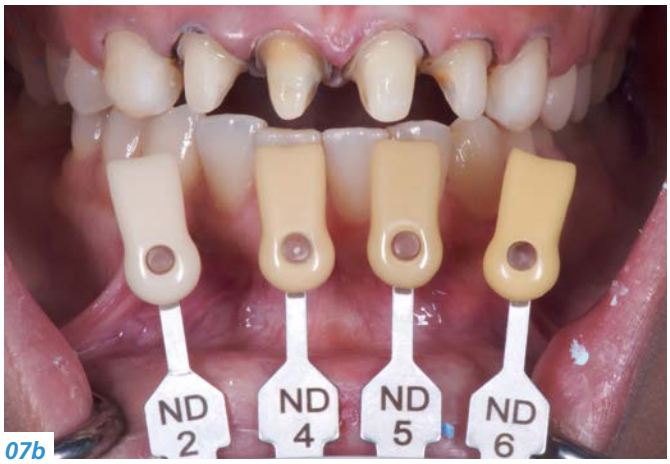

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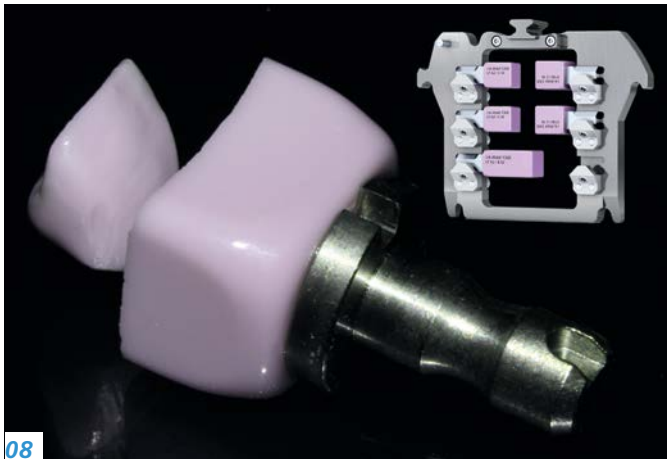
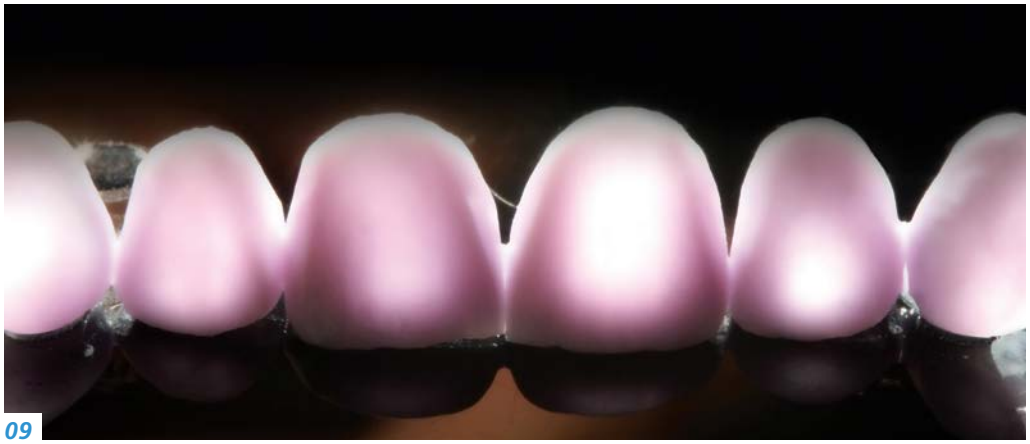


08

07a — Determining the shade of the lower teeth

07b — Selecting the shade of the tooth preparations using the IPS Natural Die Material shade guide

08 — Lithium disilicate block (IPS e.max CAD) in the blue intermediate crystalline stage on the e.matrix holder (for the Zenotec select millling machine) ready for wet machining



09

09 — Restorations in transmitted light prior to crystallization (blue stage): note the differences in material thickness

10

10 — Try-in of the restorations in the blue intermediate crystalline stage

highly translucent materials in restorations with slightly increased wall thicknesses always entails the risk that the restoration may be less bright and the chroma could be higher than the actual shade. For these reasons, the HT block was not seen as ideal for the crowns on teeth UL2 and UR2.

The IPS e.max Shade Navigation App (SNA) was used to find the most suitable material. This app takes all the factors affecting the shade of a restoration into account to identify the block that is best suited to achieve the given shade. The app is fast and easy to use. You only have to enter the data pertaining to the case at hand. The app delivers an excellent result.

Initial input for the crowns:

- → Desired tooth shade: 1M2 (= A1)
- → Indication: crowns for UL1, UL2, UR1, UR2
- → Preparation shade: ND2
- → Material thickness: 1.2 mm
- → Material: IPS e.max CAD

Based on the data entered, the app recommended an IPS e.max CAD block in shade MT BL4. This block was required to mask the small area of discolouration (ND4) on the UL1 and to offset the slight drop in hue and value caused by the buccal reduction and the ceramic veneering.

To identify a suitable block for the veneers on teeth UL3 and UR3, "Add new restoration" was activated on the app and the following data was entered:

- → Desired tooth shade: 1M2 (= A1)
- → Indication: veneers for UL3 and UR3
- → Preparation shade: ND1
- → Material thickness: 0.5 mm
- → Material: IPS e.max CAD

The "Free selection" option was used to see if the shade was also suitable for the crowns. It was possible to assess if the MT BL4 was appropriate for all restorations, which it was. So, the MT BL4 shade was employed for both the crowns and the veneers.

Try-in and insertion

After the grinding process, a clinical try-in was performed while the restorations were still in their blue intermediate crystalline stage (**Figs 9 and 10**). The evaluation was carried out with the dentist's specifications and the patient's expectations in mind. In this context, photos of the lips and face of the patient play an essential role for the quality of the technician's work. Adjustments can be applied as required and the photos can be viewed from various angles.

Layering OR staining?

A straightforward and uniform result could have been achieved by simply glazing/staining and crystallizing the "blue" restoration in a single firing process. In this case, however, we are talking about an esthetically demanding situation. The crowns and veneers were therefore completed with the IPS e.max Ceram layering ceramic after they had been crystallized to attain a natural looking result, increase the translucency and achieve an optimum match in terms of depth, chroma, value and hue. Initial characterizations were already applied to the cervical and interdental areas during the crystallization process (e.g. with IPS e.max CAD Crystall./Shades).

Transferring the preparation shade to the model

The dentin shade of the tooth preparations had to be transferred to the model before the layering scheme and ceramic veneering materials could be selected. This is essential to keep a consistent shade match throughout the manufacturing process up to the insertion of the restoration. Model dies were created using IPS Natural Die Material. Even some of the existing orange spots on the dentin (e.g. cervical area of right central incisor) were reproduced on the model dies (using light-curing characterization materials from the SR Nexco® range).

Finalizing the restorations

Following a simple cut-back in the incisal third, a natural-looking transition was created between the layers using the IPS e.max Ceram Mamelon and Opal materials as well as a variety of brighter shades **(Fig. 11)**. After firing, a great deal of care was invested in perfecting the texture, contours and surface characteristics **(Fig. 12)**. At the end, the shade match was checked on the model dies. A variety of (try-in) materials can be used to adjust the brightness between veneers and crowns at the try-in and subsequent seating of the restorations. In addition, a natural-looking lustre blends in harmoniously with the natural surroundings in the patient's mouth. Glaze firing is therefore an important and critical firing process. It should be the result of the interplay between manual polishing, quality of gloss and the firing parameters **(Fig. 13)**.

11 *— Restorations on the working model: restorations in the blue stage on one side and the result on the other, i.e. tooth-coloured restorations after crystallization and veneering with IPS e.max Ceram*

12 *— Verifying the contours and microtexture with gold powder*

13 *— Examination on unsegmented model: closed interdental spaces after Glaze firing and manual polishing*

14

15

16

14 — Result after four weeks. Note the soft feminine alignment of the teeth

15 — Restorations after six months. The restorations harmonize with the teeth in the lower jaw – the slightly lighter shade was requested by the patient

16 — Restorations after 4.5 years: The four crowns and two veneers are durable, their shade has remained stable and the soft tissues surrounding them looks healthy.

Cementation and recall

The crowns and veneers were placed adhesively using Variolink® Esthetic luting composite. This material is ideally suited for the permanent cementation of demanding ceramic restorations. Excess composite was removed with the help of fine diamond burs, rubber finishers and polishers. Occlusal interferences were eliminated. At the first recall, the restorations were inspected and some last modifications implemented **(Fig. 14)**.

Conclusion

Ceramic restorations have been used in cosmetic dentistry for over thirty years. Past experience has shown that the quality and longevity of these restorations depend to a considerable extent on the experience of the treatment team. Modern materials, however, are offering ever more reliability and flexibility. The restorations described in this report were re-inspected after approx. 4.5 years **(Figs 15 and 16)**. They continued to be in very good condition, reflecting the effectiveness of the material and the manufacturing process.

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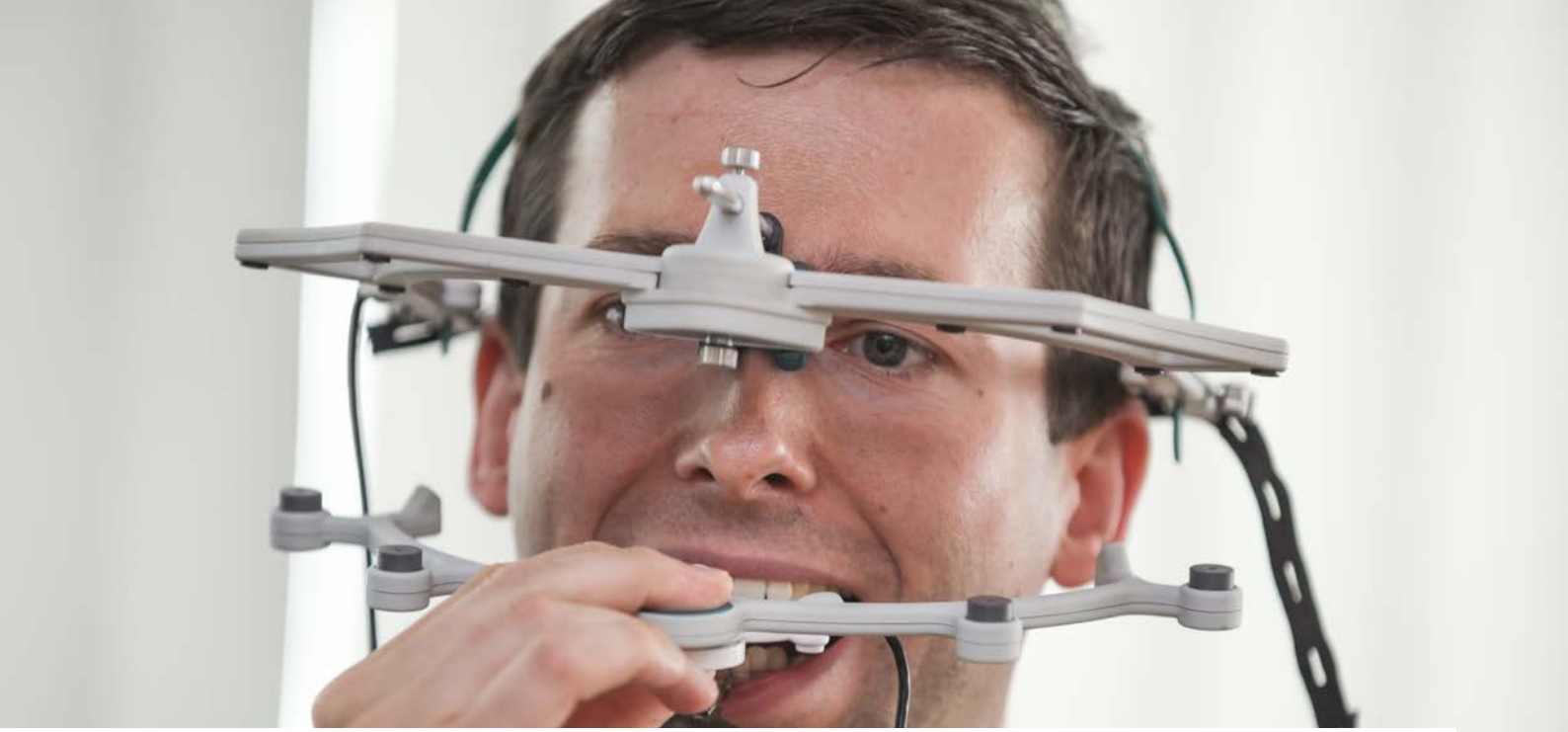

Developing enhanced digital methods to analyze occlusion and jaw movement

How innovative ideas from non-dental fields are advancing dentistry
Interview with Dr Sebastian Ruge, a mathematician from Greifswald/Germany

Ideas from non-dental fields such as mathematics and information technology open up new and interesting perspectives in dentistry. For example: digital innovations for analyzing dental occlusion

Dr Ruge, when and how did you enter the field of dentistry?

It was during my studies, when Professor Bernd Kordass, a specialist in dental occlusion and a pioneer of digital occlusal analysis, was looking for someone who was well-versed in computer graphics and visualization.

What was your brief?

Professor Kordass wanted to see scanned models in motion. He asked me to use my computer engineering skills to develop a suitable software.

Could you explain this in more detail?

I developed a software which shows the actual movements of the lower jaw. Later on, I designed computer games with which patients can exercise their jaws. For example, I created a table tennis game which could be played at various speeds and levels of difficulty and was entirely controlled by jaw movements.

What is the purpose of games such as these?

Patients can train and extend specific jaw movements in a playful way. This helps to prevent or resolve occlusal problems such as tight muscles, jaw pain and restricted range of motion. The lower jaw becomes more flexible in the process. Since all the data is recorded, the results can be documented and quantified in detail.

How did you gain your knowledge of dentistry?

I was quickly accepted by my colleagues. They allowed me to take part in many different parts of the clinical treatment process and gain hands-on experience in the dental lab where I was given the opportunity to try out my ideas.

In general: How can dentistry benefit from mathematics?

Mathematicians have a tendency to analyze and logically structure everything. This is a bonus in situations where the root of the problem needs to be identified first, before any suitable solution can be developed.

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Expert tip: Flexural strength and why it is important

Flexural strength is a term that is frequently used in the dental world. Every manufacturer of dental materials provides values that refer to this feature, because flexural strength is considered to be a key value when it comes to the stability and toughness of a material.

Measuring methods come in various forms

In materials science, flexural strength refers to the resistance of a material against deformation. It also indicates how much force is required to break a test sample.

The flexural strength determined during a test depends on the measuring method used and the surface preparation of the samples – in other words, on whether a material is polished or ground. As a result, comparisons of the flexural strength of materials should be made with great care. Values obtained from different measuring methods must not be compared.

Large and minimally invasive restorations

High flexural strength is important for load-bearing restorations in cases where the material is exposed to high levels of stress or tension. The number of units in a restoration greatly depends on the stability of the material: the stronger the material, the larger the restoration. The degree of toughness required for the different types of restorations or indications is specified in official standards.

High flexural strength affects the way in which a restoration is constructed. A strong material will be stable enough to allow the fabrication of even the thinnest and most delicate restorations.

Champions of strength

Zirconia is probably the best-performing all-ceramic in terms of flexural strength: for example, IPS e.max® ZirCAD LT (Low Translucency) has a flexural strength of 1,200 MPa.

Cherry on top in complete denture prosthetics: individuality and naturalness

Removable prosthetics as high-quality restorative treatment in the edentulous patient

A report by Erwin Eitler, Zahnmanufaktur, Bern/Switzerland

Restorative treatment of the edentulous jaw requires, above all, sound knowledge of the function and statics of dental prosthetics. Customized pink-and-white esthetics that match the expectation of the patient represent the "cherry on top" here, adding extra quality to the treatment.

We all know it, but let's say it again: The number of edentulous patients will increase sharply over the coming years due to ongoing changes in demographics. The older people grow, the larger the number of edentulous patients will become. Complete prosthetics will therefore remain of high relevance for both clinicians and technicians and should not be neglected neither in the education and training nor in the day-to-day work of dental professionals. Sound knowledge coupled with clinical and technical expertise are essential to achieve satisfactory results. Upfront, complete dentures for edentulous patients appear to hold little promise from an economic point of view. However, the writer of this report maintains that this is a question of perspective. Complete denture prosthetics is a supreme discipline that allows a customized approach for each individual patient. An appropriate treatment strategy can be selected from a range of processing techniques to meet the individual needs of the patient being treated. Accordingly, outcomes range form e.g. highly esthetic, custom-made tooth replacements to "basic" complete dentures manufactured using a digital method. Whichever method is used, function and statics will always be at a high level. Any compromises in statics and function would not be acceptable.

Preoperative situation

The 75-year-old female patient presented with severe periodontal damage in the upper and lower jaw **(Figs 1 and 2)**. The oral cavity was free of inflammation and looked well maintained. However, the periodontium had been irreversibly damaged by periodontal disease. The clinical diagnosis showed that the teeth in the upper jaw could no longer be preserved. Some of the lower teeth also had to be removed. However, the lower premolars and canines were still in a good enough condition to be used as anchors for a dental prosthesis.

A conversation was held with the patient to discuss her expectations and treatment options. She wanted to have dentures that could give her stability. Most important of all, she wanted to be able to chew normally again. She also described her difficulties in speaking and expressed her discomfort about her appearance. She wished to have a "beautiful" smile again and be able to speak without impediment. In addition, the dentures should be easy to clean and handle and they should be hard-wearing. Implant-based treatment measures were not an option, as she wanted to avoid any additional surgical intervention. It was therefore decided to restore the upper jaw with a complete denture and the lower jaw with a partial model cast denture.

Treatment planning

Crafting a tooth replacement for a family member is always a special task for a dental technician; especially if, as in this case, said family member was the technician's own grandma. This increases the challenge of a task that is already demanding (complete dentures). The goal was to create dentures that harmonize with the face of the patient in a naturally beautiful and discreet way. Functional and yet highly esthetic dentures should be achieved.

01 and 02 — *Preoperative situation. The esthetic and functional shortcomings are clearly visible on the baseline pictures.*

03 — *The anterior setup was tried in and the phonetic and esthetic details adjusted as required.*

04 and 05 — *The teeth were set up on the models that were articulated in line with the jaw relation.*

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Primary requirements of the patient on the dentures:

- → Restored chewing function
- → Improved phonetics
- → Discreet integration of the dentures
- → Individualized esthetics
- → Easy to clean

Anterior teeth and setup in the oral cavity

First, the teeth in the upper and lower jaw that could no longer be preserved were extracted and the extraction wounds were allowed to heal. After that, impressions of the oral situation were taken. The diagnostic casts were used to establish the arrangement of the upper anterior teeth. For this task, high-quality prefabricated denture teeth (SR Vivodent® S PE) were used. These moulds provide impressive individualized esthetics for the anterior region. The expressive texture and internal stratification of the teeth lend an age-appropriate natural liveliness to the dentures. In addition, the teeth are made of a material that meets the requirements for durability, consisting of highly cross-linked DCL (Double Cross Linked) polymer. According to the manufacturer, the DCL polymer is a modified polymethyl methacrylate variant that offers higher compressive strength and better durability than conventional PMMAs – while the material's flexibility is similar as that of conventional resins.

After the casts had been analysed, the teeth were set up according to the known parameters. Despite clearly defined esthetic guidelines, it is crucial to check the setup on the patient and to adjust it as needed. The anterior setup was adjusted in the mouth of the patient to meet her individual esthetic and phonetic requirements. The patient was instructed to perform various phonetic exercises and produce certain sounds so that her speech pattern could be observed. These observations were then used to adjust the arrangement of the teeth **(Fig. 3)**. In this way, an ideal setup was achieved for the upper anterior tooth row.

Tooth setup

Master models were created on the basis of a mucostatic impression of the upper jaw. The models were then mounted on the articulator in a centric relation in line with the bite registration. The four anterior teeth in the lower jaw were set up to match the setup established in the oral cavity **(Figs 4 and 5)**. In an intermediate step, a posterior try-in was performed with the help of wax rims to check the bite height defined in the oral cavity. Posterior setup was then performed accordingly. The teeth were set up in a one-tooth-to-two-teeth relation taking all the principles of complete denture prosthetics into account. The SR Orthotyp® S PE posterior moulds are also made from DCL polymer. The beautifully shaped tooth necks of the anterior and posterior moulds, modelled on nature, merit particular mentioning here. They facilitate the esthetic conversion into composite because the shape imitates the appearance of solid teeth growing from the "gums". A try-in of the setup in the oral cavity helped to verify the arrangement of the anterior teeth established in wax stage by stage.

Completing the dentures

A model cast framework was produced for the lower jaw. The dentures are locked into place in the mouth with the help of six clasps. If the patient should lose another tooth, the denture can be easily extended. Special care was taken to ensure that the model cast framework featured an open periodontal design to facilitate self-cleansing.

The SR IvoBase® system was used for transferring the maxillary wax-up into resin – a system that couples efficiency with reliability. The injection procedure offsets the chemical shrinkage of the resin during polymerization. High-strength PMMA-based IvoBase was used for the manufacture of the denture base. The waxed-up dentures were invested and the sprues attached. After the moulds had been cast and the wax boiled out from the plaster, the flask and the denture teeth were prepared for the application of the denture base

06

06 — The denture base was injection moulded and then reduced to create space for creating soft tissue customizations.

material with the injection moulding technique. The pre-dosed denture base material was mixed and filled into the injector together with the flask. The appropriate program was selected and the injection process started. The accuracy of fit on the plaster model was ideal on the first try; reworking was minimal.

A try-in of the setup in the oral cavity helped to verify the arrangement of the anterior teeth established in wax stage by stage. The patient was able to speak and laugh without any difficulty. She was pleased with her new set of teeth already at this stage.

Customizing the denture base

The denture base was reduced – similar to a cut-back – for individual veneering to make the dentures look as discreet and natural-looking as possible **(Fig. 6)**. The soft tissue (pink) esthetics of the denture base could now be designed with a variety of shades to resemble the natural gums. With its comprehensive range of gingiva shades, the light-curing SR Nexco® lab composite is well suited for reproducing soft tissue characteristics. The material is easy to process due to its exceptional properties. It is optimally matched to the IvoBase denture base materials.

Generally, key anatomical features should be borne in mind when characterizing soft tissue parts to achieve a lifelike reproduction. For instance, keratinized gingiva has a light pink colour because less blood normally flows through it. By contrast, the mucogingival areas receive a far larger supply of blood (dark red) and are interspersed with fine blood vessels. Given the versatile range of gingiva shades, SR Nexco offers abundant possibilities for creating customized characterizations in these cases. The interplay of convex and concave surfaces in the area of the alveoli and subtle stippling effects lend three-dimensionality and depth to the gingiva and these characteristics were reproduced with the help of the paste-like materials. Although they looked

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07 and 08 — The completed upper denture distinguishes itself through its characterizations with gingival composite and phonetically aligned teeth.

09 — Model cast denture in the lower jaw with an open perio-dontal design (self-cleansing).

10 — Completed dentures on the upper and lower jaw models.

already very natural, the anterior teeth were additionally slightly customized using SR Nexco – a step that in this case was motivated by the high esthetic ambitions of the dental technician (who, just to remind you, is the grandson of the patient). Step by step, the complete upper denture was given a natural look with the help of the light-curing lab composites. Final polymerization was followed by mechanical polishing **(Figs 7 and 8)**. The model cast denture for the lower jaw was also completed **(Figs 9 and 10)**.

11 and 12 — *Upper and lower dentures in situ. The customized pink and white esthetic effects make the dentures look very natural – the teeth look as though they have grown from the gums like natural teeth.*

13 and 14 — *View of the lips with inserted dentures in function.*

15 and 16 — *The patient with her dentures. New quality of life and stability*

The result

The patient was impressed with her new upper and lower dentures right away. Once inserted, their natural and highly esthetic effect became even more apparent **(Figs 11 and 12)**. This effect can be attributed, among other things, to the micro- and macro-texture of the anterior teeth and the vibrant interplay of shades between the teeth and gingiva. The harmonious interaction between the white and pink esthetics is impressive. With the dentures in situ, the functional, esthetic and phonetic parameters were again verified **(Figs 13 and 14)**. The preliminary work was worth it. The dentures met all the requirements. The patient was happy and relieved that her grandson had mastered the double challenge so well.

In her own words, she discovered a whole new zest for life **(Figs 15 and 16)**. Her tooth replacements offer her a much more satisfying situation than her own "old" teeth did in the past few years. Not only is she able to speak and eat again without impediment but she can also laugh again with all her heart. She has received positive feedback from her circle of friends and acquaintances and that has encouraged her even more. My grandma's quality of life has improved considerably and she feels much more positive about life. She is now interested in meeting up with friends again and become involved in the social life around her.

Summary

Processing technologies that enable restorative treatments customized to the needs of the individual patient are increasingly becoming established in complete denture prosthetics. For instance, digital methods allow the fabrication of solid "basic" dentures using relatively little effort. Alternatively, these basic applications can be supplemented with high-quality materials combined with – as cherry on top – a manual layering technique (gingiva) to create highly esthetic results. Irrespective of economic aspects, the basic functional and static parameters always remain the same. Every complete denture ought to restore full functionality. Sound knowledge and experience in complete denture prosthetics provide the basis for achieving this.

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Impressions of the IES 2018 in Rome

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