REFLECT

dental people for dental people 03/10

Layer by layer towards success
Restoration of a left central incisor with IPS Empress® Direct

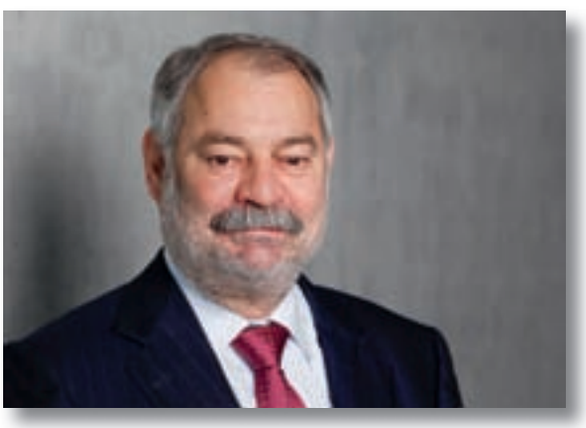
A modern classic
Treatment of edentulous patients with SR Phonares®

In the interest of the patient
Non-invasive long-term temporization with Telio CAD

ivoclar vivadent®
passion vision innovation

Editorial

Dear Reader



The latest economic crisis has had a considerable impact on many industrial sectors. As a result, consolidation has taken place with the corresponding consequences. Nevertheless, the dental industry seems to have resisted this trend, since only a slight or even negligible downturn was experienced.

Ivoclar Vivadent managed to handle the crisis successfully. The high innovative capacity of the company, which ensures a wide product and technology portfolio, significantly contributed to this outcome. Nonetheless, innovation is only possible if large sums of money are made available for investments in research and technological development. This is an important component of the Ivoclar Vivadent company strategy.

The different articles in this issue of Reflect clearly show the wide range of technologies and sciences on which the company's individual product groups are based. This scientific expertise is the product of many years of research and the corresponding investments. The spectrum ranges from ceramics to composites engineering and the development of adhesives and covers the fields of inorganic and organic chemistry. Process technology and software know-how complete the picture and highlight the fascinating aspects of development work.

Best regards

Dr Volker M Rheinberger
Chief Technology Officer

The cover shows a Telio CAD restoration being milled.

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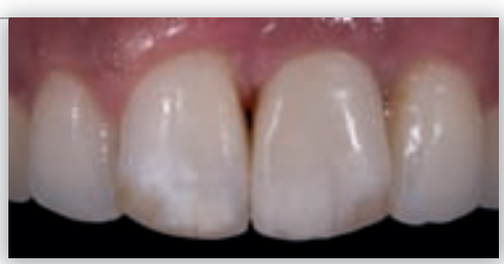

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Layer by layer towards success

Restoration of a left central incisor with IPS Empress® Direct

Dr Ali H Ozoglu, Adana/Turkey

A modern composite material enables dentists to provide restorations that are both functional and esthetic. The advantage is that direct composite restorations require a less invasive preparation method than crowns. IPS Empress Direct allows dentists to accomplish highly esthetic restorations using the layering technique.

Human teeth consist of several different strata of hard tissue and each stratum is characterized by different optical properties. It is essential to faithfully reproduce these strata and shades to achieve a natural-looking restoration. Up into the 1990s, using the layering technique was only possible in conjunction with indirect ceramic restorations and certain ceramic technologies, eg IPS Empress®, reached very high standards in this field. Systems such as IPS Empress, however, are only suited for indirect lab-fabricated restorations. Ivoclar Vivadent has now designed a composite material which allows dentists to create direct restorations using a layering approach. The successful results of IPS Empress ceramic restorations can now also be achieved in the dental practice.

Our aim is to restore the teeth of our patients with direct restorations that offer the same level of esthetics as the ceramic ones from the laboratory. For this purpose, we require materials whose optical properties can compare in every respect with the properties of natural teeth. IPS Empress Direct, a universal nano-hybrid composite material for direct esthetic restorations, fulfils this requirement. This material can be polished to a high gloss and offers a true-to-nature opacity, fluorescence and opalescence. These characteristics are essential to accomplish beautiful restorations with a natural-looking esthetic appearance. IPS Empress Direct is less sensitive to light than other materials and therefore gives users ample time to build up and contour the composite restoration. The clinical case described below shows the esthetic result achieved with IPS Empress Direct.

Fig 1 The left upper central incisor broke off in a bicycle accident.

Case study

A 12-year-old boy broke his left central incisor in a bicycle accident. He was referred to our clinic to have his tooth restored. His parents decided against a restoration with a crown and instead were pleading for a minimally invasive treatment.

The clinical examination showed that the tooth did not display any periodontal lesions, however, the pulp was exposed (Fig 1). We decided that tooth 11 should first be endodontically treated and then reconstructed with IPS Empress Direct using the direct layering technique.

The following shades were selected: A2 Enamel, A3 Enamel, A3 Dentin, Trans 30 and Trans Opal. The shade Trans 30 was chosen to create a natural reconstruction of the translucent areas between the mamelons, while Trans Opal was to be used for the enamel on the vestibular side of the incisal area. The total etch technique (Total Etch and ExciTE®) were employed for adhesive bonding. OptraSculpt® is my favourite instrument to perform such

Fig 2 Preparation of tooth 11 with undulating bevel

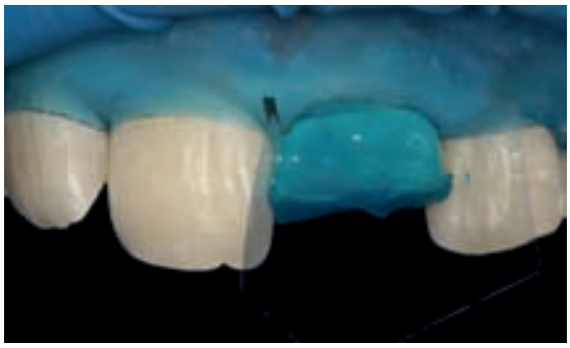

Fig 3 Acid etching with Total Etch

Fig 4 Tetric EvoFlow and IPS Empress Direct A3 Enamel were applied to the palatal area.

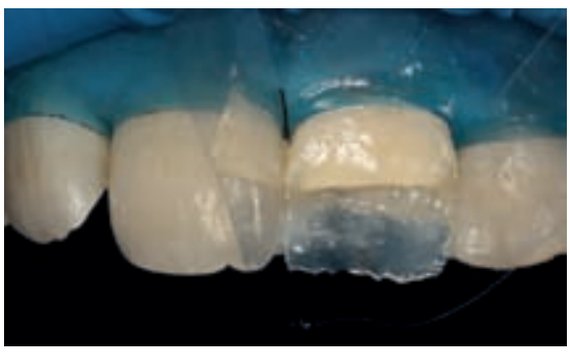

Fig 5 IPS Empress Direct Transpa 30 enhances the translucency effect.

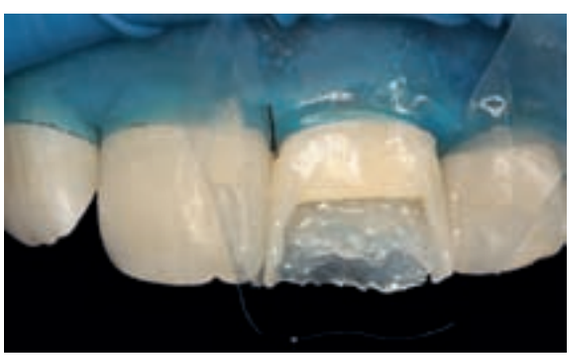

Fig 6 Reconstruction of the proximal regions with IPS Empress Direct A3 Enamel

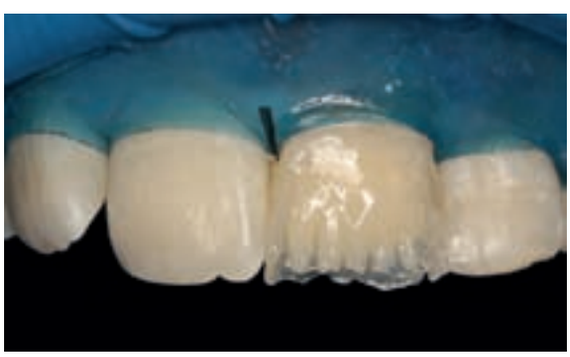

Fig 7 Reproduction of the mamelons with IPS Empress Direct A3 Dentin

delicate work. Rubber dam application is the best method to isolate the operating field. In this case, we placed an easy-to-use rubber dam (OptraDam®). We isolated the entire anterior region to be able to use the other teeth as a reference for the design of the restoration.

Undulating bevels were prepared to ensure a strong bond (Fig 2). These bevels also support the esthetic result of the restoration. All cut surfaces were then etched with 37 percent phosphoric acid (Total Etch, Fig 3). Next, the adjoining teeth and the etched areas were separated with a transparent matrix to protect the intact enamel surfaces. ExciTE was used as adhesive. The material was allowed to react for 10 seconds, gently dispersed to a thin layer and then light-cured with the LOP (Low Power) program of the bluephase® LED light unit for 10 seconds.

The palatal area was reconstructed with IPS Empress Direct A3 Enamel and Tetric EvoFlow® (Fig 4). A thin coating of Tetric EvoFlow was applied to facilitate the adaptation of the composite material to the natural tooth structure. The incisal portion of the palatal wall was built up with Trans 30 (Fig 5). The natural translucency between the mamelons was also achieved with Trans 30. The proximal areas were formed with A3 Enamel (Fig 6). The transparent matrix was again used to shape the palatal and proximal contours.

The dentin core and the mamelons were built up with A3 Dentin (Fig 7). The composite was applied to the centre of the bevelled tooth surface. The incisal portions were designed in accordance with the optical characteristics of neighbouring tooth 21.

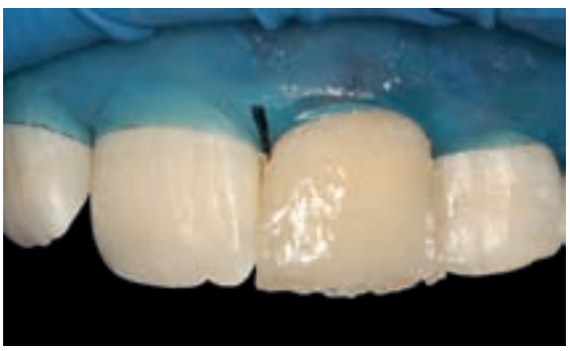

Fig 8 The vestibular areas were formed with IPS Empress Direct A3 and A2 Enamel.

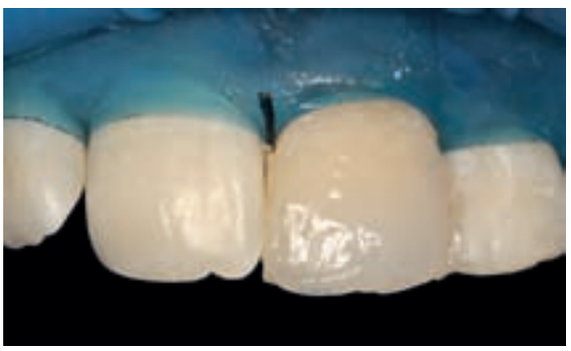

Fig 9 IPS Empress Direct Trans Opal imitates the opalescence effect of the enamel in the incisal area.

Fig 10 View after finishing and polishing. The final contours of the layered tooth were shaped according to morphological criteria.

Fig 11 Before the treatment ...

Fig 12 ... after the restoration with composite material

Finally, the prepared surfaces and the composite dentin core were covered with IPS Empress Direct A3 Enamel and A2 Enamel (Fig 8). Then, Trans Opal material was applied to the incisal edge. This allowed us to achieve a true-to-nature imitation of the opalescent effect found in the incisal edge of natural teeth (Fig 9). Each layer was light cured for 15 seconds using the SOF (Soft Start) program of the bluephase LED light unit.

Diamond-coated grinders and discs, such as the Astropol® and Astrobrush® set, are well suited for completing restorations. In this case, these instruments were used to finish and polish the restoration (Fig 10). After all characteristics of the natural morphology had been reproduced in the carefully layered composite restoration, the material was cured to its final hardness. For this purpose, the restoration was cured for 10 seconds with the HIP (High Power) program of the bluephase light.

Conclusion

This type of esthetic and yet minimally invasive restoration constitutes a highly satisfactory treatment option for both the clinician and patient (Figs 11 and 12). Even extensive restorations can be completed in only one appointment. IPS Empress Direct offers dentists an opportunity to extend their range of treatments and enhance their practice by offering a new treatment option. The use of high-quality materials and the ability to apply them properly lead to successful results. ❑

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Computer-aided crown design

Fabrication of CAD/CAM crowns chairside

Dr Andreas Bindl, Zurich/Switzerland

CAD/CAM technology allows dental professionals to manufacture solid all-ceramic crowns chairside. A digital image of the preparation is captured with an intraoral camera and the crown is designed accordingly. A variety of ceramics are available for the construction of the crown, for example an esthetic, easy-to-mill ceramic (IPS Empress® CAD). As this leucite glass-ceramic is weaker than zirconium oxide, these crowns must be seated with the adhesive technique (for example with Syntac®/Variolink® II or Multilink® Automix). This makes them strong enough to withstand the masticatory forces in the long term.

IPS e.max® CAD, which has been on the market for some time, is a lithium disilicate glass-ceramic (LS_2) that demonstrates a flexural strength of 360 MPa. This ceramic is machined to the desired shape while it is still in its metasilicate or "blue" state (approx 130 MPa). Subsequently, the ceramic is crystallized for 20 minutes. During this process, the material attains its final state and obtains its excellent mechanical and esthetic properties. IPS e.max CAD is available in a low-translucency (LT) version, which is suitable for the fabrication of crowns and implant-retained crowns. The high-translucency (HT) form is intended for the construction of inlays and partial crowns. The stains and glaze are applied before the crystallization process. As a result, subsequent polishing is unnecessary. Due to the high strength of the restoration, adhesive cementation with a separate dentin conditioner is not indicated as long as the thickness of the ceramic does not fall below 1.5 mm. Self-adhesive cementation materials can be used. The new self-adhesive composite cement SpeedCEM is particularly suitable for this purpose.
The chairside creation of a crown is described on the basis of a clinical case using IPS e.max CAD LT and the new SpeedCEM luting cement.

Fig 1 Preoperative situation: The buccal wall of tooth 25 is cracked and features a large damaged composite filling – a clear indication for a crown.

Clinical case study

Tooth 25 of a 32-year-old female patient was restored with a crown due to extensive destruction of the dental hard tissue (Fig 1). First, the tooth was prepared with a shoulder of approx 1.0 mm in width (epigingivally). Subsequently, the preparation was dusted with IPS® Contrast Spray and a digital impression was taken with the CEREC Bluecam camera. The new CEREC software version 3.80 generates a visual image of the antagonists, which replaces the centric bite record. In order to match the upper and lower teeth, an image of the centric situation is captured from the buccal aspect (Fig 2). The upper and lower teeth are matched semi-automatically (Fig 3). The 3.80 software version is capable of designing biogeneric occlusal surfaces for full crowns. The software provides a design proposal for the tooth morphology, which is based on the occlusal surface of the distal neighbouring tooth and the antagonist (Fig 4). The image of the bucco-oral cross-section of the crown allows the user to check the minimum occlusal thickness of 1.5 mm (Fig 5). The minimal densification of the ceramic (0.2 vol%) during the crystallization process is taken into account by the software and adjusted accordingly.

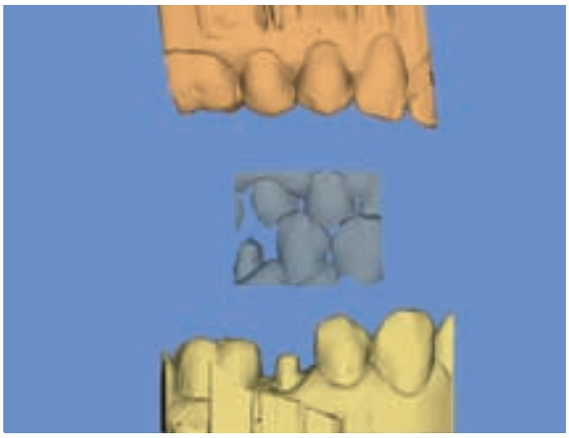

Fig 2 A digital impression is taken of the preparation and the antagonists and the situation in centric occlusion (CEREC Bluecam) from the buccal aspect (middle).

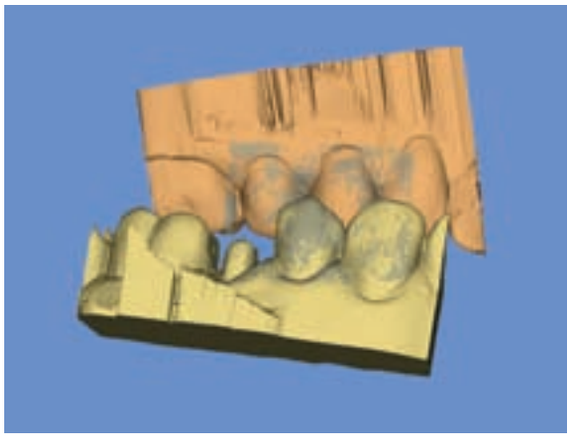

Fig 3 Semi-automatic alignment of the upper and lower jaw models with the help of the buccal image

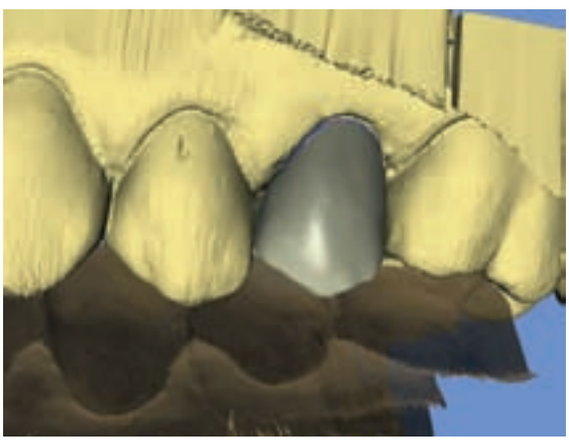

Fig 4 The biogeneric crown software designs an occlusal surface according to the individual situation.

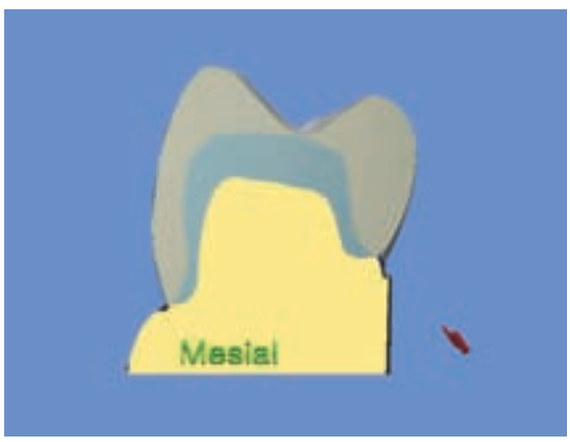

Fig 5 Bucco-oral cross-section of the restoration. The minimum occlusal thickness of 1.5 mm is checked.

Fig 6 Occlusal view of the crown in the "blue" state during try-in, before crystallization firing

Fig 7 Buccal view of the crown in the "blue" state during try-in, before crystallization firing

Fig 8 Occlusal view of the crystallized and glazed crown 25

Fig 9 Buccal view of the crystallized and glazed crown 25

Fig 10 Cementation of the crown with the dual-curing, self-adhesive luting composite SpeedCEM

Fig 11 Buccal view of the crown seated with a self-adhesive luting cement after the clean-up of excess

Fig 12 Occlusal view of the crown seated with self-adhesive luting composite

After the crown had been milled, the proximal and occlusal contacts were adjusted on the patient (Figs 6 and 7). In this case, the "white" and "creme" materials from the corresponding stains assortment (IPS e.max® CAD Crystall./Stains) were sparingly applied to the cusp tips and the "sunset" material on the tooth neck and in the fissures. Immediately afterwards, a glaze in spray form (IPS e.max® CAD Crystall./Glaze Spray) was applied on the outer surfaces of the crown. The spray was applied several times. Once the restoration was fully coated with a white-opaque glaze layer, the crown was fired in a combined crystallization and firing process in the Programat® CS furnace (Figs 8 and 9). Before the restoration was cemented in place, the inner surface of the crown was etched with 4.9 percent hydrofluoric acid (IPS Ceramic Etching Gel) for 20 seconds. Subsequently it was silanized for 60 seconds (Monobond Plus). The crown lumen was filled with the self-adhesive SpeedCEM. Next, the crown was securely seated on the prepared tooth by applying even pressure (Fig 10). The cement residue was polymerized for one second per surface (mesio-oral, disto-oral, mesio-buccal, disto-buccal) with a curing light (bluephase® in the low-power LOP mode) at a distance of about 5 mm. In this cured state, the cement was removed with great care using a scaler and a probe. The cement was fully cured with the bluephase in the HIP (High Power) mode. Subsequently, the cement margin was polished. The final inspection revealed the restoration to be in harmony with the overall situation (Figs 11 and 12). ❑

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A modern classic

Treatment of edentulous patients with SR Phonares®

George Priest, DMD, Hilton Head Island, SC/USA

Despite the decline in the proportion of edentulous patients, continued population growth and greater longevity of older patients will increase the need for dental services for these patients in the foreseeable future. Furthermore, this elderly and edentulous population is showing a growing demand for lifelike, esthetic restorations.

Patients are often dissatisfied with removable complete dentures. Implants provide a solution in such cases. A mandibular overdenture supported by as few as two implants, for example, offers a viable alternative. The treatment of edentulous patients with endosseous implants has almost become a routine procedure. In fact, the McGill Consensus has established the two-implant mandibular overdenture as a standard of care. Typically, maxillary implant prostheses entail more complexity and expense than those for edentulous mandibles. Preliminary results from at least one study, however, indicate that a maxillary overdenture supported by four independent implants may demonstrate predictable longevity, thus reducing the cost and difficulty in maxillary implant reconstruction (Figs 1 to 4). Patients were similarly satisfied with both fixed and re-

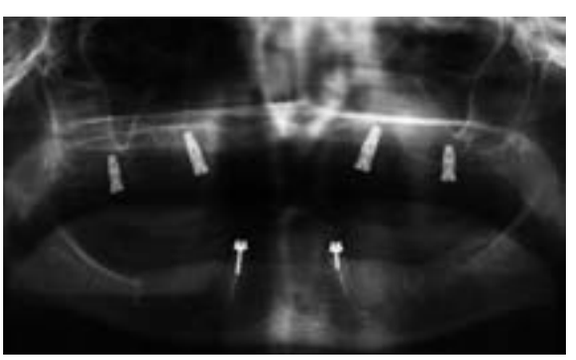

***Fig 1** X-ray of a 62-year-old female patient. Four implants had been inserted in the edentulous maxillary arch.*

***Fig 2** Clinical picture showing the implants distributed around the maxillary arch*

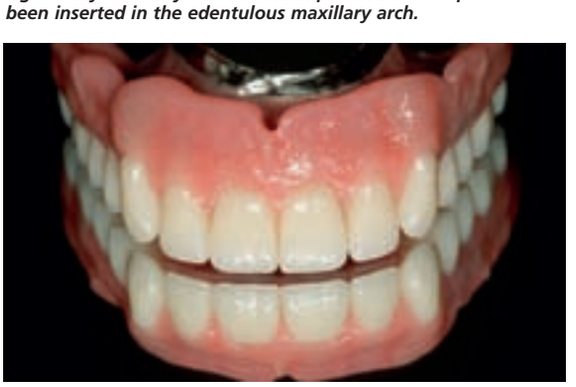

***Fig 3** The implant-supported denture made with Phonares teeth*

***Fig 4** The patient was extremely pleased with her renewed smile and secure prosthesis.*

Fig 5 Not a nice sight: The patient was unhappy with the restoration which demonstrated significant wear.

Fig 6 Worn denture teeth negatively affected the facial appearance of a 59-year-old female patient.

movable implant-supported prostheses in the edentulous maxilla. Therefore, this solution for endentulism in the maxilla and mandible has become the treatment of choice for a large segment of the edentulous population.

Denture teeth and the potential of new materials

A major challenge with conventional denture teeth in implant prostheses is the lack of durability. Although implant and prosthesis survival rates remain high in edentulous patients, a significant prosthetic problem has been wear and fracture of resin denture teeth. One study showed that fractures of resin teeth were the next most common complication, after speech problems. Another study that demonstrated high success rates with four-implant overdentures reported fracture of acrylic components (including denture teeth) in 14 percent of total cases. One reason for the reported incidence of denture tooth fracture is higher occlusal forces in implant denture wearers than those in conventional denture wearers. In a Medline review, Goodcare et al. reported an incidence of resin veneer fracture of implant fixed partial dentures of 22 percent. Other investigations have also reported a high frequency of denture tooth fracture in implant prostheses for edentulous patients. Similarly, ceramic prostheses are more prone to fracture on implants than on tooth-supported restorations (Fig 5). Implant prostheses with resin denture teeth, however, are easier and less costly to repair than those with ceramic teeth.

Recently developed denture teeth composed of nano-filled composite resin demonstrated more wear than ceramic teeth, but less than that of acrylic resin teeth. Composite/resin teeth seem to be more suitable for prostheses opposing natural teeth than ceramic teeth in terms of wear resistance. An in vitro study has confirmed this finding. Traditional resin denture teeth, however, have two shortcomings:

1. Conventional resins do not replicate light and optical properties of teeth as closely as ceramic compositions.
2. The anatomical form of denture teeth is often deficient.

Tooth loss has been found to be not only a physical disability; but the loss of confidence related to an altered appearance can be an emotionally traumatic experience as well (Fig 6). The esthetic aspect of complete edentulism, therefore, has a profound impact on overall patient satisfaction (Figs 7 to 8b). As a result, clinicians should also continue to direct their efforts towards enhancing esthetics for edentulous patients treated with implant prostheses.

Potential of Phonares

Phonares denture teeth manufactured by Ivoclar Vivadent have been designed to overcome the obstacles of traditional denture tooth durability and esthetics. They are constructed from nano-hybrid composite (NHC) that contains macro-fillers for strength and colour stability, micro-fillers for wear resistance, nano-fillers for translucency and polymethyl methacrylate (PMMA) for bonding and toughness. Tooth-like translucency is achieved from the small filler particle size that improves the refractive index of Phonares teeth. Individualized layering gives these teeth a natural-looking colour. Contemporary moulds, based on age, shape and size facilitate the selection process in the fabrication of the restoration. The anatomical occlusal form of the posterior moulds corresponds to functional principles and simplifies the arrangement of either lingualized or natural occlusal schemes. Palatal and lingual contours are complete, therefore allowing festooning that more closely mimics natural sulcular sculpting. The unique interproximal "set and fit" design of the maxillary anterior teeth provides for easy overlapping of tooth surfaces without creating widened interproximal spaces. Broadened cervical tooth contours are conducive to fitting over implants, abutments and screw access openings.

My experience with Phonares denture teeth has been very positive. Using Phonares denture teeth, anatomical festooning and customized gingival acrylic resin, the esthetic outcomes have been on a par with more costly and complex implant-supported all-ceramic prostheses. In the past, anatomically incorrect and deficient contours of traditional denture teeth resulted in

Fig 7 Phonares denture teeth were used to construct a new maxillary denture for this female patient.

Figs 8a and b A more youthful smile and the confidence of the patient were restored.

Fig 9 The patient received a maxillary and a mandibular denture. The lifelike optical properties of Phonares teeth pleased not only the patient, but us as well.

Fig 10 Phonares teeth are conducive to anatomical papilla and sulcular festooning more appropriate for mature patients. Laboratory technicians may now modify their waxing techniques to reflect these improvements.

festooning that did not mimic natural soft tissue profiles. Overlapping proximal tooth surfaces for more lifelike tooth arrangements and narrow or reduced tooth necks often resulted in open proximal spaces. Lingual and palatal contours that did not extend apically made gingival festooning lacking in these areas.

Phonares teeth are conducive to anatomical papilla and sulcular festooning more appropriate for mature patients. Laboratory technicians may now modify their waxing techniques to reflect these improvements (Figs 9 and 10). The "set and fit" proximal surfaces allow slight overlapping, while maintaining tight proximal contacts (Figs 11 and 12). Tooth necks are wider and more anatomical, which minimizes proximal spacing and eliminates excess papillae heights. Lingual and palatal festooning can mimic natural soft tissue by following the complete anatomical form of Phonares teeth (Fig 13). Improved moulds and seamless individualized layering of the nano-hybrid composite resin teeth enhance esthetics even more (Fig 14). My patients have been very accepting of the youthful and vibrant translucent light qualities and colour gradations of Phonares teeth.

Fig 11 The maxillary failing anterior teeth of this male patient were significantly overlapped.

Figs 12 and 13 Maintaining some semblance of the overlapped teeth required no proximal modification of the Phonares denture teeth.

Fig 14 By subtly mimicking the arrangement of his original teeth, we maintained the character of the patient's original smile.

Conclusions

Phonares teeth offer superior esthetics and durability to implant prostheses for edentulous patients. Although implants have been extremely successful for edentulous patients, prosthetic maintenance has been problematic due to wear and fracture of denture teeth. The innovative composition of Phonares denture teeth should provide greater durability and longevity, resulting in fewer prosthetic revisions for implant prostheses. The lifelike moulds and optical properties of Phonares denture teeth impart an appearance that is nearly indistinguishable from natural teeth. They are a significant development in enhancing implant treatment outcomes for edentulous patients. ❑

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

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Performance esthetics from a high-strength material

The versatility of lithium disilicate

John C Schwartz, DDS, Metairie, LA/USA

Depending on the clinical situation and the location of teeth, materials with different mechanical properties need to be employed when restoring teeth with fixed porcelain veneer crowns. This is pivotal in full-mouth rehabilitation, for example. However, the use of many different materials may entail difficulties in achieving harmonious shading or even render a uniform outcome impossible. The exceptional properties of lithium disilicate glass-ceramic enable dental professionals to create natural-looking restorations which fulfil the different requirements – without having to make concessions with regard to shading.

Typically, strength values of dental porcelains are relied on to indicate porcelain crown performance. However, strength is a conditional, rather than an inherent, property of dental porcelains. In vitro strength data alone cannot be used to assume a material's long-term performance in vivo. In two-phase porcelain systems consisting of a framework and veneering material, the design of the substructure has a decisive influence on the overall strength. It is therefore logical to consider fabrication design as a factor in the overall strength performance of an all-ceramic crown in vivo. Apart from the physical properties of the materials, the correct dimensional relation between the veneer and the substructure is a prerequisite for the success of two-phase porcelain systems. While the substructure functions primarily as the system's strength, the veneering porcelain provides its esthetics. Examples of two-phase porcelain systems include porcelain-fused-to-metal crowns, zirconia crowns and veneered lithium disilicate crowns. Increasing the strength function of the system would imply thickening the substructure. Thickening the substructure creates less room for the outer phase to perform its esthetic function.

Traditionally, creating a structural design to maximize esthetics has reduced the strength value of biphase systems due to small dimensions of the substructure. An example is limiting a substructure to a coping form. While esthetic, the coping design leaves the veneering porcelain unsupported in cusp-to-fossa function and vulnerable to long-term stress fracture. Possessing a high-strength substructure that has considerable esthetic advantages over other substrates can improve the strength of a system without compromising esthetic values.

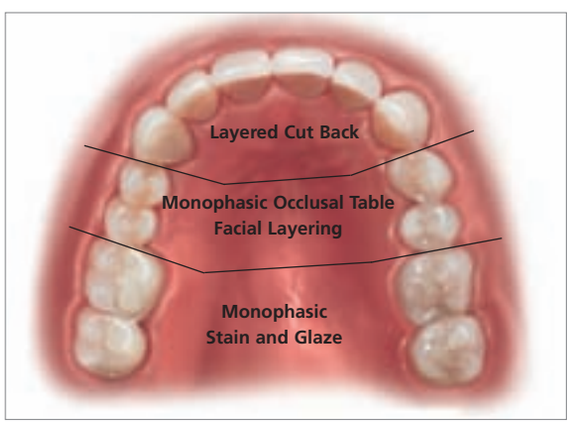

Fig 1 Different indications require different fabrication and layering techniques: IPS e.max® lithium disilicate allows uniform results to be achieved.

A hybrid substructure design, which supports a cusp-to-fossa relationship, increases the strength of the system. Refractive index values increase when the substructure thickens; increasing the thickness of the substructure results in a crown of higher value. By acknowledging the individual strengths and weaknesses of the components of the biphase porcelain systems, it is possible to engineer structural stabilization factors in esthetic crown design. The material that most closely fits these ideal synergistic criteria is lithium disilicate.

Applications of lithium disilicate glass-ceramic

Monophasic lithium disilicate crowns can be used on molars, for which strength is a desirable trait. For ante-

Fig 2 Preoperative frontal view of the patient's condition: The areas of heavy wear are clearly visible. Clinical crown loss was estimated to be between 20 and 70 percent.

Fig 3 Preoperative occlusal view of the patient's maxillary arch

rior reconstructions, however, veneered lithium disilicate should be used to emphasize esthetics. A synergy between the strength of the lithium disilicate substructure and the esthetics of the veneering material can be attained with IPS e.max® System. This product allows all-ceramic restorations to compete with traditional restorations in terms of in vitro strength. At the same time, the esthetic value expected from all-ceramic crowns is not compromised.

Monophasic lithium disilicate restorations can be used in posterior areas, where strength is most important. When used in the bicuspid region of the mouth, the facial aspect (visible portion) should be layered using IPS e.max® Ceram. As a result, esthetics are improved without compromising the core integrity strength. In the fabrication of anterior crowns, the artistic skills of dental technicians are utilized to achieve high esthetics.

When creating full-contour, monophasic IPS e.max LS_2 crowns, the cusp-to-fossa relationship should be studied first. Proper "waxing" in cusp-to-fossa physiology limits compression and shearing forces. Monophasic construction also allows higher resistance to fracture. The ideology behind the monophasic lithium disilicate crown is similar to that of full cast gold crowns (Fig 1).

Case presentation

In this particular case, a 59-year-old male complained about his unattractive smile and wanted one that was more esthetically pleasing. At the time of presentation, the patient had a long dental history of missing posterior teeth, root canal therapy, tooth mobility issues, sensitive teeth, full metal crowns, PFM crowns, amalgam fillings, discolored teeth and difficulty in chewing (Figs 2 and 3). Additionally, the clinical and radiographic examination revealed clicking and popping upon opening of the mouth in both temporomandibular joints (TMJs). Upon palpation, there was also a slight discomfort of the posterior capsule of the right TMJ, but the left posterior and lateral capsules were within normal limits.

Diagnosis: Occlusion

The patient's maxillary and mandibular midlines were aligned but demonstrated tracking to the right upon opening. There was a Class III occlusal relationship, with a deep overbite that approached an edge-to-edge overjet anterior position, with a lack of anterior guiding patterns.

Diagnosis: Gingiva

A periodontal examination revealed generalized pocketing of 1 to 3 mm, with isolated pocketing of 4 mm. Additionally, anterior and posterior isolated gingival recession was noted, with associated isolated thinning of keratinized gingiva. Other issues, such as wide keratinized gingival banding, blunted papillae and uneven periodontal outline form also were observed during the examination. The gingiva was irritated and demonstrated isolated bleeding upon probing.

Diagnosis: Dental hard tissue

During the dental evaluation, missing teeth, crowns, amalgam fillings, composite fillings, heavy wear facets, exposed dentin surfaces, enamel splintering and clinical crown loss, estimated between 20 and 70 percent, were revealed.

Treatment plan

The diagnosis from this evaluation encompassed worn dentition, collapsed occlusion, generalized chronic mild gingivitis, generalized chronic mild periodontitis and mild MPDS/TMD. Based on this diagnosis, it was necessary to develop an extensive treatment plan that would not only increase the esthetic value of the patient's teeth, but also their functionality. The treatment plan included opening the bite and establishing a vertical dimension of occlusion, establishing anterior guidance patterns and restoring the dentition. It also was decided that a diagnostic wax-up, based on photographic analysis, would be used in this treatment plan (Fig 4), which allowed the planned restoration to be built up in a precise and detailed manner. The wax-up was used to establish the length-to-width parameters of the natural teeth, the incisal plane, occlusal plane and the fixed arch parameters. These steps were all necessary to provide an outcome that was both esthetically pleasing to the patient and, more importantly, functional.

Fig 4 The diagnostic wax-up should be created with care as it forms the basis for the restoration.

Fig 5 Lithium disilicate substructures for the anterior crowns

Fig 6 The lithium disilicate CAD/CAM restorations (IPS e.max CAD) were placed on the model in their "blue" phase after milling.

Fig 7 Customized build-up of the anterior crowns

Fig 8 A porcelain enamel layer was applied to the layered crowns.

Fabrication considerations

The benefit of hybrid restorations (veneered frameworks) is that the design of the framework can be adjusted to the requirements of the clinical situation and optimum support of the veneering ceramic can be ensured, regardless of whether the press or CAD/CAM technique are used. In the case presented, the CAD/CAM technique was employed (E4D Dentist CAD/CAM System, D4D Technologies, USA). The copings were designed on the computer as described below. A coping form of 1.25 mm to 1.5 mm minimum thickness was designed. The central developmental lobes were designed to within 1 mm of the final desired cuspal location. Next, the proximal developmental lobes were waxed to within 1 mm of the desired marginal ridge location. Located on the buccal and lingual aspects of a natural tooth, there is an area of demarcation between enamel and dentin. Ceramists term this area the "enamel break", which is where the enamel appears to become thicker and less supported by the thickness of the dentin. The location of the enamel break should be determined from preoperative photographs. On the working cusps of the crown, a ledge should be waxed at the enamel break to within 0.5 mm of the final survey outline form of the crown. This strengthens the working cusp and creates a stress breaker in the middle of the crown. This stress breaker relieves tension at the margin of the crown, where the bond can be subjected to long-term effects of occlusal stresses. The working ledge can be concealed due to the chameleon effect of the lithium disilicate material. The balancing (ie nonworking) cusps do not require a working ledge of support. However, nonworking cusps should be prepared for the development of parafunctional interferences by waxing shearing stress breakers into the coping design. Once this had been accomplished, the lithium disilicate high-strength copings were milled using IPS e.max® CAD lithium disilicate blocks (Figs 5 and 6).

Creating the esthetics began with the application of deep stains to the lithium disilicate coping. Next, to lower the value of the coping and create a luminary zone for light refraction, the crown was built up entirely using IPS e.max® Ceram Transpa neutral. Enamel stains and characterizations were applied (Fig 7). This enhances the esthetics particularly in the anterior region. Finally, the outer enamel layer was finished in the appropriate shade S2 enamel and the crowns were

Figs 9 and 10 View of the completed restorations on the model

Figs 11 and 12 View of the IPS e.max lithium disilicate restorations after seating – the completed full-mouth rehabilitation has a natural and harmonious appearance, even though different fabrication procedures were employed.

baked again (Fig 8). The crowns were then texture-finished with stones and surface-polished with the Astropol® polishing system. A light layer of glaze was then applied for the final bake. Once the final bake had been completed, the monophasic lithium disilicate crowns were ready for seating in the mouth (Figs 9 and 10). The lithium disilicate crowns were tried in to ensure proper seating and to prevent any issues during the final cementation and polishing processes. Once any issues had been addressed, final placement of the lithium disilicate restorations could be accomplished.

Permanent cementation

The prepared teeth were pre-treated using conventional procedures. The pre-treatment of the crowns was carried out according to the respective directions for use. The inner surfaces of the crowns were etched with hydrofluoric acid for 20 seconds, after which a silane coupling agent was applied. Dentin and enamel surfaces were wetted using a bonding agent (ExciTE®). Excess was blown off using pressurized air, and the surfaces were light-cured for 20 seconds. A light-curing bonding agent (Heliobond) was applied on top of the ExciTE layer, and the excess was blown off. A dual-cure adhesive luting composite (Variolink® II) was placed in the crowns, after which they were carefully seated, cleaned and light-cured. The postoperative all-ceramic crown results exhibited excellent biomimetic behavior and physiologic function (Figs 11 and 12).

Conclusion

Creating high-strength lithium disilicate crowns without compromising the esthetic function of the all-ceramic restorations can be achieved by utilizing monophasic molar crowns, biphasic bicuspid crowns with facial layering, and anterior biphasic crowns with lingual support (cf Fig 1). In vitro strength values of dental porcelains may indicate the performance of these restorations, but these data alone cannot be used to assume the structural performance of the restoration in vivo. Therefore, it is not only important, but necessary, to consider fabrication design as a factor in the overall strength and performance of an all-ceramic crown. The use of a lithium disilicate material – as described herein – can enable dentists and laboratory ceramists to provide patients with structurally durable and esthetically pleasing restorative results even in difficult cases when eg slight functional problems are present. ❑

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In the interest of the patient

Non-invasive long-term temporization with Telio CAD

Prof Dr Daniel Edelhoff and Josef Schweiger, DT, Munich/Germany

New manufacturing technologies have paved the way for completely new treatment strategies. High-performance polymer materials allow a relatively rapid improvement of the initial clinical situation. These materials are instrumental in the long-term development of functional and esthetic characteristics. The following case report describes the rehabilitation of a general malformation of the dental hard tissues. The young patient received non-invasive long-term temporary restorations; hence the teeth did not have to be invasively prepared. The restorations were CAD/CAM manufactured using the high-performance polymer Telio CAD. This approach allowed us to achieve an improvement in the initial clinical situation while the patient was still in his growth years. The long-term temporization phase forms the basis for the final restoration at a later stage.

Initial situation

A 13-year-old boy came to our practice together with his parents because of severely discoloured and malformed teeth. His desire to have a "new" esthetic appearance was quite understandable (Fig 1). The patient said that he was pain free but complained about the social stress that he felt because of the unpleasant look of his teeth. After an evaluation of the clinical findings and the patient's case history, he was diagnosed with dentinogenesis imperfecta type II. The challenge which we faced in his treatment was his age, as he was still in his growth years. Our aim was to achieve an immediate improvement of the situation, which meant that we had to establish an appropriate morphology of the teeth and adjust the vertical dimension of occlusion (VDO). In addition, reliable retention of the restorations in the pre-damaged tooth structure had to be ensured.

Treatment planning

The aim of the treatment was to establish an appropriate morphology of the teeth with an anterior/canine protected dynamic occlusion and to adjust the vertical dimension accordingly. Further destruction of the teeth, which had already been damaged, had to be prevented to give the patient a chance to have a pleasant social and professional future.

Before completing the final stages of therapy planning, we removed the caries from teeth 16 and 46 and filled the cavities with restorative material (Tetric EvoFlow®/Ceram®, Syntac®) (Figs 2a and b). Portrait and intraoral photos were taken to provide the dental technician with a first impression of the initial situation. Alginate impressions of the upper and lower jaw were taken to create diagnostic models. In addition, a centric bite record and an arbitrary facebow registration were taken.

As the dentition had already undergone extensive esthetic and functional changes and the patient was still in his growth processes, appropriate treatment planning was not an easy task. After the clinical findings had been evaluated in the laboratory and practice and all advantages and disadvantages of alternative restorative treatment options had been considered, the patient together

Fig 1 Initial situation: severely discoloured teeth and disharmony in the size and shape of the teeth due to congenital dysplasia

Figs 2a and b Teeth 16 and 46 are severely damaged. The enamel was chipped off.

Fig 3 Try-in of the mock-up. A diagnostic template (Duran thermoforming foil, 0.5 mm) was created from the wax-up and filled with temporary material and placed on the teeth, which had been isolated with liquid Vaseline.

Figs 4a and b The long-term temporaries were CAD/CAM manufactured using the high-performance polymer Telio CAD on the basis of the study wax-up. They helped to improve the esthetic appearance and evaluate the vertical bite dimension during the growth stages of the patient.

Fig 5 The long-term temporaries were trial fitted using various colours of try-in pastes. The sectioned Michigan splint enabled an accurate transfer of the vertical bite height.

with his family and the practice team decided to follow the following therapy plan:

1. Study wax-up to establish an esthetic and functional morphology of the teeth
2. Evaluation of the esthetics by means of a mock-up, using the wax-up as a basis (Fig 3)
3. Functional evaluation of the situation: transfer of the newly established vertical dimension to a modified Michigan splint
4. Precision impressions of the uncut teeth
5. Wax-up digitization and fabrication of CAD/CAM manufactured long-term temporary restorations using a high-performance polymer (Telio CAD)
6. Try-in and final esthetic incorporation of non-invasive temporaries.

Clinical procedure

Preliminary treatment

After the wax-up had been adjusted to meet the envisaged esthetic criteria, the 12-week splint therapy began, which also served as a functional evaluation phase. The vertical dimension established in the wax-up was accurately transferred to the oral cavity of the patient. During this phase, the patient had a chance to become accustomed to the new vertical occlusal height.

Long-term temporization

Following the functional evaluation phase, maxillary and mandibular high-precision impressions of the uncut teeth were taken. The impressions were sent to the laboratory together with a facebow. A centric bite record was taken to ensure an accurate transfer of the occlusal dimension – for this purpose the Michigan splint was sectioned.

The temporary restorations were fabricated using the high-performance polymer Telio CAD (shade A2). The study wax-up, which served as basis for the CAD/CAM manufacture of the restorations, was digitized. This procedure resulted in form-identical long-term temporaries (Figs 4a and b).

Figs 6a and b Non-invasive rehabilitation of the dentition: clinical picture after adhesive cementation of the posterior restorations. The correct selection of the appropriate luting composite shade helped to almost completely mask out the severely discoloured tooth structure.

Figs 7a and b Situation before and after adhesive cementation of the long-term temporaries. A slight trace of discoloration can be noticed only at the restoration margins. The reason for this is the thin thickness of these veneer-shaped restorations.

It was difficult to mask the extremely discoloured tooth structure with the thin temporaries. To check the accuracy of fit and shade match, the restorations were trial fitted in the patient's mouth using various colours of glycerine gel (Try-in pastes High Value +2 and High Value +3 of the Variolink® Veneer Professional Set) (Fig 5).

Seating

Based on the try-in with the try-in pastes, the dual-curing, low-viscosity shade "basic white opaque" (Variolink II Professional Set) was selected for the final placement of the temporaries. Before they were incorporated, the inner surfaces of the restorations were silicoated using the Rotatec system (Rotatec Soft 30 µm, distance to nozzle: 10 mm, blast pressure: 1 bar, blast time per unit: 10 seconds). Subsequently, the restorations were silanized using Monobond S and coated with a layer of Heliobond bonding agent. The natural tooth structure was conditioned using the total etch technique and the Syntac dentin adhesive system. Final polymerization was performed with a bluephase® G2 light-curing unit (Figs 6a and b).

Conclusion

The temporization phase with the new vertical bite dimension allows a good prediction of the final rehabilitation planned for the time after the patient has reached full growth (Figs 7a and b). The immediate treatment with long-term temporary restorations enabled us to meet the needs of the patient already at this stage using a non-invasive technique and the result left him completely satisfied (Figs 8a and b). ❑

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

Figs 8a and b Portrait pictures before and after. The esthetic and functional expectations were met promptly using a non-invasive approach – in the interest of the patient.

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From desire to reality

Rehabilitation with implant-borne anterior reconstructions using IPS e.max® Press and the Straumann® Anatomic IPS e.max® Abutment

August Bruguera, DT, Barcelona/Spain, and Dr Pedro Couto Viana, Porto/Portugal

Replacing a single missing central incisor is quite challenging, particularly if implants are used. The precise reproduction of the anatomy and morphology of the natural tooth as well as the re-creation of its characteristic layers is not an easy task. Complementary information provided by the attending dentist is therefore very important.

Case presentation

The patient presented with a missing upper central incisor, which she had lost in an accident. She was dissatisfied with her smile and wanted her upper anterior teeth to be realigned in order to re-establish a natural overall appearance. Following orthodontic treatment, a Straumann Bone Level Implant (RC 4.1 mm SLActive®) was placed in the optimal three-dimensional position (Figs 1 and 2).

Figs 1 and 2 Implantation of a Straumann Bone Level Implant with radiographic control

Shade determination

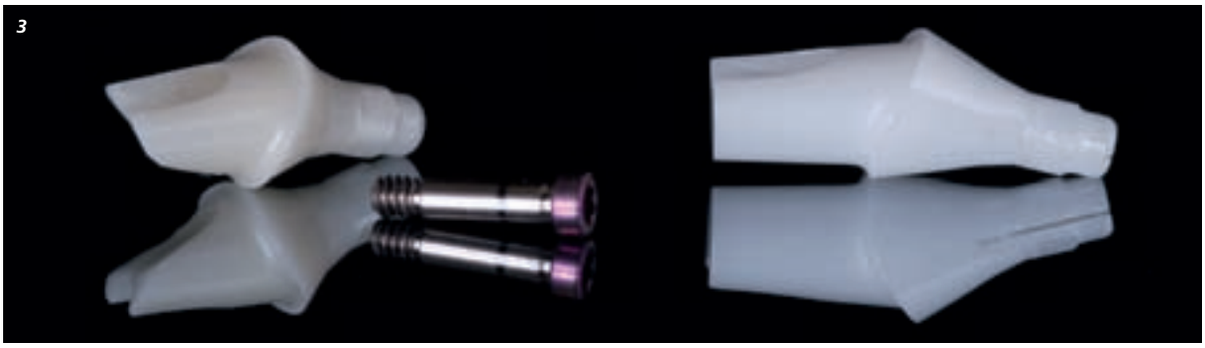
With a bit of practice and dexterity, the anatomy of a single anterior tooth can be reproduced with relative ease, provided that the model gives a detailed rendering of the adjacent teeth and thus provides all the relevant information. In contrast, the determination and reproduction of the tooth shade is a complex and difficult issue. Even small deviations may have a major detrimental effect on the success of the case. There are two reliable ways for dentists to communicate shade-related information to the dental laboratory:

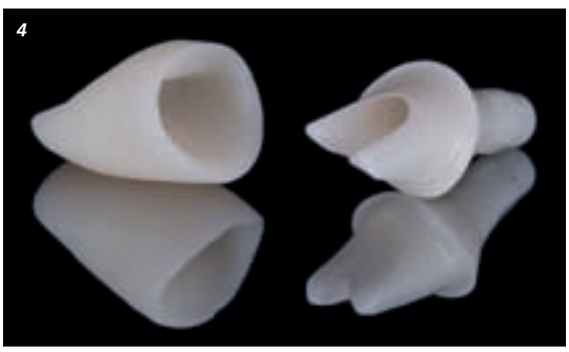
1. Either the attending dentist provides detailed shade information by means of digital photographs, or
2. The patient pays a visit to the laboratory so that the dental technician can establish a layering scheme. However, it is important to note that a good layering protocol is only a first step in the creation of an esthetic restoration, which does not guarantee its "perfect" implementation.

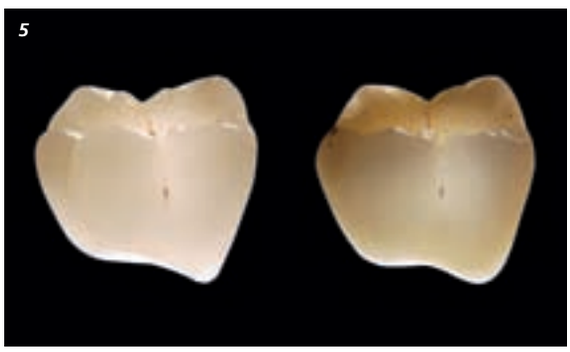
Photographs are an important tool in this type of procedure. In order to employ them effectively, the following conditions have to be met when taking photographs:

- The remaining dentition has to be completely moistened.
- The vestibular aspect of the reference tooth must be on one level with the natural tooth. Both teeth must be positioned perpendicular to the lens of the camera.
- The shade designation on the shade tab must be clearly visible.
- Extensive reflection areas both on the surface of the natural tooth and that of the shade tab reduce the informative value of the picture and should thus be avoided.

Digital photographs simplify the identification of the differently shaded areas of natural teeth. Precise shade matching can only be accomplished if the patient visits the dental laboratory. In the present case, the neces-







Figs 3 and 4 The Straumann Anatomic IPS e.max Abutment used in combination with IPS e.max in the anterior region allows highly predictable esthetics as well as high biocompatibility to be achieved.

Fig 5 Comparison of lithium disilicate (LS_2) glass-ceramic (left) and veneered zirconium oxide ceramic (right). LS_2 is the material of choice when it comes to single crowns.

sity of a patient visit to the lab was discussed with Dr Couto Viana, the attending dentist. The patient fully understood our request and was prepared to pay our lab a visit despite the large distance between Porto and Barcelona.

Zirconium oxide abutments

Zirconium oxide abutments are among the most disputed products in implantology: Their fracture strength, the internal and external connections, the interaction between retention screw and abutment – all these issues are raised repeatedly. However, everybody seems to agree that zirconium oxide abutments lead to highly predictable results especially in the restoration of anterior teeth.

Another argument that speaks in favour of zirconium oxide abutments is the material's high biocompatibility. Soft tissue management using Consistent Emergence Profiles requires the given emergence profiles to be maintained (clearly discernible in Figs 3 and 4). A comparison of zirconium oxide and lithium disilicate (crown materials) shows that the latter can be etched and silanized and thus be optimally prepared for adhesive cementation. A special tip for you: In order to create an etchable surface on the Straumann Anatomic IPS e.max Abutment, the bonding surface may be covered with a thin layer of veneering ceramic prior to the modelling of the crown. For this purpose, IPS e.max® Ceram ZirLiner is applied first. Then a layer of IPS e.max® Ceram Deep Dentin in the desired shade is applied. As a result, the dentin shade will shimmer through from within the restoration and a basis is created for an adhesive cementation protocol.

Why use IPS e.max Press to fabricate the crown?

For the fabrication of single crowns, lithium disilicate (LS_2) is the material of choice for me (Fig 5). Due to its high flexural strength and esthetic properties, this material offers the best options. However, a clear distinction must be made between anterior and posterior teeth. The occlusal load an anterior crown has to withstand is hardly comparable to the stress a posterior crown is exposed to. If a posterior tooth is restored with a crown, IPS e.max Press allows a reliable solution to be achieved (monolithic restoration), independent of whether the restoration is tooth- or implant-supported. IPS e.max Press can be used in either the staining technique, the cut-back technique or the layering technique. Layered crowns have the advantage that they allow custom shade matching to be performed. However, if a simple layering scheme is applied, the range of stains available provides sufficient possibilities of matching the shade of the crown to that of the remaining dentition. Consequently, I use IPS e.max Press HT ingots in the restoration of posterior teeth, since they offer a well-balanced mix of translucency and chroma. As far as brightness is concerned, I prefer to use shades that are one or two tones lighter than the final tooth shade. This allows me to better control the brightness value. Colour saturation can be adjusted by means of Shades. In the anterior region, the require-

Figs 6 and 7 A nearly perfect copy of the natural counterpart was achieved with lithium disilicate (IPS e.max Press). Implant-supported reconstruction of tooth 21.

Fig 8 Lithium disilicate enables the demands of patients to be fulfilled in an optimal way. The picture shows the happy patient.

ments are completely different. While high flexural strength is not an issue, a more complex layering scheme is essential. I usually work with MO ingots which are one tone lighter than the final shade planned. In the case presented in this article, an MO1 ingot was pressed.

Fine tuning of the restoration

The final adjustment of the shade of the restoration in the mouth of the patient plays an important role in the treatment success – any mistakes can be corrected at once. First, the IPS e.max Dentin and Incisal shades are applied together with individual characterizations based on the layering scheme and fired. The surface layer, which imparts translucency to the IPS e.max restoration, is not applied yet. This allows possible colour deficiencies to be adjusted directly in the mouth and inadequately shaded ceramic portions to be removed if necessary. The brightness of the first layer should not be too low, as this will make the restoration appear greyish. As indicated above, this can be avoided by using a somewhat lighter press ingot.

Adjusting the fit of the restoration

In the case presented, the patient visited the laboratory personally. This made it easy to establish the right level of colour saturation and brightness. Once the ceramic build-up was optimally adjusted in terms of shade, the translucent portions could be added. At the same time, the anatomy and surface texture were completed. This was relatively easy to accomplish, as the natural counterpart reproduced in plaster provided excellent guidelines. The final stain firing cycle is important, as with the ceramic layering technique alone restorations cannot be characterized as required and the optimum dentin shade cannot be achieved. With Shades and Essences, the intensity of the different shade areas can be perfectly adjusted. The combination of Straumann Anatomic IPS e.max Abutment and IPS e.max Press enables restorations to be achieved that perfectly match the neighbouring teeth (Figs 6 to 8).

A detailed account of the surgical procedure was published in issue 03/2010 of the Straumann Starget magazine. ❑

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