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01/2019

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Editorial

Dear Reader

The digital revolution is transforming the way we live and work. Big changes bring big opportunities as well as big challenges for governments, businesses and every single one of us. At Ivoclar Vivadent, we believe that our opportunities will outweigh our challenges, because we are well-equipped for an exciting future. We are taking advantage of the latest technologies to simplify and streamline processes and systems. The dental industry is an extremely vibrant one, combining creativity and craftsmanship with new technologies. However, a smile remains analogue. Therefore, creativity and fine craftsmanship remain indispensable in this field.

We are constantly on the lookout for new and intelligent solutions in order to offer people around the world leading-edge, esthetic dental restorations. Creativity is the key to simplicity: Streamlined work processes heighten productivity and ensure consistent high quality. Apart from providing our customers with top products, we believe in offering them superior learning opportunities and excellent customer service. On the basis of these strengths, we strive to improve ourselves every day. Our efforts are focused on making your work an enjoyable experience and enabling you to provide your customers and patients with the best possible results.

Esthetics and efficiency are not mutually exclusive. As a result, we have coined a new concept called "the art of efficiency".

The best possible oral health and a bright self-confident smile are good for the body and the soul. A smile lifts your mood and spreads happiness among others. That's why they say the shortest distance between two people is a smile.

I hope that this publication will give you some new insights.

Diego Gabathuler
Designated CEO of Ivoclar Vivadent AG

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An exciting change

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An exciting change

Comparison of the IPS d.SIGN and IPS Style ceramic systems

A report by Velimir Žujić, Rijeka, Croatia

Change is exciting – also in day-to-day dental lab work. The author switched to using IPS Style layering ceramic some time ago. Before he started working with this ceramic system, he thoroughly tested the material and compared it to the product he had previously used.

The main aim of switching to a new ceramic system is to improve the quality of one's results. We regularly used the fluorapatite-leucite glass-ceramic IPS d.SIGN® in our laboratory. Then, one day we asked ourselves the following question: Would IPS Style® (the first patented metal-ceramic material containing oxyapatite) offer a sound alternative to our accustomed product? We decided to test the new material on flat cobalt-chromium alloy samples. These test specimens enabled us to take a closer look at the layering ceramic. We used these base metal alloy samples (Colado CC) to examine and compare several properties of IPS d.SIGN and IPS Style: for example shade, brightness, shrinkage, fluorescence and dimensional stability.

Conditioning and opaquer application

One specimen was oxidized at 950 °C with a holding time of one minute. The other sample was treated with a bonding agent. Two metal specimens with different bases were now sufficiently prepared for the application of the ceramic materials. Next, the samples were coated with IPS d.SIGN Paste Opaquer and IPS Style Ceram Powder Opaquer. The opaquer products of both systems have a smooth consistency. We had never used an opaquer in powder form before, so applying the IPS Style material was completely new to us. Nevertheless, we were impressed by its ease of application and the excellent results.

Shrinkage behaviour and shade effect

In the next step, we compared the Dentin and Transpa T Neutral materials as well as the Opal Effect OE1 materials. Each of the ceramics was applied to one of the metal samples. A line was drawn down the middle of the sample with a spatula for the purpose of comparing the shrinkage behaviour. The two different ceramics showed the same colour after firing. It was interesting to note that IPS Style exhibited less horizontal shrinkage than IPS d.SIGN **(Fig. 1)**. The vertical shrinkage of both ceramics was almost identical. The samples were held next to each other and examined under a polarizing light. IPS Style was shown to be somewhat brighter than IPS d.SIGN. Both materials exhibited almost the same level of fluorescence. In this comparison IPS Style was at a slight advantage because its Transpa T Neutral and the Incisal materials displayed a more lifelike fluorescence.

Dimensional stability and test results

The dimensional stability of the ceramics was clearly visible after the first firing cycle. The IPS Style layers successfully maintained their shape after firing. In contrast, IPS d.SIGN did not retain its shape completely. After this test series, we felt that we had gained enough information about the new material for our purposes. Even though the tests were relatively simple, they provided us with valuable insights into the two ceramic systems. Now we were ready to compare the two materials on the basis of an actual case study.

01 *— Test samples showing shrinkage behaviour. Left: Application of the ceramic on the metal sample. Centre: IPS d.SIGN Right: IPS Style*

02

03

04

02 — Initial situation. The patient wished to have the appearance of her upper teeth enhanced.

03 — Teeth 15 to 25 were prepared.

04 — Printed model with SLM metal copings

Case study

The patient was dissatisfied with the appearance of her upper teeth (Fig. 2). She wanted a new tooth colour, but wished the shape and position of her teeth to be maintained as best as possible. This simplified shade selection, since we "merely" had to select a slightly lighter tooth shade. Next, the teeth 15 to 25 were prepared (Fig. 3). Then a digital impression of the situation was taken with an intraoral scanner. From the manufacturing centre we were able to order both printed models and selective laser melting (SLM) metal copings. Both the models and the copings were produced simultaneously. This allowed us to start with the ceramic application immediately (Fig. 4). The restorations were built up on the frameworks with the two ceramic materials so that we could compare IPS Style and IPS d.SIGN in the patient's mouth. A detailed description of the procedure involving the two ceramics is provided below.

Preparation of the copings

First, the metal copings were oxidized according to the instructions of the manufacturer and then the opaquer was applied. The IPS d.SIGN Paste Opaquer and the IPS Style Ceram Powder Opaquer exhibited excellent flow and masking properties (Fig. 5). Two firing cycles were adequate for producing the desired masking effect. The opaquer in paste form was easy to apply, since the material is supplied ready for use from the syringe. Depending on its application, the rather dense paste may have to be diluted with some Paste Opaquer Liquid. The IPS Style Ceram Powder Opaquer, however, is mixed to the desired consistency with a matching liquid component. The product is easy to apply with a brush or a glass-ceramic or ceramic instrument. Margin material was used to create a shoulder, thereby enhancing the esthetic appearance of the restoration and establishing a tight seal to the gingiva. The Margin materials of the IPS Style and IPS d.SIGN systems helped to create a beautiful margin (Figs 6 and 7).

05

06

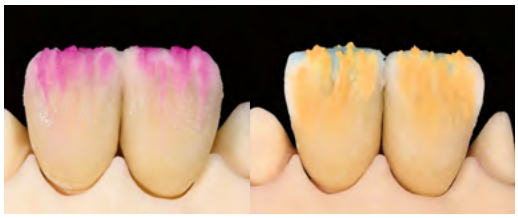
05 — Comparison of the opaquer (left: IPS d.SIGN; right: IPS Style)

06 and 07 — Application of the ceramic margin using the Margin materials of the two ceramic systems (left: IPS d.SIGN; right: IPS Style)

07

08 and 09 — *The ceramic materials were mixed with Liquid Visual Eyes for the purpose of visually comparing the two materials during the layering process (left: IPS d.SIGN; right: IPS Style)*

10 — *Comparison of the crowns after the first firing (left: IPS d.SIGN; right: IPS Style)*



11 — *Adjustment of the incisal teeth with Transpa and Mamelon materials (left: IPS d.SIGN; right: IPS Style)*

12 — *Application of Transpa Dentin, Transpa Incisal and Transpa Impulse for the corrective firing cycle*

13 — *The two anterior crowns after the corrective firing (left: IPS d.SIGN; right: IPS Style)*

First firing

In order to make a visual comparison of the layers placed with the two ceramics, the materials were mixed with Liquid Visual Eyes (Harvest Dental). The Visual Eyes Liquid is a product that renders the colour of the fired ceramic visible before the material is actually fired (Figs 8 and 9). The basic dentin layer was created with 25 % Cervical Transpa orange-pink and 25 % Cervical Transpa khaki mixed with 50 % Dentin B2. Unmixed Dentin material was used in the central part. The incisal mamelons were produced with a mixture of 80 % Dentin B2 and 20 % Special Incisal grey. In the horizontal cut-back space, Effect material Inter Incisal white-blue was applied. The incisal margin was completed with Opal Effect OE 1 and Transpa materials (neutral, orange grey). The mamelons and internal characteristics were created with a very fine separating instrument. After the first firing, the colours of IPS Style and IPS d.SIGN looked good and appeared almost identical (Fig. 10). IPS Style Ceram and IPS d.SIGN Transpa as well as Mamelon materials were used to make some slight adjustments to the shape of the anterior teeth. At this stage, a comparison showed that a few distal areas in the incisal edge of the IPS d.SIGN restoration were slightly more translucent.

Customization of the layers and second firing

After the first corrective firing cycle, the teeth were customized with suitable IPS Ivocolor® stains. These materials are used to characterize restorations (e.g. mamelons), imitate enamel cracks and adjust the colour intensity and translucency of certain areas. Subsequently, the stains were fired. In this case, a reddish hue was imparted to the incisal edge with IPS Ivocolor Essence E21 basic red to achieve a "lip gloss infiltrated" effect in the dental enamel. For the second firing, the crowns were coated with Transpa Dentin, Transpa Incisal and Transpa Impulse (Figs 11 to 13).

14 — *The final restoration (IPS d.SIGN) after the second corrective firing cycle*

15 — *The final restoration (IPS Style) after the second corrective firing cycle*

16 — In terms of fluorescence, both materials met our criteria.

17 — The final choice fell on the IPS Style restorations: shown in the mouth.

18 — The seated restorations (layered with IPS Style) harmoniously blend into the overall natural oral environment.

Comparison of the results

After the second corrective firing of the different IPS Style Ceram Transpa materials, we were convinced that the product fulfilled all our criteria: The dimensional and shade stability of the ceramic was impressive. We effectively controlled the brightness of the material by adding Transpa T neutral. All in all, we were completely satisfied with the result. The colours of IPS Style were lifelike and they were identical to those of IPS d.SIGN. A direct comparison clearly shows the excellent colour coordination of the different ceramic ranges **(Figs 14 and 15)**. Furthermore, the same shade system applies to the IPS e.max® all-ceramics and the SR Nexco® light-curing laboratory composite.

Summary

IPS Style is definitely capable of replacing IPS d.SIGN, which we used in our laboratory for quite some time. It completely satisfied us in terms of its shade and dimensional stability and its high strength. This ceramic offers us incredible flexibility and satisfies all our demands. Moreover, the ceramic system is geared towards modern manufacturing techniques: At present, we use printed, milled and conventionally cast metal to fabricate the frameworks used in our laboratory. The different fabrication methods involve a wide range of CTEs. IPS Style accommodates this requirement and does not cause any problems related to fracture during firing. The ceramic is characterized by minimal shrinkage and high dimensional stability. IPS d.SIGN, however, shows less dimensional stability and therefore does not perform as well in interdental areas and deep fissures. In this respect, it is less predictable than IPS Style. Nevertheless, the shade stability of IPS d.SIGN is comparable to that of IPS Style. In terms of fluorescence, both materials equally meet our criteria **(Fig. 6)**. IPS Style Ceram Incisal and IPS Style Ceram Transpa T Neutral have a slightly more lifelike fluorescence than the corresponding IPS d.SIGN materials.

Conclusion

In the end, the IPS Style solution had a slight advantage. We chose it for the final restoration because of its beautiful tooth shapes and vital appearance in the mouth **(Figs 17 and 18)**.

Acknowledgements

I would like to thank Dr Patricia Žujić for her collaboration on this case and Iris F., our patient, for her patience during this project. I would also like to thank all my colleagues and friends from the TTT Group at Ivoclar Vivadent in Vienna. This group provides us with incredible opportunities to exchange experiences and new ideas.

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“I look back with pride and gratitude”

A retrospective of Ivoclar Vivadent’s successful history

An Interview with Robert Ganley, Ivoclar Vivadent’s CEO 2003–2019

Robert Ganley, US-born, has been Ivoclar Vivadent’s CEO for 16 years. This summer, he will pass the baton to Swiss-born Diego Gabathuler. In this interview, he reveals the secret behind Ivoclar Vivadent’s success, he talks about the new products presented at IDS and reflects on his career.

Mr Ganley, why is Ivoclar Vivadent so successful?

We deliver what the customer needs and wants: Innovation that creates opportunities and esthetics. In all that we do we focus on the needs of our customers. Dentistry can be a simple business. The most important strategic tool is “listening”. If you “connect” with your customers and ask them about their business and their challenges they will tell you the problems and even propose the solutions. You simply need to listen and then to act. We are the leaders in quality innovations for esthetic dentistry.

Which new innovations did you present at IDS 2019?

At IDS, we showcased perhaps our strongest portfolio of innovative products for dental laboratories and dental practices. I will mention the most important ones:

1. The 3s PowerCure product system: a direct restorative system that allows dentists to reduce treatment times by more than half, while still achieving the same level of quality and esthetics. Many clinicians are seeking a composite that delivers treatment efficiency and reliability. The 3s PowerCure product system is optimally coordinated for direct restorative procedures to enhance efficiency and esthetics.
2. The Bluephase G4 curing light: the first intelligent light featuring an automatic curing assistant

01 — *Specialized information and entertainment at Ivoclar Vivadent’s IDS booth*

02 — *The exhibition team conducted many inspiring sales conversations.*

03 — *The 3s PowerCure product system was one of the exhibition highlights.*

04 — *The highly motivated Ivoclar Vivadent exhibition team*

3. IPS e.max ZirCAD Prime: This innovative product is the Next Generation of All-Ceramics from the Leader in All-Ceramics. Prime features a unique combination of two raw materials and the new Gradient Processing Technology. It is the first all-ceramic material with anterior esthetics that can be used anywhere in the mouth and for all indications. Prime is the high-esthetic, high-strength all-ceramic solution that the market has wished for since the launch of IPS Empress.
4. The PrograPrint 3D printing system for dental laboratories: This innovative system includes printing materials and equipment for printing, cleaning and post-curing. It extends the existing Ivoclar Digital portfolio and ideally complements the PrograMill milling machine range. High accuracy and high efficiency in a controlled system – another wish of the market fulfilled.

You will soon pass the baton to Diego Gabathuler, who will succeed you as CEO. As you look back on your 16 years at Ivoclar Vivadent what stands out for you about your tenure?

Looking back on what we have achieved thanks to the many dedicated employees in our company, I feel a particular sense of pride and gratitude. Ivoclar Vivadent has revolutionized the dental world in many ways. We have been a leading innovator in both material development and product marketing. We introduced "esthetics as a primary goal" to the market with the launch of the "Esthetic Revolution". In doing so we changed material science, we changed processes and we changed the expectations of the laboratory technician, the dentist and the patient.

In your dual role as CEO of the Ivoclar Vivadent Group and Managing Director of the North American subsidiary, you commuted between the US and Liechtenstein for many years …

Yes, that's true. Although it was demanding, I had the benefit of being in two important dental markets every week. This gave me the opportunity to be with customers and listen to customer needs all of the time. I was promoted in the same year as were the new CEOs of Sirona, Straumann and Nobel Biocare, all central European companies. Each CEO would travel 50 % of the time and each would be in the US and Europe every month. So you see my schedule was not so different.

I am often asked still today how I am able to maintain the schedule. I describe it this way – I do my best every day and I receive from my job more energy than I put in. My job energizes me! I consider myself lucky.

What are your plans for the future?

I will remain very active both on the Supervisory Board of Ivoclar Vivadent and in other positions. It is likely that I will fly less. I am confident, however, that Swiss will survive even without my weekly flights!

05 — *Every evening, customers were received at the Rheinterrassen.*

06 — *Robert Ganley (right) and his successor Diego Gabathuler*

The gold standard: IPS e.max Press – one material for virtually all indications?!

Posterior occlusal veneers in the dental practice

An article by Dr Diether Reusch and Jan Strüder, Westerburg, Germany

The book titled "Porcelain Laminate Veneers" by David A. Garber, Ronald E. Goldstein and Ronald A. Feinmann has had a great influence on the prosthetic and restorative methods developed by the authors. Based on the resounding success of the adhesive technique, a minimally invasive approach evolved for the reconstruction of teeth.

In 1990 "Westerburger Kontakte", a private postgraduate dental training institute, offered the first course on ceramic crowns, inlays and veneers. Today, as was the case almost 30 years ago, it is still considered quite an amazing feat that ceramics can be used in the same way as gold alloys. A study conducted by A. Krummel, A. Garling, M. Sasse and M. Kern at the Christian-Albrechts-Universitaet Kiel (University of Kiel) showed that occlusal veneers in the posterior region with a minimum thickness of 0.3 to 0.6 mm offer a very promising treatment solution. In our dental practice, we restore posterior teeth with occlusal veneers or partial crowns. These restorations measuring 0.5 to 7.0 mm in thickness are made of monolithic IPS Empress or LS_2 and they are cemented with the adhesive technique. In anterior teeth, we use adhesively bonded monolithic 360° veneers, partial crowns or laminate veneers measuring 0.3 to 0.5 mm in thickness. In contrast to gold, which deforms quite easily and metal-ceramic solutions, which can fracture, most all-ceramic materials are virtually indestructible. Therefore, these materials fulfil exceptionally high standards in terms of the static and the dynamic occlusion.

Diagnosis and treatment planning

As a result of parafunctional habits and biocorrosion the front teeth of our 23-year-old patient showed considerable attrition. The palatal enamel in the upper jaw had been completely worn away **(Figs 1 and 2)**. Hardly any of the occlusal enamel remained on the posterior teeth.

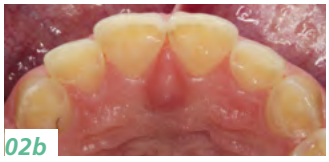
Functional analysis, wax-up and preparation planning

The upper jaw model was articulated according to skull-related orientation principles. The joint-related orientation was used for the lower jaw. The lower jaw movements were recorded in order to program the articulator. A diagnostic wax-up was produced on the duplicate models **(Fig. 3)**. The aim was to raise the vertical height to the level required for the reconstruction of the front teeth ("logical" tooth shape). The length of the anterior teeth was established with a mock-up, which was used to test the phonetic, functional and esthetic parameters. As far as the lateral movements were concerned, our


01a


01b

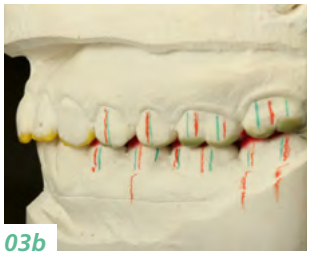

02a


02b

01 and 02 — *Initial situation. Loss of tooth length and palatal enamel*


03a


03c

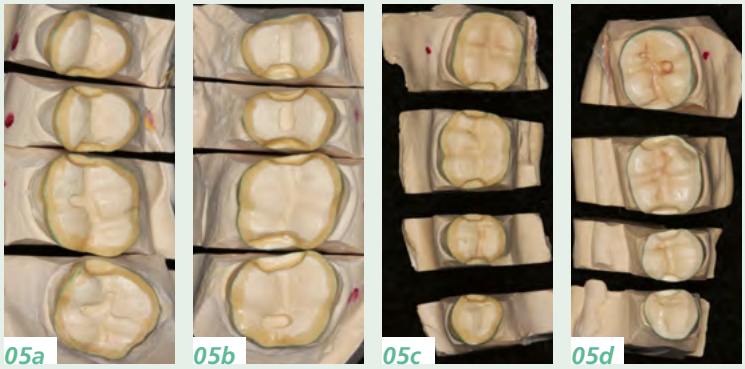

03b

03 — *Diagnostic wax-up*

04a

04b

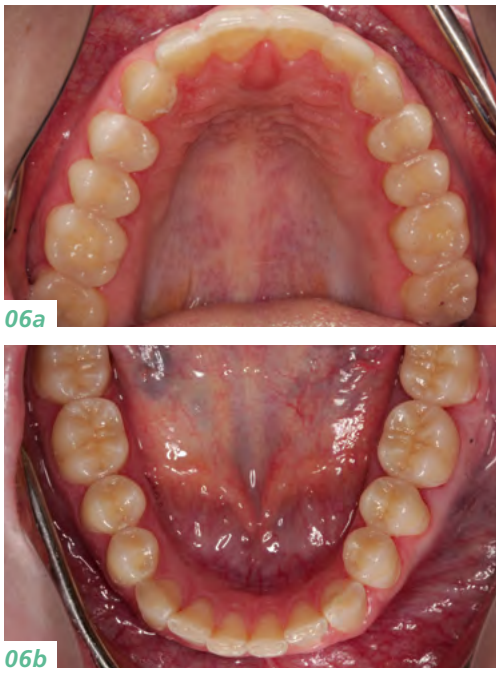
04 — Mock-up made of provisional composite resin



05a 05b 05c 05d

05 — Models of prepared posterior teeth

objective was to achieve immediate disclusion of the posterior teeth. Any interfering cusps were relocated. As a guide for the appropriate functional preparation, the dental technician marked the original location of the working cusps (red lines) and the non-supporting cusps (green lines) on the buccal surface of the teeth. Markings were made on the gingiva of the model to indicate the new position of the cusps and spaces. A mould of the duplicate wax-ups was made using a thermoforming process. A temporary composite resin was filled in the moulds, which were placed on the teeth. Once the material had set, the moulds were removed. Together with the patient we were then able to evaluate the planned changes in terms of phonetics, function and esthetics (Fig. 4) before the teeth were actually prepared.



06a

06b

06 — Upper and lower anterior teeth: lengthened with composite resin; upper posterior teeth with provisional restorations; lower posterior teeth with permanent partial crowns (characterized)

1st treatment phase: temporary upper posterior restoration and permanent lower posterior restoration

The posterior teeth in the upper and lower jaw were prepared, and the models (Fig. 5) were mounted in the articulator on the basis of the obtained facebow and centric relation data. The support pin was adjusted in accordance with the planned vertical dimension. The lower posterior teeth were waxed up with the help of an occlusal plane plate. Next, the wax crowns were invested and reproduced with ceramic. The crowns were placed using an adhesive cementation technique (self-etch technique, Adhese® Universal, Variolink® and Monobond® Etch & Prime).

We placed an indirect temporary restoration made of composite resin in the upper posterior jaw. The unprepared anterior teeth were provisionally treated with an adhesively bonded composite resin mock-up (Fig. 6). The upper dental arch was slightly expanded towards the buccal aspect and the anterior teeth were lengthened. The restorations featured the vertical dimension and cusp positions that were determined by means of the mock-up. Small adjustments were made in the upper temporary restoration by means of splint therapy.

2nd treatment phase: permanent upper and lower anterior restorations

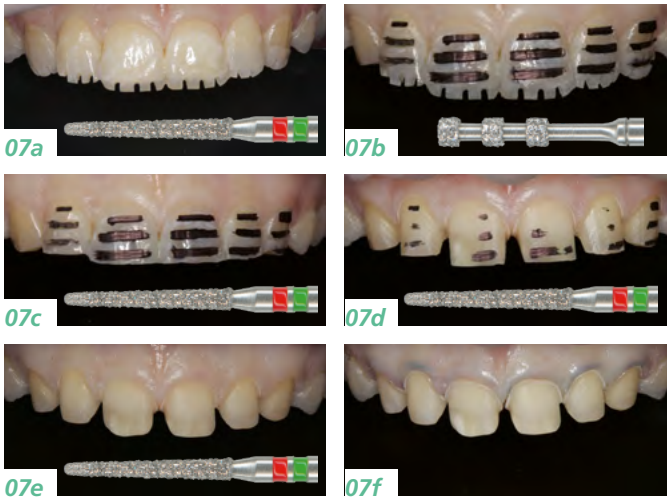
Preparation and fabrication of the temporary restorations

The upper and lower anterior teeth were prepared on the basis of minimally invasive principles (Figs 7 and 8).

Step 1: A "dual-grit" diamond was used to mark the depth to which the incisal edge needed to be removed through the adhesively bonded mock-up (generally 1.0 to 1.5 mm).

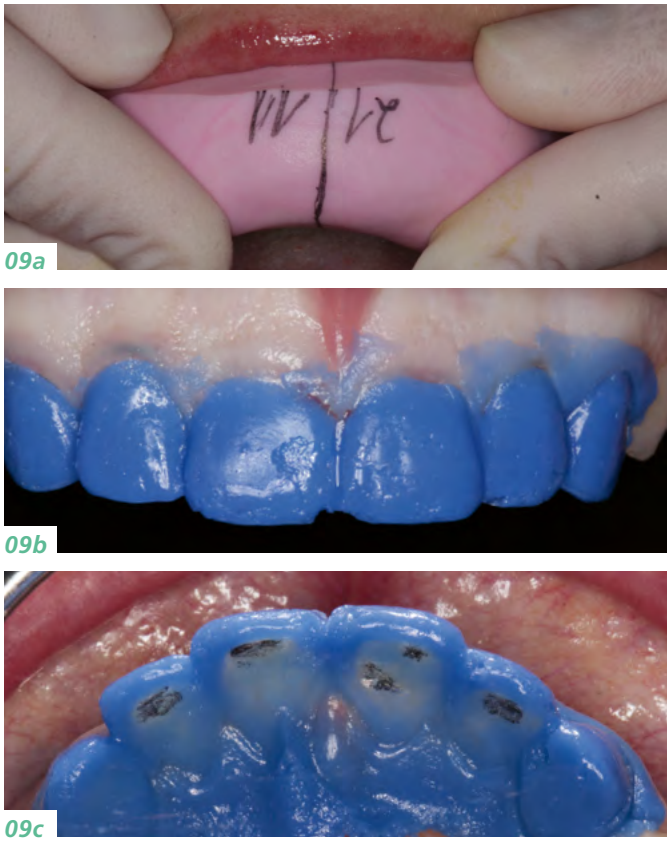
Step 2: A special grinder was used to apply 0.5 mm horizontal depth markings on the facial surface of the teeth through the mock-up. The grooves were marked with an insoluble fine liner.

Step 3: The incisal edges were removed. For this purpose, the "dual-grit" diamond was inclined towards the palatal aspect at an angle of about 30°.



07 — *The individual minimally invasive preparation steps in the upper anterior teeth*

08 — *Completed preparation of the upper and lower anterior teeth (partial preparation)*



09 — *Examination of the prepared teeth using hydrocolloid*

Step 4: The proximal parts of the teeth were removed with a "dual-grit" diamond (0.3 mm) or a flame-shaped bur (014).

Step 5: The mock-up was removed and the labial enamel was cut away until the markings were no longer visible. The cervical areas of the teeth were prepared along the gingival margin. The palatal preparation depth was between 0.3 and 0.5 mm. In the areas where the enamel loss on the palatal surface extended beyond the tubercle, we prepared the teeth for a 360° veneer. This was done to prevent palatal fractures from occurring.

Step 6: Before we finely contoured the margins, we placed a #000 retraction cord. The teeth were prepared with a red contra-angle handpiece at reduced speed (40,000 rpm) up to the level of the retracted gingiva. This preparation step can be done with air cooling.

A silicone matrix, which was produced on the basis of the diagnostic wax-up, was filled with hydrocolloid. Alternatively, the thermoforming method could have been used to make a mould of the wax-up, which would have been filled with silicone impression material. This enabled us to check whether or not we had removed enough of the tooth structure (Fig. 9). If the hydrocolloid is less than 0.3 mm thick, the tooth structure that needs to be further reduced is marked with a wax pencil.

After this impression step, a model was produced with a fast-setting stone (Whip Mix Snap-Stone) in order to check the prepared surfaces. The silicone matrix (diagnostic wax-up) was given to a specialized dental assistant who fabricated the indirect provisional restorations.

Preparation of the lower front teeth and fabrication of the model

The lower front teeth were prepared and checked in the same way as the upper front teeth. The preparation depth was not to exceed 0.3 mm. Before the impressions were taken, a #0 cord (soaked with ViscoStat Clear, Ultradent) was placed over the #000 cord. It was removed shortly before the impression material was inserted. The #000 cord keeps the sulcus open and dry during the impression taking process. We took an overall impression and two partial impressions for the reconstruction of the individual teeth. The articulator was programmed with all the necessary movement data of the lower jaw.

Wax-up for the examination of the phonetics, function and esthetics

The dental technician produced a wax-up of the front teeth using an esthetic wax. This allowed the dental technician, the dentist and the patient to jointly examine the phonetic, functional and esthetic properties of the restoration (Fig. 10). The adjustments were made with the consent of the patient. Subsequently, the wax-up was invested and then the restoration was pressed.

Determination of the tooth colour and fabrication of the crowns

The final appearance of very thin veneers and crowns is considerably dependent on the colour of the remaining tooth structure. Therefore, the colour of every single prepared tooth was determined. Furthermore, the dental technician produced individual dies with the corresponding shade in the dental lab (IPS Natural Die Material).

The lab-fabricated crowns were characterized before they were tried in. This allowed the phonetic, functional and esthetic properties of the teeth to be checked and documented by means of photographs taken with a smartphone. After the necessary adjustments had been made, the restorations were glaze fired. The completed restorations (360° veneers/partial crowns) measured between 0.3 and 0.5 mm in thickness **(Fig. 11)**.

Adhesive cementation

If possible, a rubber dam should be used to establish a dry working field for the adhesive cementation technique. Alternatively, a #00 retraction cord should be placed in the sulcus before the cementation procedure in order to make the preparation margin easily accessible **(Fig. 12)**. In the present case, the neighbouring teeth were isolated with Teflon tape. We usually place the crowns in pairs. In this case, after etching with 37 % phosphoric acid, the entire preparation was shown to be located in the enamel tooth structure. Dentin was visible in individual areas, where it had been exposed due to the parafunctional habits of the patient.

The upper and lower front teeth as well as the lower posterior teeth were permanently restored. A few minor adjustments still needed to be made on the occlusal surfaces of the temporary upper restoration.

3rd treatment phase: permanent upper posterior restoration

We removed the indirect restorations in the upper posterior region and took impressions of both jaws. A centric jaw relation record was made using thermoplastic sticks (GC Bite Compound, GC). The upper jaw model was positioned in the articulator on the basis of an arbitrary facebow record. With the help of the two thermoplastic bite records, the lower jaw model was mounted in the articulator in a joint-related orientation.

Application of ReFu wax

We fabricated the upper partial crowns with ReFu wax (Reference Function wax, Keydent). Initially, this wax was very hard. As a result, we were able to check the contact points after the placement of the crowns with the help of Shimstock contact foil. In the oral environment, the wax became softer. We asked our patient to make certain forceful


10a


10b


10c

10 — Wax-up for the examination of the phonetics, function and esthetics


11a


11b


11c

11 — Try-in of the restoration after the stains firing cycle


12a


12b

12 — Adhesive cementation of the restorations in the upper anterior jaw

movements, some of which simulated parafunctions (Fig. 13). If a cusp interfered, this was shown on the chewing surface and the necessary adjustments could be made. Subsequently, the waxed-up models were invested and the monolithic partial crowns were fabricated using lithium disilicate (IPS e.max Press) in the press technique. The restorations were characterized and glazed (Fig. 14). No adjustments were necessary after the restorations had been adhesively bonded. The thickness of the posterior partial crowns measured about 0.5 mm on average.

Adhesive cementation

A rubber dam was placed and the neighbouring teeth were protected with Teflon tape. Then the posterior partial crowns were seated in pairs on the prepared upper teeth using the adhesive cementation technique (Fig. 15). After the restorations had been cemented in the patient's mouth, we checked the dynamic occlusion with the help of Occlusal Indicator Wax (Kerr) (Fig. 16). The wax did not show any premature occlusal contacts.

IPS e.max Press – why is it the gold standard?

- Biocompatible
- Biomimetic
- Minimally invasive
- Extremely strong
- Long-lasting; hardly any failures after 25 years
- Excellent conversion of wax-ups into ceramic crowns
- Easy to use
- Easy to colour
- High accuracy of fit
- Controlled function, also in bruxers
- Affordable costs: glazed monolithic crowns
- One material for virtually every indication


13a


13b

13 — *Examination of the static and dynamic occlusion with ReFu wax*

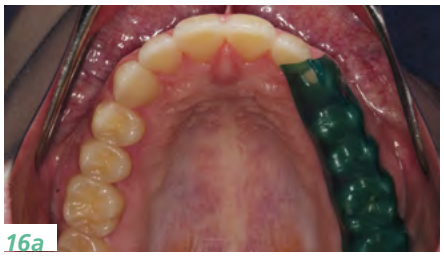

14

14 — *The pressed ceramic restorations prior to placement*


15a


15b

15 — *Ceramic partial crowns seated with the adhesive technique*

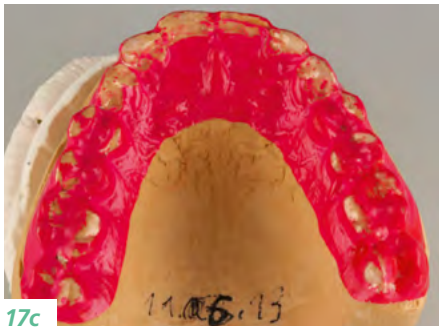

16a


16b

16 — *Examination of the dynamic occlusion using an occlusal indicator wax*


17a


17b


17c


17d

17 — *Brux Checker foil (left: initial situation; right: after the restorative treatment)*

Brux Checker foil

The patient was given a Brux Checker foil and instructed to use it for two nights (Fig. 17). This allowed us to make sure and record that the restorations were free from any interference during sleep and bruxing. In most cases, no subsequent grinding adjustments are necessary.

Summary

Minimally invasive restorations measuring 0.3 to 0.6 mm in thickness placed with the adhesive technique have shown to be a reliable treatment option in our practice. We have been working with the described method since 1993. Particularly in young patients showing a substantial loss of enamel, we know of no other comparable long-lasting and minimally invasive treatment approach.

Note

Ivoclar Vivadent does not recommend that IPS e.max Press and IPS e.max CAD are used in patients with bruxism. Nevertheless, our experience has shown that if all the functional and parafunctional aspects are properly considered, no complications are to be expected in bruxers.

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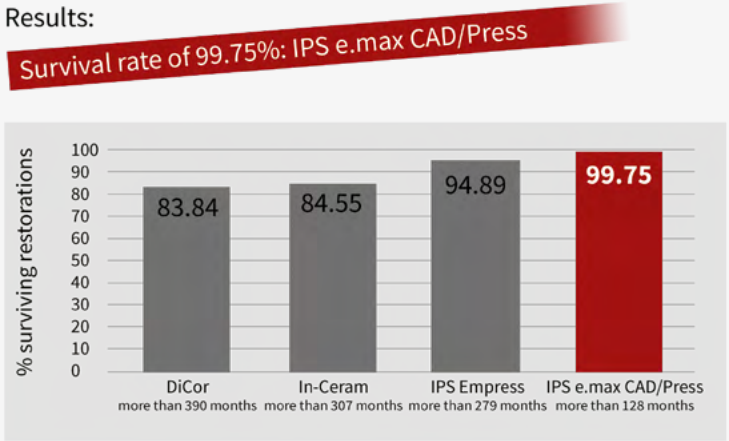
How durable are IPS e.max Press and IPS e.max CAD restorations?

In a study by K. A. Malament, IPS e.max® CAD/Press performed the best out of all the dental glass-ceramics tested, with a survival rate of 99.75 % over a period of just more than ten years.

Within the framework of this study, 6000 all-ceramic restorations have been placed since 1983. Four different types of ceramics have been evaluated

- Dicor/Dentsply Sirona (n = 1504)
- In-Ceram/Vita (n = 330)
- IPS Empress (n = 2133)
- IPS e.max Press or CAD (n = 2364)

Records for Dicor have been kept since 1983, for In-Ceram since 1990, for IPS Empress® since 1992 and for IPS e.max since 2005.



Surviving glass-ceramic restorations in % per product after different periods of time

View Scientific Report online

Surpassed expectations

Despite the shortest observation period of just over ten years (128 months), lithium disilicate restorations made of IPS e.max Press and IPS e.max CAD showed the highest survival rate of 99.75 % in this large scale survey. According to K. A. Malament the materials fulfilled and even surpassed all the clinical practice requirements.

Source: IPS e.max, Scientific Report, Vol. 03/2001-2017

Clinical data confirms success

The performance of IPS e.max has been scientifically monitored since the inception of the product. The study results of notable experts from around the world have contributed to the compilation of an excellent data base. The average survival rate for both lithium disilicate and zironium oxide is 96 %. The IPS e.max Scientific Report contains a summary of all the available *in vivo* and *in vitro* study results.

Easy and efficient: Composite resin blocks for the CAD/CAM technique

Single-tooth restorations with Tetric CAD

A report by Dr Hidetaka Sasaki, Tokyo, Japan

Composite blocks for CAD/CAM applications are on the rise, particularly for producing small restorations, such as inlays, onlays and occlusal veneers. And quite rightly so, for this type of material has a lot to offer: it exhibits sound mechanical properties combined with an extraordinary grinding accuracy and it is easy and efficient to process in day-to-day procedures.

The following clinical report describes the workflow to create an esthetic single-tooth restoration using the new Tetric CAD® composite block. The blocks are available in two degrees of translucency – HT and MT – and in a variety of shades. They exhibit a pronounced chameleon effect to provide restorations that blend in well with the optical characteristics of the surrounding residual tooth structure. The material can be polished to a high gloss in a few seconds both intraorally and extraorally. In addition, it can be easily repaired intraorally with conventional composite resins.

Clinical case

The pre-op showed a defective amalgam filling on tooth 36 in the lower posterior region. The filling needed replacing (Fig. 1). The indication for a multi-surface inlay was given. It was the patient's wish to have an esthetic, i. e. tooth-coloured restoration. We decided to opt for the Tetric CAD composite blocks. This material is part of the portfolio of Ivoclar Vivadent blocks and is suitable for permanent single-tooth restorations. It is supplied in industrially processed, pre-cured blocks that exhibit superior strength and a higher filler content than direct restoratives. Because they have undergone an industrial polymerization process, shrinkage stress is not an issue with Tetric CAD.

Designing the restoration

Shade selection is performed on the natural dentition, primarily on the neighbouring teeth. We decided to use shade HT A2. The HT blocks are a good choice, particularly when it comes to producing fairly small restorations such as inlays as they provide a pronounced chameleon effect. Once the old amalgam was removed, the tooth was prepared in line with the recommended preparation guidelines (Fig. 2). Then, an optical impression was taken using an intraoral scanner and the inlay was designed in the CAD module (Fig. 3). Subsequently, the restoration was ground from the block.

Grinding times are considerably shorter for CAD/CAM composite resins compared with other materials. Although the composite is softer to grind, the restoration is not affected by this. It only means that the grinding tools are less quickly worn and offer a long service life, maximizing the cost efficiency of the practice.

Composites are "flexible" materials. Their modulus of elasticity is similar to that of dentin. High flexural strength provides adequate resistance and stability. Given their low brittleness, composites can be ground to exhibit highly homogeneous surfaces and to obtain accurate, thinly tapered margins without loss of strength. Marginal chipping or crack formation are unlikely to occur.

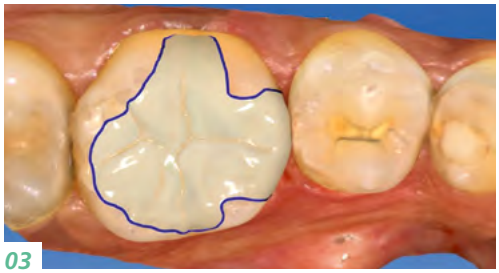
In the present case, a try-in was performed immediately after the grinding process to check the fit of the inlay with the natural residual tooth structure (Fig. 4).

Conditioning the restoration

The attachment point was easy to smooth out with fine-grit diamonds. This was followed by extraoral polishing using composite polishers (e. g. OptraPol®) (Fig. 5). Particularly noteworthy was the speed with which the restoration was polished to a high gloss. It only took a few seconds to achieve a glossy surface (Fig. 6). Composites do not require an additional glaze firing cycle. This has a positive effect on the time resources of the practice.

01

02



03

04

01 — Preoperative situation: defective amalgam filling on tooth 36

02 — Prepared tooth

03 — Designing the inlay in the CAD module

04 — Checking the fit and shade match of the inlay after the grinding process

It is essential to condition and pre-treat the bonding surface correctly. This requires the use of an adhesive system that is appropriate for this type of material to ensure the longevity of the restoration. The manufacturer's instructions should be followed at all times.

In the present case, the bonding surface of the inlay was air-blasted with aluminium oxide (50–100 µm) at a pressure of 1–1.5 bar, followed by thorough rinsing (Fig. 7). The restoration can be cleaned either in an ultrasonic unit or with a steam cleaner. It is recommended to additionally clean the restoration with 70 % ethanol to disinfect it. Pre-treating the restoration in this way is mandatory for Tetric CAD because air-blasting increases the surface area and creates a retentive pattern that acts as a basis for the adhesive cementation. Pre-treating therefore ensures a reliable bond between the luting material and the restoration.

To condition the restoration, Adhese® Universal adhesive was applied and scrubbed into the pre-treated bonding surface for 20 seconds using a microbrush (Adhese Universal is also available in the VivaPen® delivery system for direct applications). It is important to observe the recommended agitation time to ensure that the adhesive can penetrate sufficiently (Fig. 8). Excess material is carefully dispersed using compressed oil-free air until a glossy immobile film results. Pooling must be avoided.

It is not necessary to light-cure the adhesive at this point: the adhesive will be cured together with the luting composite when the inlay is placed on the tooth.

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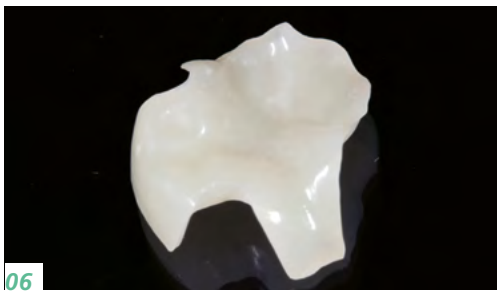

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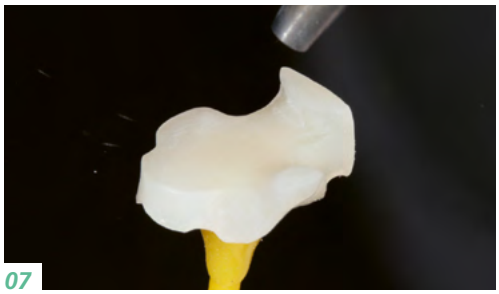

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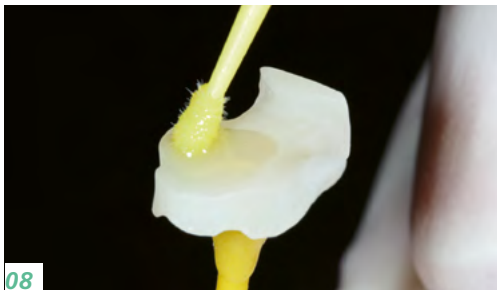


08

05 — Extraoral polishing with OptraPol

06 — Restoration after high-gloss polishing

07 — Air-blasting the bonding surface with 50–100 µm aluminium oxide at 1–1.5 bar; followed by cleaning

08 — Scrubbing Adhese Universal into the bonding surface for 20 s, followed by drying with air

Pre-treating the prepared tooth

Adequate isolation of the operating field is required for reliable bonding. The tooth preparation was cleaned and then conditioned, rinsed and dried using a conventional etch & rinse procedure. Adhese Universal adhesive was scrubbed into the tooth structure for 20 seconds and then dispersed (Fig.9). The adhesive was then light cured for 10 seconds using the Bluephase Style curing light (Fig. 10). According to the manufacturer's recommendation, a curing light emitting a light intensity of least 500 mW/cm² should be used for this step.

Placing the restoration

The inlay was seated using Variolink® Esthetic luting composite. The luting composite was applied directly from the syringe onto the bonding surface and then the inlay was seated and retained in position applying light pressure (Fig.11). Variolink Esthetic is particularly well suited for this step because excess material can be removed from the cement line with ease and it does not cause a "buffering effect" as is often the case with harder luting composites (Fig. 12). Tack-curing from all sides for 2 seconds facilitates the clean-up process.

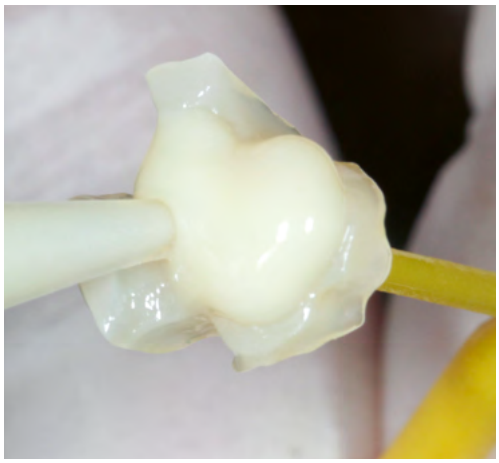
The cement line should be covered with air block gel (e. g. Liquid Strip) to prevent the formation of an oxygen inhibition layer (Fig. 13).

At the final curing stage, the adhesive on the bonding surface and the luting composite are cured togehter (exposure time: 10 seconds per mm of composite and segment). It is recommended to use a curing light that produces a light intensity of at least 1,000 mW/cm² for this step.

At this stage, the adhesive and the luting composite applied to the bonding surface are polymerized by the light passing through the restoration. In the process, a reliable adhesive bond forms. Upon completion of the light-curing step, Liquid Strip can be rinsed off (Fig. 14).

09 — Conditioning the prepared tooth with Adhese Universal for 20 s, followed by drying with air

10 — Light-curing for 10 s using Bluephase Style



11 — Applying Variolink Esthetic luting composite to the bonding surface

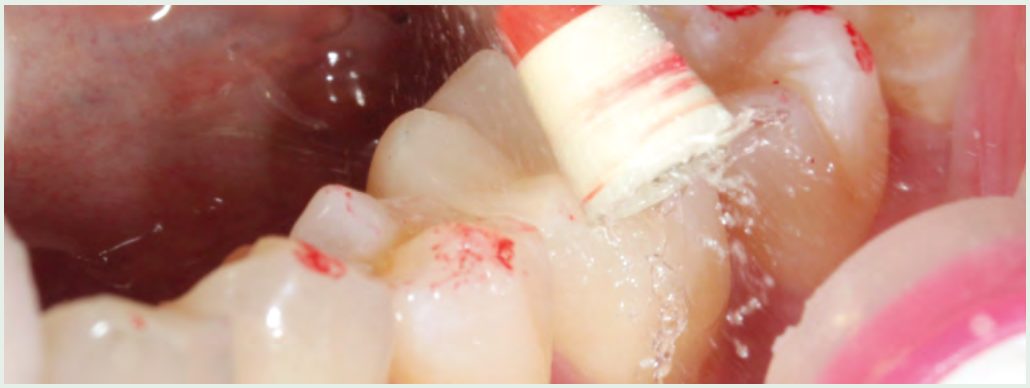
12 — Inserting and positioning the inlay on the tooth; followed by the removal of excess material

13

14

13 — Applying Liquid Strip to prevent the formation of an inhibition layer

14 — Light-curing all segments for 10 s per mm of composite using a Bluephase Style



15 — Occlusal check followed by intraoral polishing with OptraPol

16 — Inlay in situ: great optical integration thanks to chameleon effect

Finishing and outcome

An occlusal check was carried out and any interferences were removed using fine diamonds. In the present case, final intraoral polishing was performed with the OptraPol polishers (Fig. 15).

This procedure resulted in a highly esthetic single-tooth restoration. Because of the chameleon effect, the inlay blends seamlessly into the surrounding natural tooth structure (Fig. 16).

Conclusion

Highly esthetic permanent single-tooth restorations can be achieved with the composite blocks of the Tetric CAD range in really short times. The guidelines for the adhesive technique need to be observed and a coordinated luting system must be used.

Easy and rapid processing and polishing procedures and the possibility for effecting intraoral repairs, similar to conventional filling composites, enable a highly efficient treatment workflow and increase the efficiency of day-to-day procedures in the dental practice.

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Preoperative digital planning

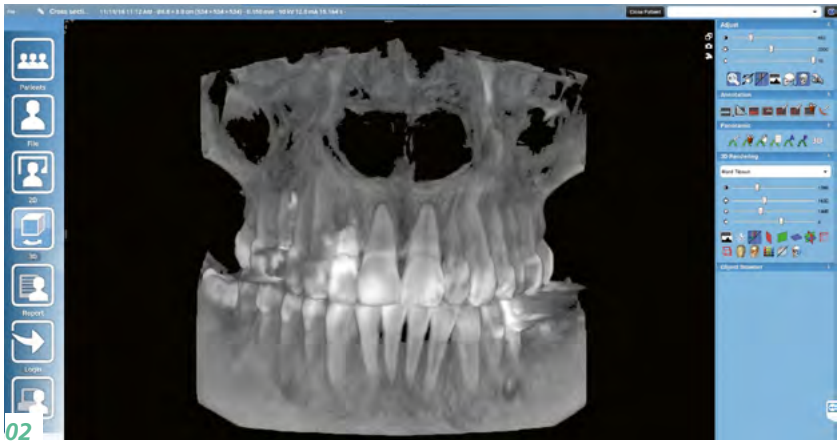
RAW workflow: A professional's approach to planning monolithic restorations on single-tooth implants

A report by Florin Cofar, DDS, Timisoara/Romania, and Dr Eric van Dooren, Antwerp, Belgium

Digital planning and preparation provides a high level of reliability in implant-prosthetic procedures. Preliminary virtual simulation of the surgical intervention can provide the necessary confidence and certainty to carry out the actual surgery with peace of mind. Two dental professionals describe their procedure.

Every workflow begins with an information gathering exercise. If a digital workflow is followed, the information consists of data that can be processed by the software being used. Our prosthetics team employs a photo-video protocol to examine the esthetic-functional relationship between the smile, dental situation and face of the patient. In addition to conventional photographic documentation and video sequences, we use digital volume tomography (DVT) and intraoral scans in the assessment of implant prosthetics cases. By merging all the information gathered we obtain what we call a "digital clone". These amalgamated data sets enable us to plan all steps in a virtual treatment suite as if we were working on a clone of the patient. Below we present our procedure, using the example of an implant prosthetic single-tooth restoration.

01



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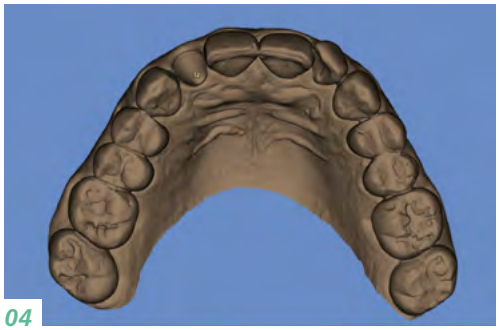
03

01 — Portrait image prior to the intervention

02 — DVT data set in the software program

03 — Surface scan of the preoperative situation



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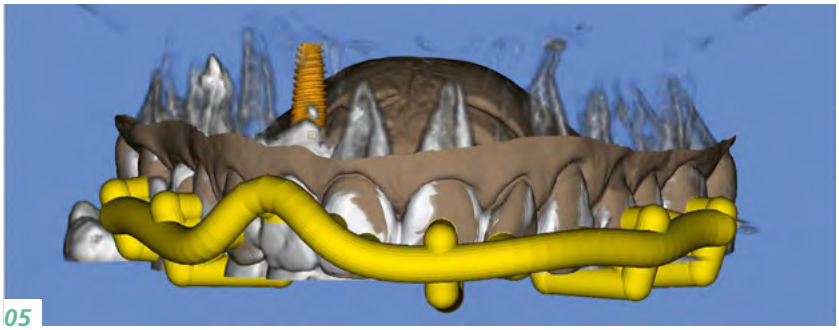

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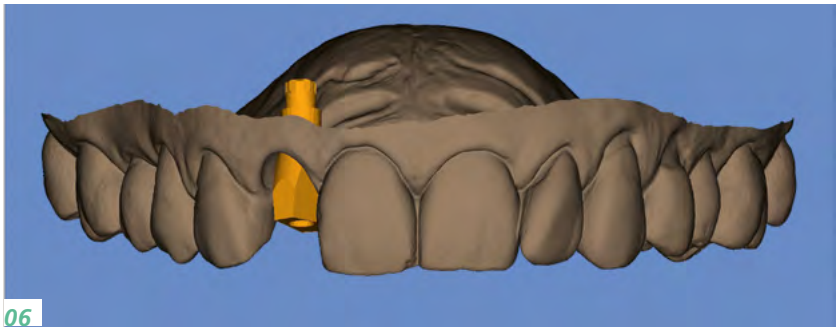


06

04 — Virtual extraction of the tooth in need of treatment

05 — Designing the drill template

06 — Digitally designed alveolar cavity with scan body

Creating a digital clone

The process begins by obtaining a high-quality portrait photograph, a DVT and an STL file (Figs 1 to 3). In the case presented here, tooth 12 can no longer be preserved and needs to be replaced with an implant prosthetic restoration. Designing the prosthetic restoration forms the first stage of the implant planning sequence. In the present case, the shape of the existing tooth should be maintained. If an analogue workflow is followed, the premise for the implant is the extraction of the tooth. This scenario also forms the first step in the digital procedure described here - however, the tooth is "only" extracted virtually. We can extract the tooth digitally to design e.g. the future alveolar cavity (emergence profile) and generate an optimized emergence profile. An alveolar model is required for:

1) designing the drill template (navigated implant insertion) and
2) fabricating a temporary restoration / abutment prior to the surgical intervention.

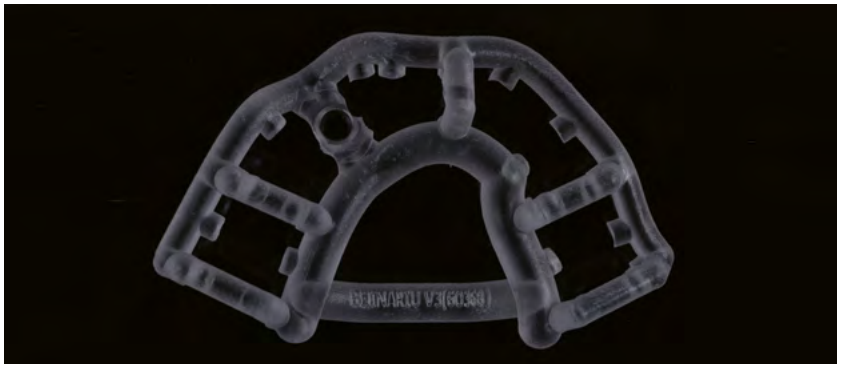
We only ever use copies of the data files. The original data sets remain untouched. Several methods can be employed to perform the virtual tooth extraction. In our opinion, the most effective approach is to use the "Provisional Pontic" CAD process and to design the alveolar cavity to have an optimum shape. You should always work on two levels when executing this step. The working scan represents the first level. The original scan with the tooth represents the second level in this scenario.

Implant prosthetic planning

The implant crown is designed (virtual wax-up). In the present case, the tooth being replaced serves as the template. The crown reflects the position and proportions of the original tooth. A copy of the scan file is again used as working file on which the virtual tooth extraction is performed. This allows us to go back to the original data and compare it with the working file. We define the ideal implant placement position and design the peri-implant soft tissue contours on the screen to provide an adequate emergence profile (Fig. 4). We then prepare a drill template for safe transfer of the implant position to the oral cavity. Even though most dentists are familiar with this procedure, we will briefly address the fundamentals: Basically, three data sets are required for preparing a drill template:

1) a scan showing the digitally extracted tooth,
2) a data file of the DVT, and
3) a scan showing the CAD design of the tooth being treated; in the present case, this means the original scan with the existing tooth.

At the next step, we simulate the surgical procedure on the screen. The implant is inserted digitally and then a template of the procedure is exported. The conditions of the alveolar bone can be assessed to determine the bone's fitness for the planned procedure. If necessary, the alveolar bone may be adjusted, for instance by planning a bone transplant. Alternatively, a compromise may be made and it may be preferable to opt for a cemented restoration or a change in the design instead. We take all the major decisions at the virtual implant insertion stage. The details can then be transferred to the clinical situation by means of the drill template. The position of the implant is established with the help of the wax-up (3 to 4 mm deeper). The implant angle and position should be selected so that the available bone structure can be used to optimum effect, without deviating too much from the specifications of the prosthetic restoration. In this case, the aim is to provide a screw-retained restoration. We are still using our "digital clone" to plan these steps. Once the preparatory steps have been completed, the drill template is printed (Fig. 5). In addition, the STL file of the implant model including the optimized alveolar cavity design and digital scan body (Fig. 6) are prepared to design the temporary restoration.



7 — Printed drill template (Mguide, MIS)

8 — Immediate temporary restoration

Designing the temporary restoration

The virtual implant model (Fig. 6) is imported into the construction software to design the abutment and/or temporary restoration. The crown-abutment interface should be placed in an optimum position in the previously prepared alveolar cavity. The Ti base has been defined at the time when the implant depth was determined during the implant planning step. In the present case, the implant has a depth of 3 to 4 mm. The optimum length of the Ti base is therefore 1.5 mm.

The temporary restoration is placed on a Ti base with free rotation to prevent potential problems caused by the implant index position.

Whether a screw-retained or cemented restoration is chosen is at the discretion of the dentist. We tend to prefer screw-retained restorations. However, the ultimate decision about which restoration to use can only be made at the point when the surgical intervention is planned. Whether the prosthetic restoration is made in one piece or as a hybrid crown is also at the discretion of the dentist. Hybrid restorations are normally preferred in esthetically demanding situations and one-piece restorations in the posterior region.

Surgical phase

All the items required for the surgical intervention have been prepared and are now ready for use: This includes the printed drill template (Fig. 7) and the temporary implant restoration (Fig. 8). Tooth 12 is now extracted atraumatically in the "real world" (Fig. 9). Immediately afterwards, the fit of the drill

9 — Atraumatic tooth extraction

10 — Implant insertion (NP implant, MIS) with drill template

11 — Drill template and implant after insertion

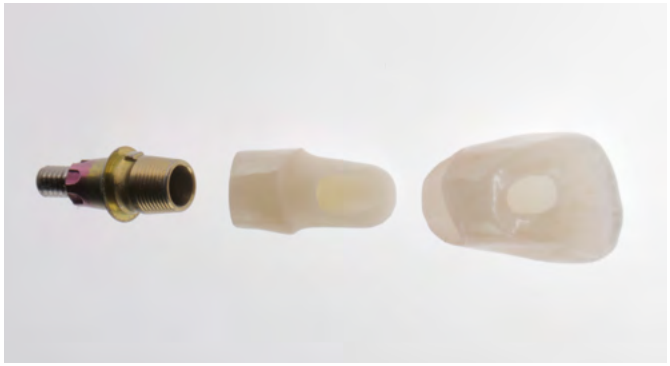
12 — Temporary restoration after the surgical intervention

template is checked in the oral cavity and the implant is inserted according to the drill protocol (Fig. 10). This is followed by the augmentative measures planned in advance and finally, the temporary crown is screwed on (Figs 11 and 12).

Prosthetic restoration

After a healing phase of at least eight weeks, the temporary restoration is removed and the design is copied. This is the first time in the entire procedure that the actual scan body is used (Fig. 13). The scan body assists in recording the position of the implant. This position corresponds to the originally planned position and also reflects the implant index position. This method ensures the accuracy of the restoration procedure. The transgingival areas have already been formed at the time of the temporary restoration. In the present case, the thickness of the gingival tissue should be additionally increased. For the final restoration, a Ti base of the same length as the one for the temporary restoration is used. This time, however, the base features an anti-rotation lock. A large selection of materials is available for the final restoration. We normally use hybrid restorations for the restoration of single implants. Here, the restoration consists of a monolithic zirconium oxide abutment (Zenostar) and a monolithic multi-shaded

13 — Clinical situation with scan body



14 — Implant prosthetic restoration

15 — Close-up of the final situation

16 — Portrait image after completion of the restoration

all-ceramic crown (IPS e.max ZirCAD MT Multi). The restoration is characterized with stains and completed without any shape modifications (Figs 14 to 16).

Conclusion

Errors can be avoided by planning the intervention on a "digital clone" and preparing any auxiliary and therapeutic devices ahead of the actual surgical procedure. If this approach is used, suboptimal implant placement – both prosthetically and surgically – can be detected and corrected in advance. In addition, necessary augmentative measures are already evident at the planning stage and can be prepared accordingly. This way, "surprises" during the intervention on the patient can be avoided as far as possible. This brings a high level of reliability and certainty to the treatment process.

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