

A teal-colored dental crown is shown on the left, and a wax model of a tooth is on the right. The background is a solid teal color.

# reflect

01 / 2017

## 14

### Many ways with one material

Challenge: Three teams seek to solve a real case in Vienna

### 06 From digital planning to the mock-up and final restoration

Presentation of a modern work concept on the basis of a veneer fabrication

### 20 The exact reproduction of natural dentition

All-ceramic crowns in a complex anterior restoration

The logo for Ivoclar Vivadent, featuring a series of colored dots above the text "ivoclar" and "vivadent" in blue, with a registered trademark symbol. Below the text is the tagline "passion vision innovation".

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passion vision innovation



## Editorial

### Dear Readers

The world seems to be spinning faster than ever. In many areas of life, major changes are on the horizon. New technologies and their intelligent interlinkage have been game-changing in many branches of industry and have catapulted young companies forward. Prominent examples include the digital TV and video entertainment network Netflix, Uber transport services, and the online accommodation provider Airbnb. Apart from that, there are several less well-known young companies that are revolutionizing the market with their unprecedented approaches. One example: With data obtained via satellites, valuable prognoses can be made on the development of real estate prices in certain regions or even on the future prices of raw materials. Moreover, in the field of robot technology, a breakthrough is imminent. It will make our life easier, safer and more convenient. We human beings are at the centre of these developments.

Our aim is, with the help of the dentists and dental technicians around the globe, to give people a beautiful smile – by delivering highly esthetic restorations. Digitalization opens up new opportunities. Apart from providing esthetic and efficient solutions for patients, we strive to assist our dentist and dental laboratory customers in developing the full potential of their creativity and finding joy in their work.

At IDS, we presented the new category brand of Ivoclar Digital together with the related product portfolio. With this new product offering we intend to remain one of the leaders in the development of innovations. Communication and training and education are becoming increasingly important. We look forward to joining forces with you in shaping the dental future.

With this issue, Reflect presents itself in its new layout for the first time. We have also redesigned the content of the magazine. In the future, you will find interviews and background reports on exciting dental topics in Reflect, in addition to case reports. Moreover, there is a closer connection between the offline and online content. This means that you can now also read the highlight article online - featuring extensive photo spreads and video interviews. See for yourself!

Regardless of whether you prefer to enjoy Reflect offline or online – I wish you much reading pleasure!

Best wishes

A handwritten signature in black ink, appearing to read 'Diego Gabathuler'.

Diego Gabathuler  
Senior Director Sales West & South Europe, Middle East & Africa





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## Many ways with one material

Challenge: Three teams seek to solve a real case in Vienna



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[You are most welcome to read our lead article "Many ways with one material" by Dan Krammer \(p.14 et. seq.\) online: reflect-digital.ivoclarvivadent.com/en](https://reflect-digital.ivoclarvivadent.com/en)



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# The future of dentistry is digital



Setting a course for the future of dentistry on 800 square metres

An interview with Armin Ospelt, Senior Director Global Marketing, Schaan/Liechtenstein

The 37<sup>th</sup> IDS (International Dental Show) attracted a record number of visitors and was a real sensation, with numerous innovations on display. Around 2,300 exhibitors from 60 different countries took advantage of this unique event to present their products and services to a professional audience. Ivoclar Vivadent was one of the exhibitors. On 800 square metres of exhibition space, the company showed where the future of dentistry is headed. Armin Ospelt, Senior Director Global Marketing, talks about the trade fair in the following interview.

*Mr Ospelt, how would you describe IDS 2017 in a nutshell?*

Once again IDS set new standards in the dental industry. The exhibition delegates were given the opportunity to discover exciting new products. They obtained fascinating insights into the dental world of today and tomorrow. The show itself and our booth in particular were immensely popular. It was overwhelming.

*What awaited the visitors at the Ivoclar Vivadent booth?*

Ivoclar Vivadent repositioned itself for IDS 2017. In addition to highlighting our time-tested conventional products and processes, we also focused our activities on the topic of CAD/CAM. In fact, we launched a new category brand called Ivoclar Digital, including several portfolio extensions. As a result, we are now able to offer complete digital workflows that meet the requirements of dental technicians and dentists.

*What brought about this new direction?*

After acquiring the German company Wieland Dental in 2013, we felt that it would only be logical to establish a unified image and consolidate the products and know-how of both companies by creating an additional portfolio, which could then be consistently further developed. Ivoclar Digital is the new digital partner for dental technicians and dentists in every step of the digital process chain. At IDS 2017, this new approach was not only visible in the products and processes we presented, but also in the look of our booth, which had grown as a consequence, but was still located in its accustomed spot in Hall 11.3. The ultra-modern booth was set on 800 square metres and provided ample space for the 160 highly motivated members of the company's exhibition team. It gave us the opportunity to set a course for the future not only in terms of technology but also of atmosphere.

### *What exactly did you present to the visitors?*

In the new section of our booth dedicated to Ivoclar Digital, we showcased our digital expertise and our new product portfolio related to this brand. The CAD/CAM portfolio comprises scanners, software, materials and milling machines. At the exhibition, we focused our attention on the four milling machines of the new PrograMill line. These state-of-the-art machines are setting a new benchmark in CAD/CAM technology. They enable dental technicians and dentists to manufacture restorations quickly and easily using digital processes. The PrograMill units are coordinated with the desktop and intraoral scanners from 3Shape, which were also on show at our booth. Of course, we also presented our successful IPS e.max® materials system: lithium disilicate glass-ceramics on the one hand; zirconium oxide on the other.

In addition, we took advantage of the fair to inform the visitors about our extensive service offerings. Our digital expertise and our digital product portfolio are rounded off by Service+, which provides support services. Service+ is an outsourcing partner for every lab. It assists laboratories in entering our dental CAD/CAM world by carrying out designing and manufacturing jobs. This gives them the possibility to extend their spectrum of materials and indications and increase their productivity and flexibility in the choice of manufacturing methods. We furthermore conveyed our commitment to providing our customers with education and training opportunities and other services.

Finally, I would like to mention that Kapanu AG, a Swiss start-up, presented its latest developments at our booth. The company is specialized in augmented reality technology for esthetic restorative dentistry. Kapanu and Ivoclar Vivadent have joined forces on developing digital dental applications that will link the real world to the digital world. They gave a preview at our booth.

### *Did your company introduce any innovations in other fields?*

We successfully presented new products in all of our areas of expertise. In the Direct Restoratives segment, we focused on the composites of the Tetric family of products. Adhese Universal and the Bluephase Style curing units also played a significant role. The Cervitec products were the highlight of the Professional Care segment. As far as Fixed Prosthetics were concerned, we concentrated on our all-ceramic system IPS e.max and the proven press technique as well as on the Programat furnaces and the Variolink Esthetic luting composite. The new SR Vivodent S DCL/SR Orthotyp S DCL tooth lines took the spotlight in the Removable Prosthetics segment.

### *What interested the delegates in particular?*

The visitors to our booth were predominantly interested in our innovations and our new digital portfolio. They were excited to find out about the efficient and at the same time easy processing methods available to their laboratories and practices. The other areas of our booth were also highly frequented. In addition, our fantastic stage presentations attracted many spectators. We are highly satisfied with the response.

### *In which direction do you think is the dental world developing?*

The topic of digitization continues to grow in importance. This trend was not only evident at our booth. It has established itself throughout the dental industry and is gaining momentum. As is the case in many areas of our lives, the need to accomplish things at a consistently faster rate and higher standard with as little effort as possible is increasing. Growing expectations with regard to efficiency and – in our industry – esthetics have to be met with products and processes that need to comply with rising standards in terms of their reliability in particular. In the dental industry, the keywords in this context include process safety and reliability as well as the predictability and reproducibility of results. Consequently, digital processes have become indispensable. The dental industry is compelled to further develop this technology for the benefit of product users and patients. I'm convinced that the dental future is digital.

*Mr Ospelt, thank you very much for this interview.*



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# From digital planning to the mock-up and final restoration



Presentation of a modern work concept on the basis of a veneer fabrication

A report by Cyril Gaillard and Jérôme Bellamy, Bordeaux/France

“Never promise what you can’t deliver!” Particularly when undergoing esthetically motivated dental treatment, patients should be given a realistic visualization of the final outcome to avoid raising undue expectations.

The demand for cosmetic treatments is also increasing in dental practices. Today’s communication media provide patients with virtually limitless access to a wealth of information on this topic. And with it comes an increase in expectations. This can pose a conundrum to the dentist: patients want to be promised the desired results yet they should not be given undue expectations in the run-up to the treatment.

## The challenge

One of the challenges in day-to-day dentistry is the fact that the mock-up presented to the patient is produced from a wax-up and is often not consistent with the final outcome of the treatment (e.g. ceramic veneers). Several research studies have been initiated to overcome this problem. The SKYN concept is a result of this research.

## The solution

The SKYN concept is based on a unique approach: it uses natural tooth shapes to create a mock-up directly in the patient’s mouth. A wax-up is created on the basis of tooth shapes that reflect the anatomy and morphology of natural teeth in terms of height, width, curvature and surface texture. The predictability of the result is ensured by using CAD/CAM

technology to scan the mock-up, make adjustments in the oral cavity and then mill the veneers to achieve lifelike results. The reproducibility of the mock-up and the accuracy of the result arise, among others, from the performance of the CAD/CAM system, allowing the expectations of the patient to be met both promptly and effectively.

CAD/CAM technologies have brought about a revolution in dentistry. They enable the efficient manufacture of customized ceramic veneers with high accuracy and within a short period of time.

Furthermore, the restorations present an accurate copy of the esthetic wax-up. The different working steps involved in the SKYN concept are demonstrated below on the basis of a clinical case.

## Clinical case

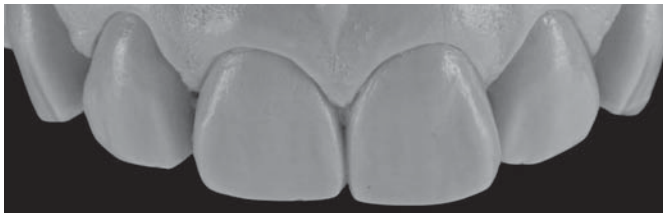
### Preoperative situation

The patient visited the practice with a request that mainly concerned esthetic criteria. She felt that her anterior restorations looked too yellowish and their shape did not fit in. The restorations had been in her mouth for several years. They should now be replaced.

First, a series of digital pictures was taken to examine the situation more closely. The patient had a high smile line. However, the fact that her gums were visible when she smiled and her upper lip was asymmetrical did not bother her (Figs 1a and b). The periodontal apparatus was healthy. The soft tissues did not show any signs of abnormalities either.



**01a and 01b** — Preoperative situation. Severely stained restorations in the upper anterior region. It does not bother the patient that her upper lip is asymmetrical and her gum line is visible when she laughs.



**02** — SKYN models (according to Dr Jan Hajtó) for the fabrication of the wax-up



**03** — The composite (IPS Empress Direct) is applied into the silicone key.



**04a and 04b** — The composite veneers created with the help of the silicone key show a natural shape and surface texture on the model.

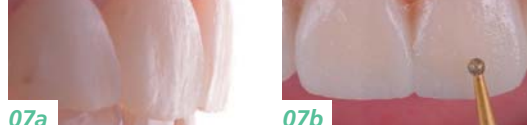
## Treatment planning

We recommended the patient to have the anterior region restored with veneers stretching from teeth 15 to 25 and advised her to have the premolars included in the restoration to achieve a harmonious appearance. The patient agreed with our proposal. We drew up the following treatment plan:

- Wax-up using composite veneers to reproduce the natural shape and texture of the teeth
- Mock-up according to the SKYN concept using a light-curing nanohybrid composite (IPS Empress® Direct)
- Intraoral digital data scan of the mock-up
- Preparation of the teeth with the help of the mock-up
- Digital impression of the preparation using an optical camera
- Fabrication of the temporaries
- Machining of the glass-ceramic veneers (IPS Empress CAD)
- Incorporation of the veneers



**05** — The mock-up is placed in the mouth. The surfaces are being reworked slightly.



**06** — Completed mock-up. Photos and videos are used to assess it.

**07a and 07b** — The surfaces of the mock-up are being reworked slightly.

## Fabricating the wax-up

The aim of the ceramic veneers was to give more volume to the teeth. The teeth should appear stronger and longer. Adjusting the dental proportions was requisite to creating a harmonious appearance between the teeth and the smile on the patient's face. To create the wax-up, we used the SKYN models ("Anterior Model Set" by Dr Jan Hajtó) as reference (Fig. 2). This is a reproduction of natural teeth. Upon request by the patient, tooth selection was performed with the help of both the DSD program (Digital Smile Design) and the VisagiSMile design and visualization software.

## Transfer to the mock-up

We created a silicone key of the vestibular surfaces with the help of the wax-up and applied a thin layer of composite material into the key using a spatula (IPS Empress Direct) (Fig. 3). Once light cured (Bluephase® with Polywave® LED), the resulting composite veneers for teeth 15 to 25 were placed on the model and stabilized with wax (Fig. 4). Once the wax-up was finalized, it was duplicated and cast in stone. We created a silicone key from this model to assist the dentist in the preparation of the teeth. The silicone key was created in two steps using two different silicone materials, one with a high hardness (Silico Dur, Cendres+Métaux) and the other with a low hardness (3M ESPE Express). The silicone key served to create the mock-up and the temporaries.

## Tooth preparation and data transfer to the lab

The mock-up was inserted with the help of the silicone key and the surface texture was reworked using a polishing system (Astropol®) (Fig. 5). The esthetic effect was validated with photographs and videos. The patient could also inspect the pictures (Figs 6 and 7). Then, the teeth were prepared using a ball-shaped bur whilst the mock-up was in place (Galip Gurel 2003) (Fig. 8). This procedure meets the requirements of minimally invasive dentistry. An impression of the prepared teeth (Fig. 9) was taken using an intraoral scanner and the temporaries were fabricated with the help of the silicone key.



**08** — Targeted preparation of the teeth with the mock-up in place



**09** — Close-up of the prepared anterior teeth



**10** — The CAD data of the digital impressions of the prepared teeth and the mock-up are superimposed.

At this point, the dentist is required to take two optical impressions: first, an impression of the prepared teeth and, second, an impression of the temporaries in the mouth. In addition, a conventional silicone impression of the prepared teeth is taken. The dental technician will use this impression to produce a physical model to check the fit and contact points of the milled ceramic veneers.

### Creating the final restoration

For the CAD construction, the two data sets (temporaries, prepared teeth) were superimposed in the software (Fig. 10).



**11** — Veneers ready for placement

Subsequently, the shape of the temporaries was matched to the preparation margins. Each component was examined (preparation margin, thickness, contact points, etc.) separately before the data was transmitted to the milling unit for machining (Fig. 11). For the fabrication of the veneers, we decided to use the IPS Empress CAD Multi blocks, which feature a lifelike shade transition from the dentin to the incisal. We selected a block in shade A1. Each veneer was positioned in the block in such a way that the translucency of the incisal area matched our requirement. Once the veneers were milled, we checked their fit on the prepared dies of the model and assessed their contact points with each other. The surface texture was lightly reworked (Fig. 12). To achieve a highly esthetic result, we additionally characterized the veneers with Stains and Essence materials (IPS Ivocolor®) before we glaze-fired them (Fig. 11).

### Seating the ceramic veneers

At the try-in, the shade and fit were checked. All ten veneers showed an excellent fit in the mouth. The next step was adhesive bonding. Prior to the bonding procedure, a rubber dam was placed to isolate the treatment field and keep it



**12** — Restorations on the model after CAD/CAM-supported fabrication of the ceramic veneers



**13** — Adhesive cementation of the ceramic veneers with a rubber dam in place





14

14 — Close-up of the veneers after seating

15 — Texture and tooth shape look natural and harmonize with each other.



15



16 — Lip appearance and portrait picture (below) with the completed restorations. The expectations of the patient have been met.

dry. As the natural teeth were not discoloured, we were able to use a translucent luting composite (Variolink® Esthetic) to insert the veneers (Fig. 13). The veneers were seated using the following protocol:

- The restorations were etched with hydrofluoric acid for 60 seconds, rinsed under running water and dried with compressed air.
- The veneers were then conditioned with silane. A universal primer (Monobond® Plus) was applied, allowed to react for 60 seconds and dried.
- The prepared teeth were etched with 37% phosphoric acid gel (Total Etch) and rinsed.
- Fluoride-releasing Excite®F DSC adhesive was applied (without light-curing).
- The veneers, which were coated with luting composite, were seated.
- The luting composite was tack-cured for 1 to 2 seconds (Bluephase with Polywave LED) to facilitate the clean-up of excess luting composite.
- Final light curing of all veneers for 40 seconds
- Removal of the rubber dam and occlusal check. At the last step, the restorations were polished.

The ceramic restorations show an appealing esthetic appearance in the mouth and harmonize beautifully with the smile of the young patient. The planned situation was accurately transferred to the final restoration (Figs 14 to 16).

## Conclusion

Modern materials in esthetic dentistry allow pleasing results to be achieved with considerably more ease than before. It may be considered a substantial progress that the resulting restorations meet not only high esthetic requirements but also essential functional criteria. State-of-the-art planning tools, digital auxiliaries, CAD/CAM-supported manufacturing and promising materials lead to excellent results and ensure high patient satisfaction. However, never mind the CAD/CAM technologies, the skills and experience of a seasoned dental technician will remain indispensable.



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# A convincing duo: zirconium oxide and fluorapatite glass-ceramic



Monolithic design and veneered framework components in a complex restoration

An article by Dr Torsten Seidenstricker, MSc, Allaman/Switzerland, and Dominique Vinci, Petit-Lancy/Switzerland

In many ways, the symbiosis of different procedures and materials allows simplified and safe work. The individual advantages are intelligently combined.

This patient case demonstrates on the one hand how a monolithic zirconium oxide framework can ensure stability and function in a complex prosthetic restoration. On the other hand, the ceramic veneering of the vestibular surfaces gives the restoration natural light-optical properties. This contributed towards the very pleasing final results.

## Starting situation

A 60-year old patient came to the dental practice as an emergency case. In addition to esthetic and functional problems, there was also severe periodontal damage. The treatment began with an in-depth diagnosis and an informative consultation. First, the teeth 25, 26, 14, 16, 11 and 12 were extracted. Then, the periodontitis was targeted. Treatment of the periodontitis was successfully completed approximately 13 months later. Implants needed to be placed in the regions 11, 12, 14, 16, 25 and 26. The clinical situation meant that all teeth in the maxilla and some teeth in the mandible had to be restored.



01 — The situation after the implants in the maxilla had healed. All-ceramic restorations were planned.



02 — Diagnosis according to photos in a design software

## Planning and temporization

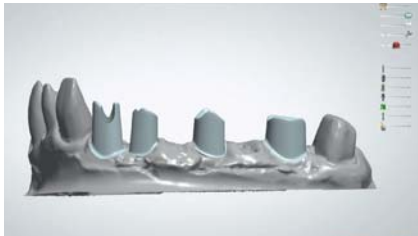
Before starting such an extensive prosthetic reconstruction, photo documentation of the oral situation and the patient's face is essential. Primarily, the photos help in assessing the axes and planes in terms of optimum esthetics and function. We work with a 3D design software (Digital Smile System, DSS). This tool enables us to simulate the possible results virtually. Another advantage of this software is that the photos can be used in the CAD software whilst the restoration is being produced.

The teeth to be extracted were removed from the situation model and the remaining teeth were prepared using the information provided by the dentist. On this foundation, we designed a wax-up with the CAD software (3Shape) and then transferred it into wax. This was the basis for a matrix made from transparent silicone, which was sent to the practice. After the dental preparation was complete (implant placement, preparation, etc.), the matrix was filled with an auto-polymerizing temporary composite (e.g. Telio C&B) and a temporary restoration was produced and then inserted into the mouth. The temporary restoration served as a dental prosthesis during the implant healing phase and it also allowed us to determine whether the situation, which



**03a and b** — The master model with the gingival mask in the articulator

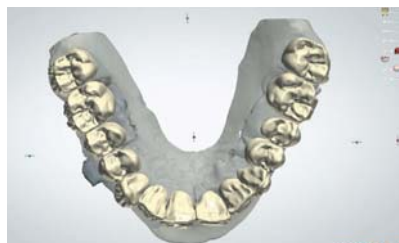
**04** — The upper wax-up in the planned final situation



**05a and b** — CAD construction of the abutments



**06** — The CAD/CAM-fabricated abutments (hybrid abutments) are screwed onto the implants.



**07a and b** — The CAD framework construction after the buccal areas had been cut back.

was planned in the laboratory, harmonized in a functional and esthetic manner in the patient's mouth. The patient wore the adapted temporary restoration for approximately six months up to the osseointegration of the implants.

The implant abutments were milled from a new translucent zirconium oxide (IPS e.max® ZirCAD). Before sintering, we stained the cervical areas of the frameworks. We used a liquid with a warm yellow tone for the infiltration. After sintering, the implant abutments were adhesively bonded to the titanium bases (TiBase, Straumann) with a luting composite (Multilink® Hybrid Abutment, shade HO), specifically designed for this indication. The self-curing composite provides excellent adhesion qualities. After adhesive bonding, the abutments could be integrated.

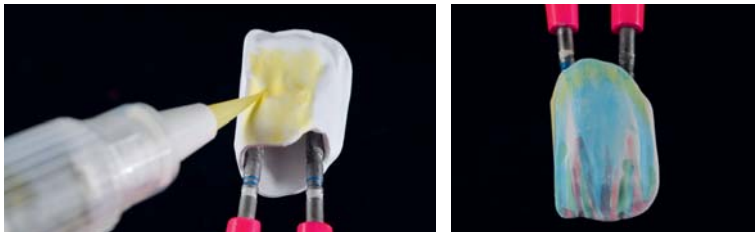
## The production of the final dental restoration

### The implant abutments

The wax-up was positioned on the master model and adapted based on the patient's and dentist's feedback. A double scan followed. We digitized both the model and the wax-up using the laboratory scanner. Subsequently, the implant abutments were produced via CAD/CAM.

Note: During the CAD design of the abutments, amongst other aspects, the parallelism of the surfaces was taken into consideration. The fit of the milled objects is very accurate; our experience has shown that an angle of 7° to 10° is ideal.





**08a and b** — Colouration of the zirconium oxide before sintering

Note: The adhesive bonding of the titanium base must be prepared very carefully in order to avoid errors or incorrect placement.

### Producing the framework

The following restorations were planned for the final prosthetic restoration:

1. a bridge in the region 11 to 13,
2. a bridge in the region 14 to 16,
3. a crown on tooth 17,
4. seven single crowns on the teeth 21 to 24 and 27 as well as in the region 25 and 26.

**09** — The zirconium oxide frameworks prepared for veneering in the buccal area



**10** — The ceramic build-up in the anterior region (IPSe.max Ceram)










**11** — Prepared for the second firing. Finely detailed adjustments in the shape and morphology



We designed the tooth shape and the occlusal morphology in full anatomical contour in the CAD software. The buccal surfaces should be built-up in ceramic in order to achieve optimum esthetics. In preparation for this, the software performed a cut-back. After the framework design, the individual elements were milled from zirconium oxide (IPS e.max ZirCAD). The material used has interesting mechanical properties which, amongst other qualities, guarantee the long-term stability of the restorations. The selected shade "LT sun" offers a light chroma, which matches perfectly the envisaged A-shade restorations. After milling the frameworks, we corrected the morphology slightly and paid particular attention to the interdental areas.

For top esthetic results, we infiltrated the frameworks with the special IPS e.max ZirCAD LT colouring liquids before sintering. In the incisal and occlusal areas, the chroma was increased and the translucency was adapted in the appropriate areas. As only the buccal surfaces are veneered in this case, the framework volume is relatively solid. We always

#### The ceramic materials (IPS e.max Ceram) for veneering the buccal areas:

-  Cervical Transpa orange-pink with Special Incisal yellow 50 % & Transpa Neutral 50 % Power Dentin A2
-  Power Incisal I for more brightness on the transition lines
-  Transpa blue 50 % and Opal Effect 1 50 %
-  Transpa orange-grey to create a contrast in the incisal area
-  Transpa orange-grey with Special Incisal yellow on the incisal edges
-  Transpa neutral
-  Transpa clear 50 % and Opal Effect 1 50 %
-  Power Incisal 2





12a



12b

**12a and b** — The finished restorations. The vestibular areas were layered individually. In the occlusal and palatal areas, the framework was designed in full anatomical contour.



**13** — Natural looking translucency with internal shade effects

carry out a slow sintering procedure (nine hours) in our laboratory with complex restorations, such as the reconstruction presented here. Subsequently, the surfaces of the monolithic zirconium oxide parts were polished and special attention was paid to the occlusal areas. For polishing, we used polishing cones from Shofu or Anaxdent. These cones guarantee thorough polishing, so that the surface can subsequently be easily polished to a high lustre. We do not use silicone cones or discs as they leave residues on the surface, which makes the application of glazing materials difficult. The areas which are difficult to access during polishing are covered with a thin glaze layer. This was followed by a restoration try-in in the patient's mouth. The dentist checked the occlusion and function.

## Veneering

After conditioning of the framework parts to be veneered, a fluorescent liner (IPS e.max Ceram ZirLiner) was applied; this gave the restoration fluorescence from the depths in order to achieve light effects resembling that of the natural dentition. Non-fluorescent materials (e.g. pure zirconium oxide) appear dull and dark. Since the framework was already coloured, we opted for a clear liner. This additionally enhanced the light transmission and contributed to the adhesion of the ceramic veneer to the zirconium oxide. A classic ceramic veneering build-up was then carried out. We used a special indicator (SmileLine, Switzerland) to mix the ceramic powder in order to differentiate the individual materials better. The IPS e.max Ceram range includes Power materials, which provide an increased level of brightness, in particular for translucent framework materials. In this case, we decided to use the Power materials. A further great advantage of the IPS e.max Ceram material is its excellent stability. The individual areas do not merge during the build-up of the ceramic veneer, so that the exact desired effects can be achieved. In order to achieve the correct shape, morphology and liveliness, a second firing was necessary. The restorations were then glazed and finished. We like to use the glaze material (IPS Ivocolor® fluo) in a creamy consistency.



**14** — The all-ceramic restorations look very natural and vital in the mouth.

## Conclusion

In the design illustrated above, only the buccal surfaces of the otherwise monolithic zirconium framework are veneered. An esthetic and durably stable result is achieved with relatively minimal effort. The qualities of the materials are used to their full advantage. These include:

- the excellent light-optical properties of IPS e.max Ceram, in this case especially the Power materials,
- the high strength of zirconium oxide,
- possibility of colouring the zirconium oxide (to achieve a warmer colour effect. White zirconium oxide is far too bright for this type of restoration. Reducing the degree of brightness would have been difficult in view of the low thickness of the veneering ceramic),
- the low amount of ceramic material (this allows minimal controlled shrinkage and ensures easy handling).



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# Many ways with one material



Challenge: Three teams seek to solve a real case in Vienna  
An article by Dan Krammer, Fuchstal/Germany

Recently, nineteen dental technicians from all over the world and one dentist from the Czech Republic convened at the International Center of Dental Education (ICDE) in Vienna. They were invited by Ivoclar Vivadent to take part in a very special educational session, where they were given the opportunity to compare their expertise with other seasoned dental professionals. The title of the challenge was “One aim, three solutions”; the material they would be using was IPS e.max.



At this unusual event, twenty participants were asked to treat a real patient by using three different treatment approaches. At the end of the session, the patient had to decide which type of restoration she preferred: the IPS e.max® CAD restoration made with a chairside method and completed by the dentist; a conventional CAD/CAM-fabricated restoration; or a restoration made of IPS e.max Press. The attending dentist and representative of the chairside approach, Dr Petr Hajný looked like he was going to break out into a sweat once he fully understood the implications of this challenge. The contenders were not to be underestimated. His preliminary

work and the needs of his patient would set the standard for his fellow contestants (Figs 2 to 3g). In actual fact, the task turned out to be more complex than was initially anticipated. A wide array of fabrication options was available. The participants were able to choose between IPS e.max CAD (lithium disilicate); highly translucent IPS e.max ZirCAD (zirconium oxide) either in monolithic or anatomically reduced form, ground or milled; or IPS e.max Press full-contour or anatomically reduced pressed and subsequently stained/veneered restorations; or a combination of all these versions. The choice was extremely wide because of the exceptional versatility of



**01** — Before the case is presented, Hannes Meischl, Technical Trainer of the ICDE in Vienna, describes the dental laboratory procedure and the available materials and equipment.



**02** — Dr Petr Hajný, a dentist and dental technician who hails from the Czech Republic, describes the case and its challenges. The task is to restore the patient's teeth 13 to 23 with all-ceramic crowns.

the all-ceramic product portfolio of Ivoclar Vivadent (Fig. 4). For those of you who find your head spinning at the thought of all these possibilities, you will be relieved to know that the solution actually turned out to be quite simple.

This contest offered a number of possibilities for comparing different methods, such as the CAD/CAM and the conventional fabrication techniques, and analyzing them according to a number of critical aspects. Nevertheless, the patient would be the deciding factor in this challenge. She would be the one who would make the final decision, irrespective of whether the restoration was fabricated chairside, stained, veneered or fabricated with the conventional or CAD/CAM technique.

Which group would get the job done first? The conventional or the CAD/CAM representatives? The dental technicians or the dentist? And at what esthetic price?

All these issues would be addressed and the debates over many different matters resolved. Could the simplest restoration perhaps be the most attractive one? How important is the number of powders and colours that are used? What is the significance of the shape and surface structure of the restoration for the overall esthetics? How important are listening skills to find out what the patient really wants?

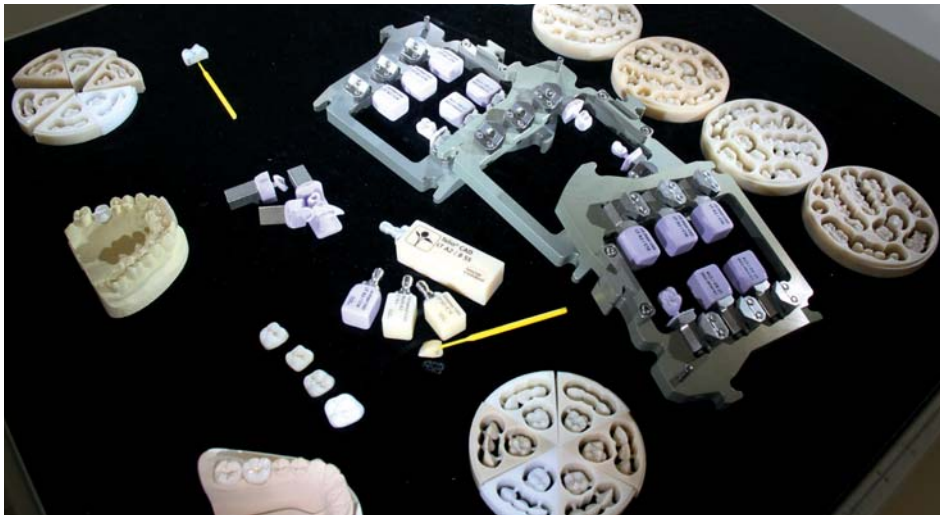
In any case, the event offered the participants a wonderful opportunity to find out all the answers to these questions and more from the most important person in this case: that is, the patient.

Now, let's join the contestants at the ICDE in Vienna (Fig. 5) and accompany them on this exciting journey ... (Figs 6 to 41).



**03a to 03g** — Dr Hajný shows photos of the preoperative situation. He highlights the esthetic failings of the old restorations on the central incisors. In order to enhance the esthetic appearance of the new restoration, the patient agrees to have tooth 12 and 13 and tooth 22 and 23 included in the restorative treatment strategy. The three groups – conventional laboratory, CAD/CAM laboratory and CAD/CAM chairside – are allocated a specific time in which to fabricate the all-ceramic restorations for teeth 13 to 23. The old crowns are removed from tooth 11 and 21. Tooth 11 is shown to have been restored with a metal root post in the past. Dr Hajný masks the post with opaquer to adjust the shade.





**04** — The materials portfolio from Ivoclar Vivadent is immense. Therefore, the selection and combination possibilities are extensive. While this stage is easier for the conventional group, since they are using IPS e.max Press and the associated ingots, the CAD/CAM team should also be thinking about using monolithic and individually characterized IPS e.max ZirCAD zirconium oxide restorations.



**05** — Ready, steady, go: At ten o'clock sharp the participants are allowed to see the models of the case. These include a study model of the provisionally restored upper jaw and a silicone matrix, a saw-cut model of the prepared upper jaw as well as model of the lower jaw.



**06** — The CAD/CAM laboratory group has selected the digitalized situation and generated the case in the system. In other words, the teeth to be restored and the restorations have been defined in the software. The picture shows Davor Markovic studying the case.



**07** — The dental technicians provide the photographer with a lot of very interesting material. The dies are prepared for the creation of the restorations and the silicone matrices have been adjusted accordingly.



**08** — The patient is prepared for the digital capturing of the intraoral data in the practice facilities of the ICDE in Vienna. Dr Petr Hajný, the dentist, and Vjekoslav Budimir, the dental technician, prefer to pursue a digital approach. As a result, scans are conducted with two different systems.



**09** — Dr Petr Hajný and his assistant scan the patient's jaw with the CEREC Omnicam (Dentsply Sirona), an intraoral dental scanner which, like the Trios machines (3Shape), does not use powder. He takes advantage of chairside workflows to design the crowns and mill them from IPS e.max CAD MT A1.

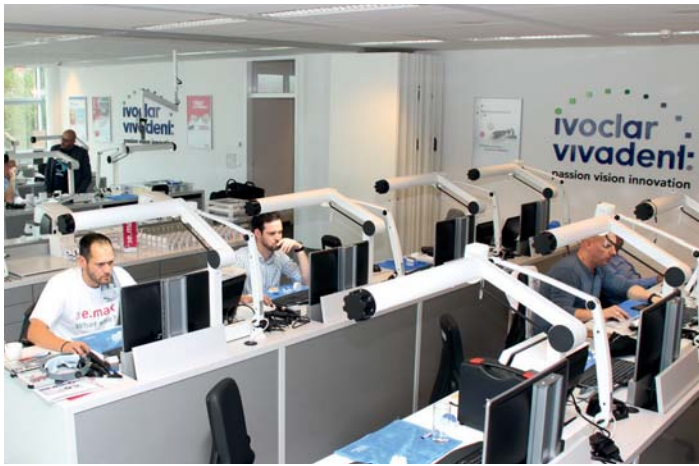


**10** — CAM software of the Wieland Zenotec select CAD/CAM system with the IPS e.max block in the block holder

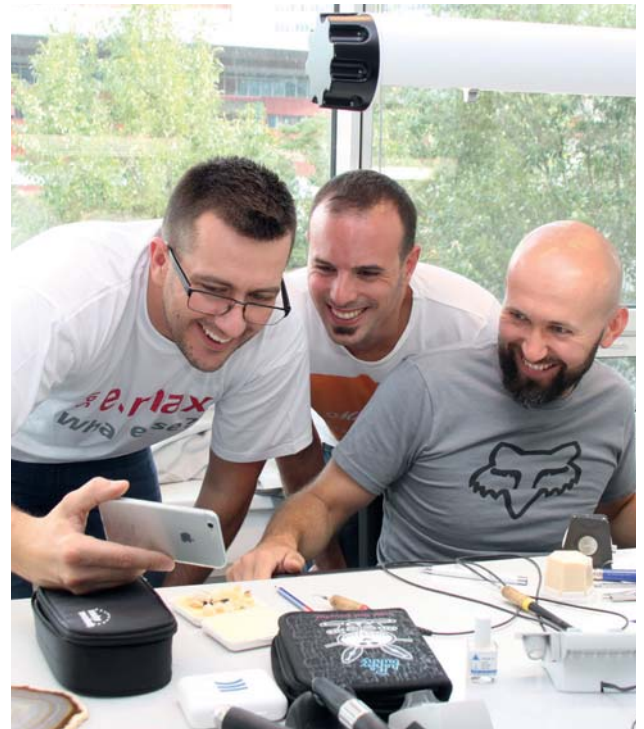


**11** — Completed, milled crown made of IPS e.max CAD MT blocks in the CAD/CAM milling machine





12 — Busy and highly concentrated contestants in the training laboratory of the ICDE in Vienna: The CAD/CAM group in the front and the conventionally working group at the back.



13 — There's also time to have some fun. The contestants from the different teams and countries get on very well with each other.



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14 to 17 — The modelled crowns, reduced crowns and frameworks are conventionally invested, placed in the pre-heating furnace, pressed, divested and then completed. The participants are well-versed in this technique and achieve the desired results in no time at all.



18 — “Look, I’m a human milling machine!” Velimir Žujić (right) jokes around with Vinko Iljadica and Alen Alić (left).



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19 and 20 — Manual finishing techniques: Velimir Žujić sprinkles dentin powder on an IPS e.max Press framework that has been coated with IPS Ivocolor® Mixing Liquid allround. In the wash firing cycle, the bond is reinforced and produces a sound base for the subsequent ceramic layers.

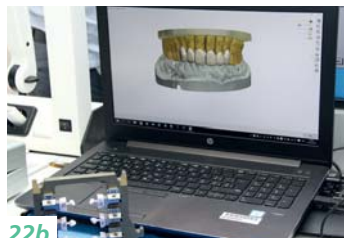


21 — Irrespective of whether a conventionally or CAD/CAM-fabricated framework is used, these types of restorations, in contrast to monolithic ones, have to be manually layered and fired multiple times.





22a



22b

**22a and 22b** — From the computer to the hand: Some of the technicians of the CAD/CAM group decided to choose the monolithic route. Nevertheless, they are doubtful about being able to outcompete the manual group. They would have to wait until the end to find out if their doubts were justified.



**23** — Dr Petr Hajný adds fine surface details to his milled lithium disilicate crowns before he finalizes them in a modified crystallization and glaze firing cycle. His chosen workflow makes him the fastest contestant and leaves him with enough time to take care of other business.



24a



24b

**24a and 24b** — The press technique is also highly efficient when the restorations are pressed to full-contour and then minimal layers are applied to add fine details. Since only a minimum amount of layering ceramic is applied, there is hardly any shrinkage and the results are highly predictable.



**25** — The contestants in the conventional group brought out the best in the IPS e.max materials. Here, one of the participants builds up the incisors to full contour on IPS e.max Press MO frameworks.



**26** — Technical talk: Three members of the CAD/CAM group visit a colleague from the conventional group for a chat.



**27** — Checking the length and alignment of the all-ceramic crowns in the articulator. The marks on the wax-up serve as a guide. It's difficult to believe that all these steps can be accomplished by a machine.



**28** — Analog version of the try-in. A good first impression was obtained by just fooling around.



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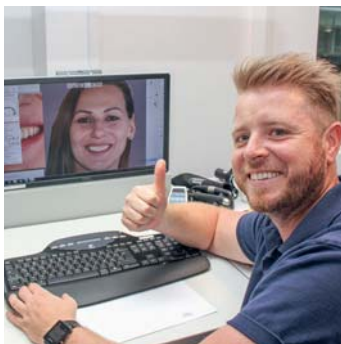
**29 and 30** — Ondřej Adam hard at work. In order to faithfully recreate the translucent edge of the lower front teeth in the upper jaw, he completely veneers the upper incisors. The result after the first firing cycle is shown in the picture.





**31 to 36** — Not to worry, the members of the CAD/CAM group aren't spending all their time staring at their computer monitors. They're also having fun and taking care of some steps manually. In the end, it's not the method that counts, but the result, which has to look as natural as possible.

**37** — Mission accomplished: Helmut Berger has incorporated his virtual creation into the picture of the patient in order to check the length and alignment of the teeth.



**38** — The day has come to an end and the excitement is palpable. Due to the large number of entries, the panel of experts including Christian Smaha (centre), a recognized Viennese dental technician, is consulted to help with the shortlisting process.



**39 to 41** — And the winner is ... the Slovakian dental technician Martin Ebringer from the conventional fabrication group. The patient immediately fell in love with his crowns. They are sparingly layered. Martin Ebringer focused on imitating the surface characteristics and the tooth shape. When he was asked about how he had managed to produce such a fantastic result, he simply said that he had talked with the patient and tried to create what she wanted: in other words, very bright, monochromatic teeth. Consequently, he tried to impart the teeth with a natural appearance by incorporating morphological details.



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# The exact reproduction of natural dentition



All-ceramic crowns in a complex anterior restoration  
An article by Yuji Tsuzuki, Kyoto/Japan

The wide variety of materials and manufacturing techniques available provide the ideal fabrication method for every indication. In combination with dental technical skills and a good understanding of shades and colours, this leads to outstanding restorations.

Imitating natural dentition is the greatest challenge in the fabrication of prosthetic restorations. A natural appearance is always determined by a number of different individual characteristic features, so the technique applied for the reproduction of the teeth cannot always be the same. This is the reason why it is essential for us to observe, learn and recognise fine details and continue to develop, step by step, every day. The basis for imitating nature is an understanding of the characteristics of healthy teeth and of ceramic materials. The reproduction of light-optical properties in particular is a challenge which requires an in-depth perception of colours. Properties such as light reflection, transmission and fluorescence contribute significantly to a successful result.

When imitating the light-optical properties, the basic structure consists of three different layers: translucent, semi-translucent and opaque. The surface colour is then applied based on a three-dimensional colour concept. Even though state-of-

the-art materials (e.g. polychromatic zirconium oxide) have become very popular due to advances in materials science, layering ceramic, built-up by hand, is still indispensable for esthetic restorations. In this article, well proven techniques will be presented based on two case reports. The wonderful IPS e.max® Ceram Selection Enamel and Effect materials were used together with the practical IPS Ivocolor® stains and glaze. Both situations proved to be a challenge in terms of the reproduction of light-optical properties. However, imitating nature is possible!

## Patient Case 1

### Starting situation and treatment plan

The approx. 50-year-old patient had suffered a fracture of the roots of teeth 11 and 21 as a result of an accident. The teeth could not be saved. After careful extraction, considerable resorption of the labial soft tissue was observed. After consultation, the patient opted for implant treatment. Prior to this, however, an "intervention" had to be carried out in the area of the labial soft tissue. The aim was to adjust the gingival contours, so that a perfect result could be achieved despite the high smile line ("gummy smile"). Due to the advanced soft tissue resorption, a removable implant superstructure made from gingiva-coloured ceramic was produced, taking esthetic and hygienic aspects into account.

The two upper central incisors occupy an important position from an esthetic point of view, since the prominence of these teeth expresses the patient's individuality. Furthermore, the central incisors are the starting point, which determine the continuity and the symmetry to the other teeth. Therefore, the restoration specifically requires these teeth to be unique and crafted carefully. In this case, from a prosthetic point of view, it was important to integrate the asymmetrical anterior teeth. The lower anterior teeth were crowded and there was no contact with the antagonists.



**01** — The situation after the implants in the regions 11 and 21 had healed.

**02** — The zirconium oxide framework. The translucency of the framework provides a good basis for the esthetics and shade effect of the restoration.







**03** — IPS e.max ZirPress G4 was used for the gingiva imitation. The basic opacity of the crowns was defined with IPS e.max Ceram Deep Dentin A3. Then, (1) IPS e.max Ceram Dentin A3.5, (2) IPS e.max Ceram Power Dentin A3.5 and (3) IPS e.max Ceram Selection Light Absorber fog (LA fo) and Light Absorber taupe (LA ta) were applied in a layered build-up. We were able to create a wonderful contrast in the “ivory-coloured” layer.



**04** — Next, (4) IPS e.max Ceram Special Incisal grey and Cervical Transpa orange, (5) IPS e.max Ceram Selection Special Enamel quartz (SEqu) and IPS e.max Ceram Opal 2 (OE2) were applied to imitate depth within the neck of the tooth. For the characterization of the incisal edge we used: (6) IPS e.max Ceram Mamelon light, (7) IPS e.max Ceram Selection LA salmon, (8) IPS e.max Ceram OE 1, (9) IPS e.max Ceram Selection LA taupe, (10) IPS e.max Ceram Power Incisal and (11) IPS e.max Ceram Deep Dentin (DD) BL3+OE2.



**05** — In addition, the mamelons were applied directly in the labial and lingual areas. For this we used (12) IPS e.max Ceram DD A3 and OD orange, in order to achieve an illusion of depth to the incisal edge. Note: The translucency of an incisal edge is determined by the proportion of layered ceramic on the labial side and by a cut-back on the lingual side.

For functional integration, the upper anterior crowns had to be placed in a narrow mesio-distal area. The implants were inserted in region 11 and 21 taking surgical and prosthetic requirements into consideration. After osseointegration, the implants would be restored with a splinted, screw-retained all-ceramic restoration.

### Inspiration during the build-up

When building up all-ceramic crowns, the following steps must be carried out with great care:

1. Control of the opacity, which influences the brightness
2. Characterization of the incisal edge with translucent or opaque materials.

Concerning the first point: Depending on the opacity of the framework material, the appropriate brightness can be achieved by means of Deep Dentin or Power Dentin (IPS e.max Ceram), even in materials with a high translucency. In order to reproduce the natural tooth shade, it is important to understand light transmission and reflection. Likewise, the skilled application of light-optical effects (e.g. fluorescence, opalescence) is of significance. This is where the new IPS e.max Ceram Selection Enamel and Effect materials are of use. With this outstanding set of materials, life-like tooth characteristics can be reproduced even better. Figs 3 to 5 illustrate the layered build-up.

In order to achieve full esthetic integration of the implants, in addition to the shade and shape of the tooth, it is also important to ensure that the surface texture is adjusted to suit the oral environment. To allow the surface texture to appear as natural as possible, fine characteristics (e.g. surface gloss) must be adapted. Note: The surface gloss changes the light reflection; it therefore affects the shade. For this reason,

it is imperative to adjust the surface texture carefully. In this case, the staining and glazing system IPS Ivocolor was used for surface finishing.

### Results

The finished crowns were screw-fixed to the implants and the result was assessed. The natural appearance was enhanced, amongst other factors, by a conscious asymmetry of the teeth. The gingival contours were ideally adjusted. The teeth (crowns) and soft tissue complement each other beautifully. Individuality! This is shown here perfectly. This was a challenging and complex case. The results were pleasing for all involved. It exceeded the pre-treatment prognosis.



**06**

**06 and 07** — It was possible to restore the teeth and soft tissue esthetically and functionally. The ceramic enabled excellent shade reproduction with many individual characteristics.



**07**



**08** — Starting situation. In addition to the mismatch of shade and morphology, functional problems were also identified.



**09a**



**09b**

**09a and 09b** — Before and after the intervention in region 22. The soft tissue situation was managed by surgical treatment and temporary restorations.

## Patient Case 2

### Starting situation

This patient was also around 50 years old at the time of treatment and came to the practice with an esthetic problem in the anterior region. The existing restorations covering teeth 23 to 12 were defective, strongly discoloured and no longer suited the patient's requirements. A slight overbite was noted. Tooth 23 had inadequate contact with the antagonist. In addition, a vertical and horizontal resorption of the alveolar ridge in region 22 was observed. Resorption of

the soft tissue due to tooth loss also affected the situation. This patient needed extensive treatment in order to achieve an esthetically pleasing result. First, an alveolar ridge augmentation procedure was performed.

On the basis of the preoperative examination, a soft tissue reconstruction was carried out. The aim was to create a harmonious gingival area. In this case, sufficient tissue was important, since the horizontal resorption of the alveolar ridge adversely affected the vestibular extent of the crowns. By the time the temporary restoration had been made, the final result had already been defined and the framework for the final restoration was planned. It should be pointed out that in the case of esthetic restorations, a close cooperation between dentist and dental technician is essential. Of course, the patient must also be involved in planning and treatment. The treatment goals are determined together in order to achieve outstanding and satisfactory results for all involved.

### Fabrication of the restoration

The frameworks (crowns and bridge) were produced from the lithium disilicate glass-ceramic IPS e.max Press (Fig. 10). Since the reproduction of translucency is a challenge in a layered ceramic restoration, contrast effects were applied within the crown during a previous staining process (Fig. 11).

The advantages of a framework made from IPS e.max Press are the high material strength and the freedom of shade reproduction and adjustment using the cut-back technique. For example, the basic opacity is determined by the translucency of the ingot.

In addition, an appearance which underlines the material advantages can also be achieved by means of a partial cut-back. IPS e.max Press offers countless possibilities for the production of esthetic restorations. In this case, the framework was specifically reduced and therefore a perfect basis was created. The vestibular regions were then built up with ceramic layers.



**10**



**11**

**10 and 11** — Framework made from an IPS e.max Press LT A1 ingot. The contrast within the crown was enhanced by applying the stains inside the crown.



12



13



14

**12 and 13** — After insertion of the crowns. The restoration blends seamlessly into the oral environment. It was possible to fulfil the esthetic and functional demands.

**14** — Representation of the surface textures and surface characteristics

After the internal shade composition and adjustment of the tooth morphology was complete, IPS Ivocolor was used to replicate the surface characteristics. In contrast to conventional stains, these stains can be fired at a lower firing temperature of 710°C.

The actual reasons for staining are:

1. adjustment of the degree of saturation
2. characterization and
3. correction of the internal structure.

IPS e.max Ceram is a low fusing ceramic. In order to adjust the surface texture during the glaze firing it is necessary to handle carefully and manage the firing programs. In cases such as this, in which a distinctive characterization is required, the stain firing sequence must be lengthened. Texture control then becomes more difficult. In view of this, IPS Ivocolor is a good product which allows characterization at a low temperature. It can therefore be applied without losing the surface texture. During the final glaze adjustment, the delicate surface characterizations and the stained areas were retained. By applying the individual characteristics of natural teeth, we aimed to create a natural appearance.

IPS e.max Ceram Selection was also used here. A successful combination of light transmission and reflection was achieved: a perfect reproduction of natural shade with the effect of depth (Figs 12 to 14).

## Conclusion

The most important advantage of IPS e.max Press is the combination of a high level of esthetics and exceptional strength. With IPS e.max lithium disilicate, the incident light behaves in a similar way to natural teeth. This ensures maximum esthetics. In addition, the material offers ideas and inspiration. The integration of IPS e.max Selection and IPS Ivocolor, as well as IPS e.max Ceram Power Dentin and Power Incisal ceramic, greatly expands the range of esthetic possibilities. In the future, the clinical indications for the IPS e.max system will be increased even further!

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# The Ivoclar Vivadent

highlights at **IDS 2017** in Cologne

