REFLECT

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High-tech restorations in four hours

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Placing bulk-fill composites

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When concepts intertwine

A complex restoration with IPS e.max

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Dear Readers

Over and over again, the articles published in Reflect show us that conducting research and development in close contact with customers is worthwhile. This is also true for the current edition of Reflect, where users from different countries report once more about the impressive results they have achieved using Ivoclar Vivadent products.

Ivoclar Vivadent is constantly developing new materials and technologies for dentists and dental technicians. Our company has a high level of scientific competence in organic chemistry, inorganic chemistry, polymer chemistry, biology, ceramics, materials science, process engineering and apparatus engineering. Our knowledge and expertise in these fields allow us to devise comprehensive solutions and as a result we are able to offer fully integrated systems. In my function as the new Chief Technology Officer and successor of Dr Volker Rheinberger, my aim is to ensure that we continue to offer a versatile range of high-quality products geared towards the needs of the customer.

This issue of Reflect offers you a diverse range of specialist articles. You can find out how an edentulous jaw may be optimally restored with Phonares II denture teeth and the IvoBase injection system for the manufacture of denture bases. Or discover how you can enhance the anterior esthetics of your patients with thin veneers made of IPS e.max Press Impulse. You can also learn more about how to use IPS e.max to restore complex cases, and much more.

I hope you find the case studies and articles in this issue inspirational and I wish you enjoyable reading.

Yours

Dr Thomas Hirt
Chief Technology Officer
Ivoclar Vivadent AG

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High-tech restorations in four hours

Implant-retained prosthetic restoration of an edentulous jaw with the SR Phonares II and IvoBase system

Dr Enrico Agliardi, Prof Enrico Gherlone and Davide Romeo, Bollate/Italy

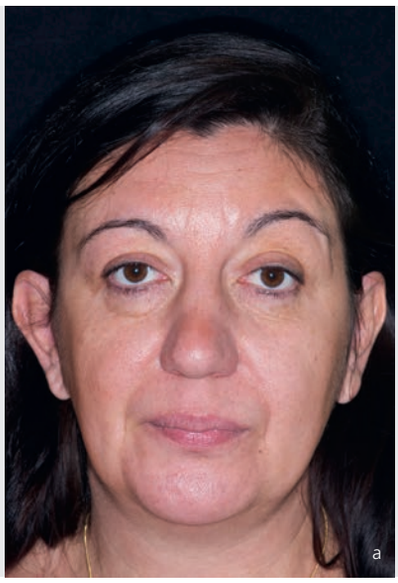
With composite denture teeth of the "latest generation", the increasing esthetic expectations of patients can be fulfilled even when restoring edentulous jaws.

Hybrid dentures supported by tilted implants provide several advantages for both the clinician and patient. Conventional treatment methods use four implants to anchor the restoration. By angling the end implants, optimal use of the bone volume available can be achieved. Consequently, the need for time-consuming procedures, such as bone augmentation, can be avoided. In addition, the patient can leave the practice a few hours after the surgical intervention with a temporary restoration in place. To meet the high esthetic expectations of edentulous patients, "individuality" plays a key role in the design of the prosthetic reconstruction – composite denture teeth of the latest generation and an especially designed denture base material based on PMMA (polymethyl methacrylate) are recommended to achieve this. These materials not only lead to a natural-looking result but also meet the demand for affordable restorations.

This report focuses on an implant-retained prosthetic treatment system for the esthetic and efficient treatment of edentulous patients. Similar to other fields of dentistry, the demand for minimally invasive procedures has been increasing in dental implant indications. Patients prefer treatment options that require less time and are based on a straightforward clinical procedure. This requirement is coupled with the factor of "esthetics". How can we combine these two aspects? "Rationalizing" the restoration of edentulous jaws is limited by the number of implants and the healing time required. In spite of this, modern implant systems and innovative prosthetic materials allow you to fabricate functional and esthetic hybrid implant restorations in a relatively short time and to discharge the previously edentulous patient with a "perfect" smile after a low-pain treatment. A well-thought-through and consistent treatment plan and collaboration with an experienced dental technician are a prerequisite for a successful outcome.

The starting point of every treatment is an accurate diagnosis based on a detailed clinical and radiographic analysis.

This is followed by a face-to-face conversation to understand the patient's expectations and to outline feasible options. Unrealistic expectations should be discouraged at this stage.




Figs 1a to d Initial situation: The upper jaw was previously restored with removable dentures. The remaining teeth were excessively loose and could no longer be saved. In the lower jaw, the patient wore a prosthesis retained by six implants.

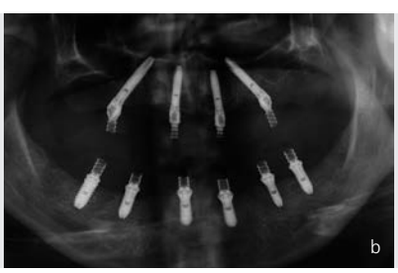
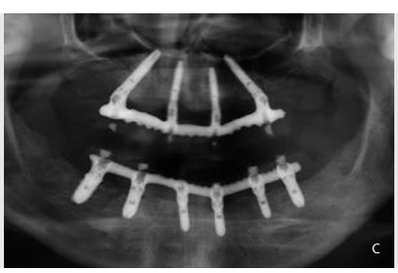
Patient case

A 42-year-old female patient came to our practice with a significantly reduced residual dentition in the maxillary jaw and removable dentures (Figs 1a to d). The mandibular jaw had received an implant-supported restoration two years ago. She complained about the severe mobility of her upper dentures. Her residual dentition was very loose because of advanced periodontal disease and could no longer be saved. Furthermore, she was unhappy about the esthetic appearance of her mandibular restoration. The patient requested a fast rehabilitation without having to undergo several surgical interventions. Her esthetic expectations were high, but her financial resources were limited.

We opted for an implant-supported prosthesis. After having explored possible treatment options, we decided to forego bone grafting in the upper jaw and, instead, to proceed according to the All-on-4™ treatment concept (Nobel Biocare AB). This system consists of a titanium-based hybrid prosthesis retained by two implants in the anterior region and two angled implants in the posterior region. This process takes optimum advantage of the existing bone to provide anchorage for the implants. In the case presented here, the final prosthesis was accomplished with a CAD/CAM milled titanium framework, nano-hybrid composite teeth (SR Phonares® II) and an IvoBase® denture base. The viability of prostheses anchored by only four dental implants with limited distal cantilever has recently been discussed in the dental literature. No differences in survival rates or marginal bone loss between axial and tilted implants have been reported.

Surgical procedure

Intravenous sedation was administered to extract the loosened teeth atraumatically and to debride the sockets. Starting from the site of the first molar, a mid-crestal incision was laid in the keratinized gingiva and a mucoperiosteal flap was elevated. The distal implants were inserted into the posterior sinus wall at an inclination of 40 degrees to the occlusal plane. In the anterior region, the implants were placed axially in the region of the lateral incisors. Angulated multi-unit abutments were fitted over the tilted distal implants, while standard abutments were placed over the anterior implants. After the flap had been repositioned, an impression and bite registration were taken. A few hours later, a lab-fabricated temporary composite bridge was inserted. This bridge ensured full occlusal contacts in maximum intercuspation from canine to canine and prevented any lateral excursion. Following a healing time of six months, a titanium base (NobelProcera®, Nobel Biocare AB) was manufactured for the final restoration (Figs 2a to c).

Figs 2a to c OPG image of the initial situation (a) and control X-rays of the temporary (b) and final restoration (c)

Fig. 3
Temporary restoration with immediate loading after insertion of the maxillary implants

Figs 4a and b Final restoration: titanium bar completed with Phonares II teeth and IvoBase denture base material using an effective, straightforward fabrication process

Fabrication of the prosthetic restoration

Both the temporaries (Fig. 3) and the final restorations (Figs 4a and b) were fabricated using the PMMA-based IvoBase hybrid denture base material, the IvoBase Injector and the Phonares II denture teeth. The IvoBase system combines the benefits of heat-curing and self-curing polymers. Polymerization shrinkage causes an inevitable loss of volume. With the IvoBase Injector, however, this loss is automatically compensated by the continual supply of material during the injection process. As a result, implant-supported temporary dentures ensuring a passive fit can be created without any difficulty. The surface quality and fracture resistance of this material are superior to those of other heat-curing polymers. Furthermore, the residual monomer content of IvoBase is 1.5 per cent, which is very low, considering that the permissible threshold for self-curing polymers is 4.5 per cent and 2.2 per cent for heat-curing polymers. If the RMR (residual monomer reduction) function is selected, the residual monomer content can be reduced to below 1 per cent. In this context, it is noteworthy to mention

Figs 5a to c Restoration incorporated in the patient's mouth. The hybrid dentures are retained by four implants in the upper jaw and six implants in the lower jaw. The surgical procedure was kept to the minimum necessary. The final result shows a maximum of esthetics due to the prosthetic materials used.

Figs 6a to d We provided this relatively young patient with an esthetic and nearly fixed prosthetic restoration using an effective method.

that the percentage (11 per cent) of fractured dental prostheses occurring in our practice has dramatically decreased since we commenced using the IvoBase system.

SR Phonares II Lingual denture teeth consist of nano-hybrid composite and have been especially designed for a lingualized occlusion scheme. These teeth are characterized by high strength and excellent wear resistance. They are particularly suitable for implant-supported dentures that are exposed to high chewing forces. These teeth impart a natural-looking appearance to the anterior region due to their esthetic surface texture, translucency, opalescence and fluorescence. The teeth feature an anatomically shaped base and, as a result, can be easily adjusted to the alveolar ridge. Each tooth is composed of four layers: the dentin core and facial incisal layer consist of NHC material, imparting natural esthetics and high wear resistance to the tooth. The back incisal and cervical layer comprise PMMA material to ensure an effective bond with conventional denture base materials. The NHC material is based on a highly cross-linked urethane dimethacrylate matrix, which comprises micro- and macrofillers of various types and sizes as well as PMMA clusters. The macrofillers are responsible for the high strength and colour stability of the teeth; the microfillers enhance the material's resistance to wear. The PMMA clusters embedded in the composite structure reduce the material's affinity for plaque accumulation and discolouration. A range of tooth moulds are offered to match the age and characteristics of the individual patient.

Light-curing pastes (SR Nexco® Stains) are available to customize the individual teeth and the denture base, or pink esthetics. The result is a natural-looking prosthesis (Figs 5a to c).

Aftercare

The prosthetic restoration was completed and incorporated comparatively quickly. Regular oral care at home and in the practice is fundamental to ensure the longevity of the restoration. The dental hygienist plays an essential part in this, providing regular professional cleaning and motivating the patient to conduct measures of oral care at home conscientiously.

Conclusion

The case described in this report shows how the dental team can provide an adequate solution for a complex case by devising a detailed treatment plan. A predictable and long-lasting result satisfying both the patient and dental team can be achieved with thorough knowledge of the materials used, an appropriate selection of components and strict adherence to the surgical and prosthetic protocols (Figs 6a to d).

Contact details:

Dr Enrico Agliardi
A.b.s. dental service
Via Roma 15
20021 Bollate (MI)
Italy
e.agliardi@studioagliardi.it

Placing bulk-fill composites

The creation of esthetic posterior restorations using Tetric EvoCeram Bulk Fill
Dr Markus Lenhard, Neunkirch/Switzerland

Bulk-fill composite simplifies layering in the direct restoration of teeth and reduces the number of working steps.

For some time now, all dental manufacturers of note have been offering composite resins suitable for the bulk-filling technique. Nevertheless, the compositions and working properties of some of these materials vary quite considerably. To me, the concept behind Tetric EvoCeram® Bulk Fill, the composite highlighted in this article, seems to be highly plausible and very well implemented. As the material allows sculpting of the occusal anatomy, the placement of a capping layer using a conventional composite is not required. Moreover, it exhibits wear resistance similar to that of conventional Tetric EvoCeram and is excellently suitable for use in occlusal load-bearing areas due to its flexural strength of 120 MPa. The special filler composition makes Tetric EvoCeram Bulk Fill easy to adapt and contour and allows for excellent polishability.

The two case reports presented below are testimony to the wide range of indications covered by Tetric EvoCeram Bulk Fill.

First case

Tooth 16 showed a fractured mesial marginal ridge that was undermined by caries (Fig. 1). Following the placement of a rubber dam, the tooth was prepared and a medium-sized Class-II cavity resulted (Fig. 2).

Fig. 1 Preoperative situation: mesial caries with fractured marginal ridge

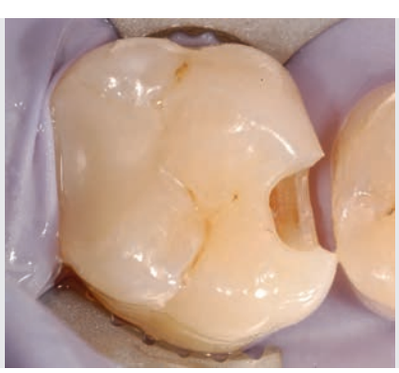


Fig. 2 Situation after tooth preparation

Fig. 3 Placement of a sectional matrix band

Fig. 4 Selective enamel etching for 30 seconds

Fig. 5 Application of AdheSE Primer and Bond

Fig. 6 The cavity was filled with a single increment of Tetric EvoCeram Bulk Fill (shade IVA).

With the exception of composite placement, which is done in 4-mm increments, the rules established for adhesive restorative procedures still apply when bulk-fill composite is used.

In order to achieve optimum adhesion to enamel, it is essential to prepare the enamel margins in such a way that the enamel prisms are obliquely cut. This entails bevelling of the vertical proximal margins and the gingival shoulder [1-5].

After a sectional matrix band had been placed (Fig. 3), a dentin/enamel bonding agent was applied. My preferred technique is a combined one [6], consisting of the selective etching of enamel for 30 seconds and the subsequent application of a two-bottle self-etch adhesive (AdheSE®) (Figs 4 and 5). One increment of shade IVA Tetric EvoCeram Bulk Fill was sufficient to fill the entire cavity (Fig. 6). Figure 7 shows the completed restoration after polishing it with Soflex discs and OptraPol® Next Generation.

Fig. 7 The completed restoration

Fig. 8 Preoperative situation: Fracture of the lingual wall of tooth 36, cracked buccal cusps

Fig. 9 Situation after preparation of the tooth

Fig. 10 The enamel was selectively etched for 30 seconds.

Fig. 11 AdhesSE Primer was applied to all cavity surfaces for 30 seconds.

Fig. 12 Application of AdhesSE Bond

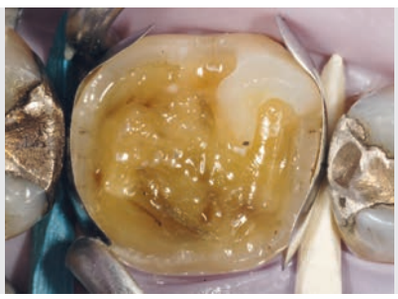


Fig. 13 Matrix bands and wedge were placed.

Fig. 14 The first Tetric EvoCeram Bulk Fill increment was placed. The size of the increment was slightly smaller than would have been admissible, as this amount of material was sufficient to appropriately reconstruct the marginal ridge.

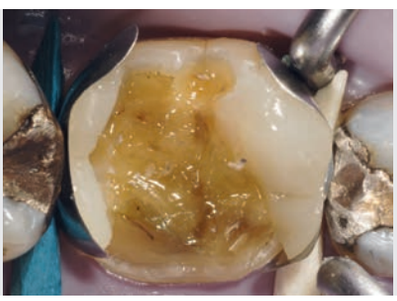


Fig. 15 Second increment: Each increment was cured for 20 seconds with the Bluephase Style curing light.

Fig. 16 Third increment

Second case

Preoperatively, tooth 36 displayed a fractured lingual wall and cracked buccal cusps (Fig. 8). Figure 9 shows the situation after placement of the rubber dam and preparation of the tooth. Merely the mesio-buccal cusp remained intact. However, it had to be shortened by 1.5 mm to ensure sufficient stability. Adhesion was again achieved by selectively etching the enamel for 30 seconds and subsequently applying AdheSE Primer and Bond (Figs 10 to 12). Following the placement of sectional matrix bands (Fig. 13), the tooth was built up in stages using Tetric EvoCeram Bulk Fill. Only six increments were needed to rebuild the entire crown (Figs 14 to 19). Each individual increment was light-cured for 20 seconds using the Bluephase® Style curing light. Even though this is twice the time recommended by the manufacturer, I believe that this length of time is necessary in view of the clinical variables that may influence polymeriza-

Fig. 17 Fourth increment

Fig. 18 Fifth increment

Fig. 19 The build-up was completed with the sixth increment.

Fig. 20 Sculpting of the occlusal surface anatomy

Fig. 21 The occlusion was checked and adjusted.

Fig. 22 Postoperative view

Fig. 23 At the recall after one year, the restoration was found to be unchanged clinically.

tion (distance to the restoration surface, irradiation angle, undercut areas), particularly when restoring occlusal load-bearing teeth. The failure mode most frequently observed in conjunction with composite resin fillings is filling fracture [7], which is most probably due to the fact that the restorations tend to be less than properly cured and thus do not demonstrate ideal physical stability.

Coarse finishing was performed with Soflex discs and fine diamonds (Fig. 20). After the occlusion had been adjusted (Fig. 21), the restoration was polished to a high gloss with OptraPol Next Generation. Figure 22 shows the restoration immediately after having been completed.

One year postoperatively, the restoration was found to be unchanged clinically (Fig. 23).

Conclusion

Tetric EvoCeram Bulk Fill considerably facilitates the placement of all types of composite fillings, from small to large ones. Due to the material's non-slump consistency and excellent sculptability, even large restorations that involve the reconstruction of cusps can be fabricated in an efficient manner. The limited range of shades has proved completely unproblematic in practical use. For the restoration of anterior dentitions and esthetically sensitive cases I normally use IPS Empress® Direct. Thus with Tetric EvoCeram Bulk Fill, Tetric EvoFlow® and IPS Empress Direct I can cover the entire spectrum of indications in the direct restoration of teeth with composite – these three are all I need.

A literature list is available from the editors on request.

Contact details:

Dr Markus Lenhard
Vordergasse 30
8213 Neunkirch
Switzerland
markus.lenhard@bluewin.ch

New materials provide improved esthetics

Restoring anterior teeth with thin veneers made of IPS e.max Press Impulse

Dr Rafael Piñeiro Sande, Cambados – Pontevedra/Spain

With the advent of new materials such as lithium disilicate, very thin veneers can now be fabricated. These ultra thin veneers require only minimal removal of natural tooth structure.

The all-ceramic system IPS e.max® covers all the current all-ceramic indications. It is suitable for use with CAD/CAM and press methods. The wide assortment of IPS e.max Press products comprises ingots in four levels of translucency (HT, LT, MO, HO) and Impulse ingots in three different "value" (Value 1, 2, 3) and two "opal" shades (Opal 1, 2). These materials are particularly useful for fabricating single tooth restorations if dental enamel has been damaged or stained, as described in detail in the following case study.

Clinical case

The 39-year-old patient consulted us about improving the appearance of her front teeth (Fig. 1). Apart from slight periodontal problems, we diagnosed proximal caries in the first incisors as well as Class III dental and skeletal malocclusion with an open bite (Fig. 2).

Fig. 1 The patient wanted a more attractive smile.

Fig. 2 Close-up of the teeth before the treatment

A radiographic examination confirmed the fundamental periodontal problem and also showed peri-apical infections surrounding teeth 31 and 32.

A two-stage treatment plan was devised. The first stage involved the elimination of caries and infection. It included periodontal curettage and planing of root surfaces in order to control the underlying disease. The malocclusion was corrected with orthodontic treatment. The second stage focused on esthetics. This phase started with a clinical, radiological and photographic analysis (Figs 3 and 4). Furthermore, an impression was taken and the maxillomandibular relationship was recorded by means of an arbitrary facebow. In addition, the gum line was adjusted with the help of connective tissue transplants and the lower tooth arch was bleached. Finally, the ultra-thin veneers (< 0.5 mm) made of IPS e.max Press Impulse Opal 2 were placed.

After the teeth had been thoroughly analyzed, a wax-up was fabricated, which was subsequently used to create a mock-up. A 2-mm-thick perforated tray (Fig. 5) and two silicone matrices were produced. The first silicone matrix was used to check the vertical dimension of occlusion during preparation (Fig. 6), while the second one was used to fabricate the chairside temporary.

Preparation

In order to ensure proper reduction of the vestibular tooth surface, a depth marker was used. This bur cut orientation grooves with a depth of 0.3 mm. The incisal edge was reduced with a diamond bur (0.6 mm). This instrument was also used to remove the ridges between the grooves and completely level out the surface. The proximal and gingival areas were prepared with the same diamond.

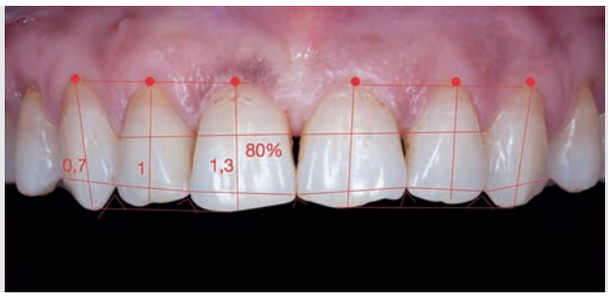


Fig. 3 Tooth analysis after the first treatment phase

Fig. 4 Smile analysis

A retraction cord was placed along the gingival margin to protect the gum tissue during the preparation procedure. The marginal and proximal areas were prepared and then polished. The entire preparation surface was completely smoothed with a polishing disc and a medium-grit polishing paste: all grooves and edges were eliminated. The silicone matrix was inserted to check the correct dimensions of the prepared teeth (Fig. 7). Then, the retraction cords were removed.

Impression

The heavy/light dual-phase impression was taken with a customized tray, which was coated with an adhesive to increase the adhesion of the impression material on the tray. The double-cord retraction technique was used: The first retraction cord (size 000) was individually packed in the sulcus of each prepared tooth. A second continuous retraction cord (size 00) was placed on top. With this method the gingiva is completely displaced from the prepared dental hard tissue and blood and saliva, which could adversely affect the precision of the impression, are absorbed. The heavy/light dual-phase impression technique employs impression materials of different viscosities. Accordingly, a heavy-body material was loaded into the tray, while a light-body material was syringed around the prepared teeth (Fig. 8).

The precision of the impression was checked and then temporary restorations were produced chairside. For this purpose, a two-component composite resin was mixed and syringed into the previously fabricated silicone matrix. Once the composite resin demonstrated an ideal consistency, the matrix was placed in the patient's mouth. The provisional material was cured and then the matrix was removed. Excess composite was trimmed away with rotary instruments. Subsequently, the temporary restorations were characterized with staining and glazing materials.

Fig. 5 Three-dimensional assessment of the preparation with a perforated tray

Fig. 6 Silicone matrix for checking the vertical dimension of occlusion of the preparation

Fig. 7 Inspection of the incisal reduction

Fig. 8 The light-body impression material is syringed in the sulcus.

Fig. 9
Die with defined preparation margin

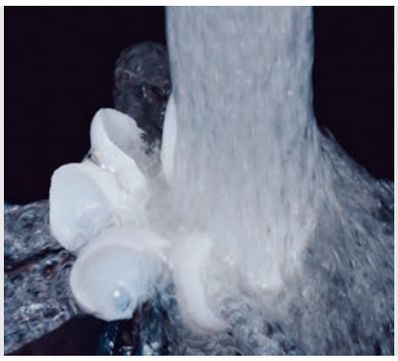


Fig. 10
Divestment of the pressed restorations

Fig. 11 The completed veneers

Laboratory work

The dental lab technician made a cast from the disinfected impression using class IV plaster. After the models had hardened, the preparation margins were defined (Fig. 9). The veneers were waxed up and then removed from the die and invested. Subsequently, they were reproduced with IPS e.max using the press technique. The veneers were divested (Fig. 10), finished and individually characterized (Fig. 11).

Fig. 12 The veneers are tried in with Variolink Try-In.

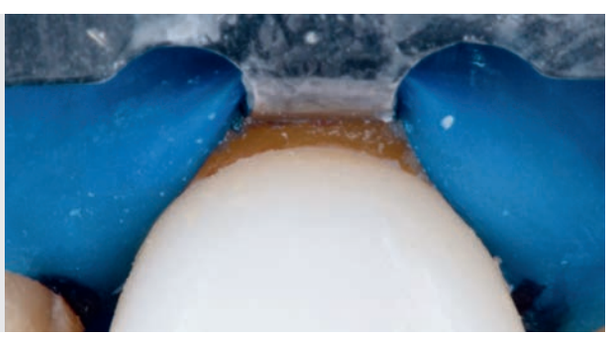


Fig. 13 Adjustment of a veneer to the vestibular margin

Try-in and cementation

In the second clinical phase, the veneers were tried-in and cemented in place. Firstly, the temporary restorations were removed and the prepared teeth were cleaned. Each veneer was tried-in individually to ensure correct fit. Next, the proximal fit was checked by positioning one veneer correctly and then placing the adjacent veneer. The position of the first veneer was examined very closely after the adjacent veneer had been placed in order to establish any changes.

Any small additional adjustments to the veneers can be made with suitable ceramic polishers.

The veneers were placed with Variolink® Veneer. In the first step, the shade of the adhesive was selected. Variolink Try-In pastes were used for this purpose, since they help simulate the final shade of the restoration (Fig. 12). The adhesive cementation procedure was divided into three stages: pretreatment of the veneers, conditioning of the prepared teeth and placement and finishing of the veneers.

A rubber dam was placed with a retentive clasp for each individual preparation. The veneers were tried-in with the Variolink Try-In pastes. Subsequently, they were rinsed with a water jet and dried with oil-free air. For optimal cleaning results, Ivoclean was applied for 20 seconds and then removed with a water jet.

The ceramic surface, which had to be kept free from contamination from now on, was treated with five-percent hydrofluoric acid (IPS Ceramic Etching Gel) for 20 seconds. The restorations were cleaned with a water jet and additional immersion in an ultrasonic bath for five minutes. Next, the veneers were dried and conditioned with the silane coupling agent Monobond Plus for 60 seconds. Any excess was dispersed with a strong stream of air. The prepared teeth now had to be cleaned with brushes and fluoride-free prophy pastes. The enamel was etched with the 37-percent orthophosphoric acid Total Etch for 30 seconds and then

Fig. 14
The seated veneers

Figs 15 and 16 The broad and satisfied smile of the patient at the conclusion of the treatment

cleaned with a water jet and oil-free, uncontaminated air. The adhesive ExciTE® F was applied shortly before the veneers were placed. The adhesive was applied thickly on enamel and dentin and carefully scrubbed in for at least 10 seconds. Excess was dispersed to a thin layer with a weak stream of air. Pooling had to be avoided in the process. A shiny surface showed that the tooth was completely sealed. The adhesive was cured for 10 seconds with a light intensity of above 500 mW/cm^2. Next, the luting cement Variolink Veneer was directly applied to the preparation.

In the final luting phase, the veneers were placed on the prepared teeth with the application of consistent pressure and then polymerized for two seconds (Fig. 13). At this stage, the luting material was not yet completely cured. As a result, it was easy to remove excess with a probe. Subsequently, the restorations were cured for 90 seconds from all sides. The margins were previously isolated with the glycerine gel Liquid Strip. This measure prevents the formation of an oxygen-inhibited layer during polymerization and enables the luting material to cure properly. Any excess was removed with the help of a scalpel. Fine-grit burs and silicone polishers were used at the palatal margin. The cementation process was finalized with the removal of the rubber dam and an inspection of the occlusion (Fig. 14).

After the treatment had ended, the patient received instructions on how to look after her restorations. She was scheduled for a recall examination after one month (Figs 15 and 16).

Conclusion

The topic of "esthetics" continues to grow in importance in dentistry. The development of innovative materials, such as IPS e.max Press Impulse, allows new techniques to be used, which enable non-invasive preparation of the teeth. Furthermore, these techniques provide esthetic benefits that eliminate the previous quality difference between the "press-on" and the layering technique.

Specialist knowledge of the adhesive cementation of lithium disilicate restorations gives dentists the professional edge needed to face the challenges associated with this type of treatment. The treatment protocol is firmly established today. Moreover, it is of utmost importance for dentists and dental technicians to do their work with great precision. In order to jointly have a positive impact on the results, both parties must know the entire procedure. Teamwork and a meticulous approach during the individual treatment phases are required to achieve esthetic outcomes.

Acknowledgement

I would like to thank Roberto Portas Moure for the excellent dental lab work and the patient for her confidence in us and her patience during the treatment.

A literature list is available from the editors on request.

Contact details:

Dr Rafael Piñeiro Sande
Clínica Dental Piñeiro Sande
Riveiro 1, Corbillón
36634 Cambados – Pontevedra
Spain
info@pineirosande.com

When concepts intertwine

A complex restoration with IPS e.max
Jan Kurtz-Hoffmann, Leipzig/Germany

In dentistry, lasting results can only be achieved if a conceptionally well-thought-out course of action is followed.

"To conceptualize" means to form an idea or concept out of observation, experience, or data. "Concept" derives from Latin conceptus and means a summary of a particular branch of knowledge or an abstract.

Practice and treatment concept

"Room for freedom" presents a key element in our practice concept. Nothing is only black and white – a view beyond the horizon allows us to be inspired by new perspectives. This underlying principle informs the way we deal with our patients and manage our practice. Without a structured approach to treatment, the situation may soon spiral out of control, paralysing the course of action and jeopardizing the success of the treatment. The patient case discussed here demonstrates how a structured treatment concept goes hand in glove with a well-thought-out material concept.

Material concept

We have been using the IPS e.max® system for many years. This system enables us to cover a multitude of indications. The materials are precisely matched to each other, from fabrication through cementation to aftercare. Sound scientific evidence provides the necessary assurance of reliability. It is important for us to work with a material system that articulates well with our practice concept; such a system should be designed coherently and enable efficient workflows.

Fig. 1 Preoperative situation marked by inadequate metal-ceramic restorations and a sunken bite.

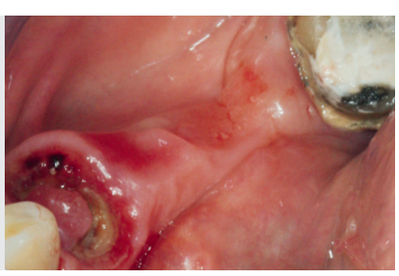


Fig. 2 The alveolar ridge revealed signs of severe atrophy after the bridge from tooth 44 to 47 had been removed.

Patient case

The patient presented in this report visited our practice in March 2009 for the first time. She was unhappy with the state of her teeth and sought advice with regard to having her prosthetic restorations replaced. Dental and periodontal charting was performed. Additionally, a functional-diagnostic and radiological examination was carried out. The situation was marked by inadequate prosthetic restorations (Fig. 1). Some of the metal-ceramic restorations had fractured; exposed margins were present. A sunken bite was one of the consequences. We also diagnosed severe periodontal defects with generalized horizontal bone atrophy and partly vertical bone loss. Inflammatory changes were observed in the soft tissue of the maxillary anterior region in particular and this situation was exacerbated by the insufficient marginal seal of the crowns. The lower posterior region was restored with a bridge from tooth 44 to 47; tooth 44 was loose and a fistula was growing from its root. The alveolar ridge was vertically so severely atrophied that bone augmentation measures were unavoidable (Fig. 2).

Planning

For the prosthetic planning phase, dental photos and study models were prepared. This was followed by model analysis, photo analysis, digital smile design, wax-up,

mock-up and treatment planning. Our way of providing treatment recommendations is also a characteristic of our practice model. We offer the "optimum of esthetics and function" to each patient. By using the objective criteria established for the patient case we suggest various treatment options. The "optimum" constitutes one of the three treatment options offered, while the result obtained with any of the alternative options may deviate only slightly from the level achieved with the optimum solution. All options comply with the high standards of state-of-the-art restorative care. In the present case, the patient opted for the following treatment plan:

- Deep cleaning and periodontal treatment
- Removal of the bridge between tooth 44 and tooth 47; extraction of tooth 44 and bone augmentation in the region of tooth 44 to tooth 46
- Temporary bridge from tooth 43 to 47
- Analysis of functional temporomandibular joint parameters
- 3D radiographic imaging for implant placement planning
- Implant insertion in the posterior mandibular region including bone augmentation
- Long-term temporization of the lower mandibular with a gradual bite raise to achieve occlusal contact in centric occlusion
- Placement of implants in the maxillary posterior region with external sinus lift
- Minimally invasive surgical crown lengthening in line with the biological width
- Long-term temporization of the maxillary jaw with gradual bite raise to achieve occlusal contact in centric occlusion
- Long-term temporaries to be worn for at least six months
- Final prosthetic restoration with centric occlusion

Tooth 17 was rotated severely because of a lack of support. Since orthodontic treatment was out of the question for the patient, we explored the possibility of crowning the tooth. However, the fact that this could only have been accomplished by preparing healthy tooth structure was an argument against it. If the tooth had been included in the prosthetic restoration at this point, it would have been necessary to remove an unduly large amount of tooth structure, entailing a risk of endodontic complication.

Pre-prosthetic treatment

After deep cleaning and oral hygiene instruction, the patient underwent a course of closely managed periodontal treatment involving comprehensive oral hygiene measures (e.g. deep scaling) to ameliorate the periodontal damage. After removal of the deposits from the sub- and supragingival areas, the soft tissue areas became gradually free of inflammation.

After taking out the bridge between tooth 44 and tooth 47, we carefully extracted tooth 44 and removed the cyst growing from it. At this stage, the alveolar ridge was augmented with bone substitute material and then covered with a closed membrane. Following the surgical intervention, the teeth were temporized with relined eggshell temporaries (Telio CAD). After six months, we inserted the implants at the sites of teeth 44, 45, 46 as well as 35 and 36 in several stages. The augmented alveolar ridge in the region of tooth 44 to tooth 46 offered now a stable foundation for the implants.

The wax-up helped to visualize our ideas with regard to the shape and function of the prospective restoration and was used in the dental lab as a basis for the fabrication of the temporary crowns and bridges. Temporization of the mandibular anterior teeth was achieved using a direct composite technique and a tray. In the maxillary jaw, two implants were inserted in the region of tooth 15 and 16 after external sinus lift surgery. After the implants had healed and been uncovered, the maxillary teeth were prepared and the preparations conditioned for the placement of the long-term temporaries. To achieve natural soft tissue contours in the subsequent final prosthetic restoration, minimally invasive surgical crown lengthening was performed on teeth 12 to 22 in the anterior region whilst the biological width of the tissue was taken into account (Fig. 3). The dental technician fabricated long-term temporaries (Telio CAD), which were inserted shortly afterwards. This approach allowed us to increase the occlusal vertical dimension in two stages. A computer-assisted functional analysis using a Cadiax system served as the basis for the fabrication of the long-term temporaries. After the patient had undergone an adaptation phase, the bite situation was reassessed and the long-term temporaries adjusted accordingly (Fig. 4).

Fig. 3 After deep cleaning, surgical crown lengthening was performed to achieve an ideal soft tissue contour in the esthetic zone.

Fig. 4 Oral situation with long-term temporaries in situ. The aim was to achieve appropriate soft tissue contours and to stabilize the vertical dimension.

The patient wore the temporaries for ten months before further treatment was undertaken. During this period, she came back to our practice for recall visits and prophylactic treatments at regular intervals.

Prosthetic treatment

Customized zirconium oxide abutments were mounted on the implants. Following minimally invasive surgical crown

Figs 5 and 6
After ten months, ideal conditions for the placement of the prosthetic restoration were present: stable soft tissue conditions, fully healed implants and accurate preparations.

lengthening, the anterior gingival margin looked clean and healthy. Now, all risks were eliminated: the implants had healed, the soft tissues were shaped and the patient's oral function and periodontal conditions were stabilized. The long-term stability of both the tissue and the overall oral situation now formed an ideal basis for the placement of the final restoration.

The temporaries were removed and the preparations reworked. We consider it to be a duty to wear loupes or use a microscope at every stage of our work. Likewise, a planned approach to preparation is equally important to achieve long-term stability. The guidelines for all-ceramic restorations were strictly observed: no angles or edges, shoulder preparation with rounded inner edges and appropriate dimensions reflecting the minimum thickness required for the restoration material (Figs 5 and 6). We checked the preparation with a lab-fabricated silicone key. Finally, the preparation margins were smoothed and finished using an ultrasonic instrument, retraction cords were placed into the sulcus followed by impression-taking with a polyether material.

When we consulted the patient on shade selection, it soon transpired that she preferred a bright tooth shade. Reconciling her preference with the material system of our choice did not pose any difficulty. Although the patient preferred a very bright shade, the technician was able to endow the restorations with a natural-looking vibrant appearance due to the ceramic system used.

The optical effect of the tooth preparation shade should not be underestimated.

This meant that we also determined the shade of the preparations in addition to tooth shade selection (Fig. 7).

Laboratory

Using the amended long-term temporaries as a basis, the dental technician created the final single crowns. The lithium disilicate (LS_2) glass ceramic IPS e.max Press was chosen for the restoration of this esthetically demanding region. This material comes very close to the natural dentition in terms of esthetics, efficiency and strength. In a step-by-step procedure, the situation was recreated in all-ceramics using first a press technique and subsequently a ceramic layering technique to customize the crowns with IPS e.max Ceram. The partially discoloured preparations were skilfully camouflaged by choosing ingots with an appropriate level of opacity. Consequently, the crowns were pressed with low-translucency ingots (IPS e.max Press LT BL4), cut back and individually layered. The final tooth shade corresponded with the A1 shade, as preferred by the patient (Fig. 8).

Fig. 7
Information about the shade of preparation plays a particularly important role if discoloration is present. The dental technician selects an appropriate IPS e.max Press ingot on the basis of this information.

Fig. 8
The all-ceramic single crowns were created using the IPS e.max Press lithium disilicate glass-ceramic. The pressed crowns were cut back and layered individually.

Fig. 9 Frontal view of the single crowns in occlusion …

Figs 10 and 11 … and the upper and lower jaw, viewed from occlusal. This patient received high-level treatment due to a structured treatment plan.

Figs 12 and 13 Following an esthetic and functional evaluation of the final result, the patient was discharged, with everybody being satisfied with the outcome.

Seating

Adhesive cementation was used for most of the restorations. The temporaries were removed and the preparations cleaned of any residual temporary luting material. Using try-in pastes, we verified each restoration in the patient's mouth and evaluated the esthetic effect. Occlusal checking was carefully performed. The seating protocol for the placement of the restorations was as follows:

- Restorations 13 to 23: adhesive cementation with Variolink® II
- Restorations 14 to 27, 34, 37, 33 to 43, 47: adhesive cementation with Multilink® Automix
- Restorations (implant-retained crowns) in region 15, 16, 35, 36, 44 to 46: cementation with glassionomer luting cement

The all-ceramic crowns were seated in compliance with the manufacturer's instructions. Subsequently, the occlusion and function were assessed, followed by final polishing of the margins and restorations (Figs 9 to 11). The patient was given a protective splint and discharged from the practice.

Result

The restorations ideally blended in with the oral and facial surroundings of the patient (Figs 12 and 13). The soft tissue was free of inflammation and the papillae had almost fully grown back already at this early stage. All functional parameters were adapted individually and met the requirements of the patient. In the following months she came to the practice for recalls at regular intervals and never showed any complaints or functional interferences during mastication. The bright tooth shade met the patient's expectation and we felt that it matched the patient's overall appearance very well. If we look at tooth 17 on the final picture (Fig. 10), our decision to preserve it proved to be right. The tooth will gradually rotate and elongate to eventually fit into the arch. Without doubt, an orthodontic intervention would have resulted in an elegant solution, but the patient wanted to avoid this additional course of treatment. Here, nature will point the way; in a few months, we will probably be able to align the tooth with the tooth row by means of a table top. Tooth 38 acted as a "sheet anchor". If the implants had not healed successfully, this tooth would have been used as an abutment for a bridge restoration. Therefore, it only received intermediate care whilst the other teeth were being restored. Since the restorations had healed successfully, it was now time to remove it.

Conclusion

A treatment concept that is based on esthetics and function is the result of a harmonious interplay of individual disciplines. A well-thought-out and coherent treatment strategy forms the basis for a successful outcome, particularly if an extensive restoration is required. Restorations meeting all the required esthetic and functional criteria can be achieved if an appropriate material system is utilized. Important though these concepts may be, the treatment team should always give themselves a certain amount of scope for freedom to pursue a targeted approach in line with the individual patient case.

Restorations involving such a high degree of complexity as in the case discussed in this report are only successful if a team works closely together. My practice partner Nico Lindemann, DDS, was responsible for the implant treatment and dental technician Frank Zalich was in charge of the laboratory work.

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Jan Kurtz-Hoffmann
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Beethovenstrasse 8
04107 Leipzig
Germany
mail@za-leipzig.de

From implant shoulder design to a harmonious smile

Restoration of an edentulous mouth with partially removable dentures

Hans-Joachim Lotz, MDT, Weikersheim/Germany

Our smile is part of our identity. Recreating the smile characteristics in an edentulous patient represents the pinnacle of dental prosthetics.

When we smile, we show emotions. People respond with many feelings to the way we use our mouth. If we show our teeth, we reveal something about ourselves. These are only a few examples illustrating the fact that our mouth does not only fulfil a biological function but also reflects our feelings. Every dentist-technician team aims to recreate the functional and anatomical characteristics of the teeth and the surrounding tissues. This is coupled with an additional issue: the patient's individuality (Figs 1a and b). This report describes the case of a female edentulous patient whose restorative needs were met with a customized esthetic restoration. Striking a balance between a high smile line, an extremely low mandibular vertical dimension and limited vertical space in the maxilla proved to be the main challenges here.

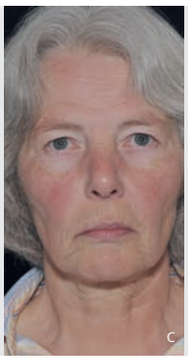
Figs 1a and b The individuality of the patient should be reflected in every prosthetic reconstruction. This patient has had a high smile line since her childhood. In her mid-sixties, she presented with an edentulous upper and lower jaw.

Patient case

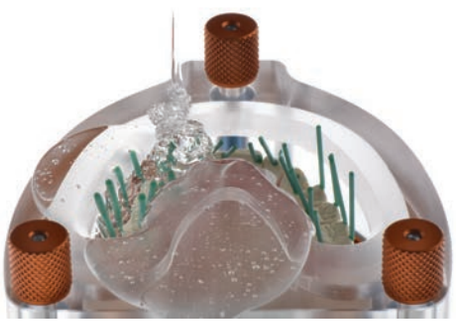
The patient came to see the treatment team with the request to have her edentulous upper and lower jaw restored. At first sight, we noticed a high smile line and short upper lip length. The lower jaw bone showed signs of severe atrophy. By comparison, the upper alveolar bone appeared to be unduly large. When we were trying to establish the best possible treatment plan to meet the patient's individual needs, we had to clarify what defined a "fixed restoration" to the patient. Restorations that are partially removable (or partially fixed) can be "fixed" in the mouth and yet offer advantages over non-removable restorations (e.g. hygiene capabilities). A partially removable implant-retained restoration presents a well-established treatment option that has been successfully used for decades and was selected for the case described in this report. The treatment team decided to insert six implants in the upper jaw and four implants in the lower jaw.

Procedure in the dental lab

After osseointegration of the implants, impression-taking was performed. Detailed prosthetic planning made it clear that fabricating the prosthesis was going to be no mean feat. Because of the large maxillary alveolar ridge, the vertical space available for the prosthetic restoration was limited. The vertical dimension in the mandible was accordingly large. This aspect was at the forefront of our considerations. The superstructure would have to be skilfully used to diminish this discrepancy. However, there were more challenges to overcome: the patient's pronounced lip dynamics posed additional difficulties for achieving good restorative esthetics. The aim was to find a way of camouflaging the transition between prosthetic and natural gingiva so that it blended naturally. Again, the lack of alveolar height proved to be a limitation – the maxillary restoration could not be designed to extend to the gingivobuccal fold. What to do instead?



Figs 2a to d Mock-up to visualize the intended result. Objective and subjective criteria were analysed.



Figs 3a and b
The mock-up was duplicated in a transparent flask using clear silicone material.

Creating the mock-up

After the models were transferred to the articulator, a mock-up was created and a try-in performed on the patient to visualize the prospective results (Figs 2a to d). Tooth-coloured polyurethane material ensured that the patient did not get distracted by an unnatural tooth colour. With the mock-up placed in the patient's mouth, the dentist was able to clarify all contingencies, whilst taking esthetic preferences, function and phonetic aspects into account. At the mock-up stage, the following objective and subjective characteristics were assessed:

- Has the facial plane been faithfully transferred to the dentures (occlusal plane)?
- How do the upper and lower jaw relate to each other (vertical bite relationship)?
- Has a harmonious balance between pink and white esthetics been achieved?
- Are pink and white esthetics harmoniously balanced?
- How much "white" is possible, how much "pink" is necessary to ensure an esthetically harmonious smile?
- Is the patient capable of articulating speech clearly (phonetics)?
- What are the patient's subjective feelings regarding the restoration and can she identify with it?
- Does she have any additional requirements or requests for amendments?

Planning the superstructure

In a tricky case like this, accurate groundwork requires time and a detailed analysis of the given situation. For the upper jaw, we decided to fabricate a telescopic bridge veneered with a lab composite. Additional locking components were required due to the lack in vertical height. The sliding friction of the telescopes alone would not have been sufficiently strong to keep the dentures tight in place. In the lower jaw, a bar-sustained prosthesis was indicated and again esthetic veneering with a composite was the method of choice. To achieve a lasting friction, attachments (Preci-Line) would be used in conjunction with the bar construction. As the existing bone was used to perform the implantation, the implants were not ideally distributed over the entire alveolar ridge. Additionally, the extreme bite height appeared to pose a certain level of difficulty; physical stability (leverage forces) was another issue of concern.

After we knew how we were going to design the superstructure, we "froze" the mock-up in a transparent flask (Figs 3a and b). This method allowed us to preserve all the specifications that we had worked out. Utilizing transparent duplicating silicone is key to be able to transfer the planned reconstruction to the final restoration.

Fabricating the final restoration

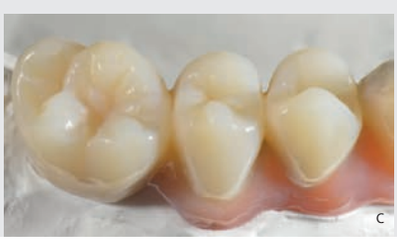
The primary and secondary retentive elements were fabricated. The frameworks were tried in on the patient and checked for accuracy of fit (Figs 4a to c). That achieving a tension-free fit was paramount in this context may here be mentioned only in passing. The frameworks were veneered with a special veneering composite: SR Nexco®. This light-curing lab composite with micro-opal fillers is

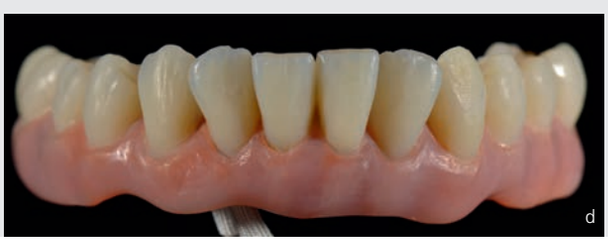
Figs 4a to c The frameworks for the superstructure fitted on the model and in the mouth without causing tension (mandible: implant-sustained bar; maxilla: telescopes for a bridge restoration).

Fig. 5 The mandibular restoration was pressed in dentin only …

Fig. 6 … and then ground to the dentin core (cut back) and …

Fig. 7 … complemented with appropriate incisal material using a flask technique.





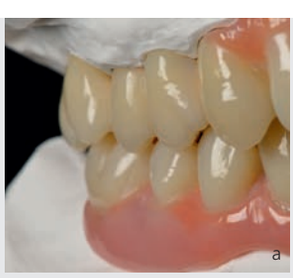
Figs 8a to d The gingival parts were manually built up in layers using the comprehensive SR Nexco shade range.

characterized by material and processing features specifically geared to the needs of the lab technician. It offers a beautiful optical appearance and good clinical behaviour. Given its physical and optical properties, SR Nexco is ideally suited for this type of work. Compared with ceramic materials, the composite is capable of absorbing forces and is therefore especially suited for veneering applications in implant restorations.

At this stage, we were able to ripe the benefits of our meticulous approach to planning and of our transparent flask method. SR Nexco dentin material of the appropriate shade was pressed onto the conditioned framework and polymerized in a curing device (Fig. 5). With this method, the prosthesis was homogeneously reproduced in dentin in a relatively short time. The reconstruction was removed from the flask and reduced to the dentin core using the silicone key as a guide, similar to the cut-back technique (Fig. 6).

Lifelike fluorescent and opalescent effects are paramount to ensure a harmonious integration of the tooth shade under varying light conditions.

Customized layering is essential to achieve a true-to-nature effect, not unlike ceramic restorations. To complement the incisal area, the corresponding incisal material was applied into the flask and pressed onto the "dentin core" using heat and then polymerized. In a few stages, we transferred the planned restoration to the final reconstruction using an esthetic dentin and incisal build-up (Fig. 7).



Figs 9a to c Completed restorations on the model

Fig. 10 After polishing: the lab composite offers an impressive surface finish.

Figs 11 and 12 The natural opalescent properties can be clearly seen here.

Fig. 13 Emotions are reflected in the mouth: the teeth naturally blend in with the oral environment.

Figs 14 and 15 In spite of the suboptimal initial situation, we achieved a result that matches the characteristics of the patient: she has been given back her individuality (cf Figs 1a and b).

After the pressed "frameworks" were finished and fitted onto the models, the functional parameters were checked in the articulator and adjustments were performed accordingly. The next stage was to create lifelike gingival parts. The comprehensive range of SR Nexco shades unfolded its true potential here. The gingival materials were manually layered onto the framework. The range includes a multitude of gingival shades – materials in various degrees of translucency and opacity are available, giving abundant scope for creativity. These materials were selectively used to create a natural-looking artificial gingiva in line with the requirements of this demanding situation (Figs 8a to d).

The restoration was completed in the customary manner. Shape, morphology and surface structure were all given due attention. After finishing (Figs 9a to c), an initial try-in was performed on the patient. All the aspects evaluated in the mock-up were checked again. In addition, the shade effect was assessed. The transition between natural and artificial gingiva in the upper jaw was examined particularly careful. A reminder: the patient shows pronounced lip dynamics and as a result the entire vestibular space is visible when she laughs. However, this characteristic did not curtail the esthetic success. All criteria were met with the satisfaction of the patient and the treatment team: approval for surface finishing and polishing was given.

During polishing the beautiful characteristics and homogeneous material properties became apparent (Fig. 10). The optimally coordinated combination of micro-opal fillers and composite matrix endows SR Nexco with the ability to be polished to an unmatched, durable high gloss. The natural looking opalescent effect can be seen in images 11 and 12 and is, among others, the result of the high content of inorganic opal fillers. The optical properties can be best observed in transmitted and incident light. It is hardly believable that this is a composite. Studies have shown that SR Nexco offers long-lasting shade stability, a durable gloss and low plaque affinity, providing the team with the necessary assurance of reliability. The patient was overjoyed with her "fixed" restoration. The dentures naturally blend in with the features of her face (Fig. 13). In spite of the suboptimal preoperative situation, we managed to create a customized and highly esthetic restoration. Both the hygiene capabilities and long-term stability of the restoration are ensured.

Conclusion

Our efforts were rewarded with a happy patient (Figs 14 and 15), when the restorations were inserted. It was equally rewarding to see this patient again after a while and be still given the same smile of gratitude. A well-structured treatment plan and ideal materials enable us to fulfil the fundamental human need for individuality.

Contact details:

Hans-Joachim Lotz, MDT
Dentallabor Hans-Joachim Lotz GmbH
Kreuzstrasse 6
97990 Weikerheim
Germany
hjlotz@mac.com

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