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Dear Reader

The growing awareness for esthetic teeth among increasing numbers of patients requires high-quality esthetic solutions that we should all be prepared to deliver. Manufacturers, dental technicians, dentists and dental distributors are all called upon. It is the concern of dentists and technicians to meet the demands of patients, may that be by new materials, technologies or acquisitions. In this context, respect and good communication between the patient, dentist and technician is just as important as providing the best possible treatment tailored to the individual needs of the patient.

The materials to be used for the treatment are essential for a successful outcome. They should be clinically proven and be part of a coordinated product system. This is exactly one of the reasons why we launched the worldwide IPS e.max® Smile Award. An international panel of renowned external experts assessed all the dental projects submitted. The panel of judges was just as impressed by the number and quality of the works submitted, as we, the initiators, were. We are pleased to give you in this issue of Reflect an insight into the award winning works from the three world regions.

You will notice that the collaboration between patient and dentist and between dentist, technician and patient played an essential part in these winning cases. Only if this interaction harmonizes, is it possible to analyse, plan and complete dental projects of such excellent quality. A big compliment to all the winners and to all the other participants who accepted the challenge and submitted excellent contributions. They are all winners to me!

As usual, you will find clinical cases involving different indications in the current issue. In addition to the all-ceramics case reports relating to the IPS e.max® Smile Award, this issue will also catch your eye with impressive contributions on complete prosthetics and direct restorative therapy.

I wish you an exciting and enjoyable read.

Sincerely

Gernot Schuller
Senior Sales Director
Austria & Eastern Europe

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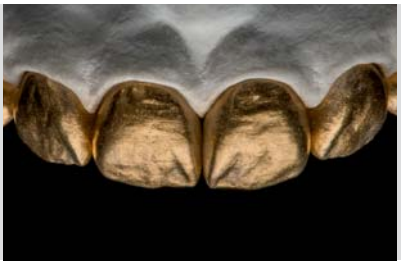

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Digitally designed and meticulously implemented

All-ceramic restorations in the upper and lower jaw after the loss of occlusal vertical dimension
Prof. Dr Petra Gierthmühlen, Dusseldorf, and Udo Plaster, Nuremberg/Germany

IPS e.max Smile Award 2016: The winning entry in the "Europe, Middle East, Africa" category describes the restorative treatment of a patient who presented with severely eroded teeth. A focused defect-oriented approach characterized this case. Digital techniques paired with accurate planning and meticulous implementation ensured the minimally invasive restoration of the worn tooth structure.

Video of the winning entry

The problem of worn and eroded teeth is becoming more prevalent. The pathological loss of tooth substance can be produced by erosion (acid-related tooth damage), attrition (tooth-to-tooth wear) or abrasion (mechanical processes). In most cases a number of factors contribute to the clinical picture. Once the causes have been established, suitable therapeutic measures can be planned. In modern dentistry, the removal of considerable amounts of tooth structure for the preparation of a restoration is viewed very critically. A more appropriate solution is to find a minimally invasive or non-invasive way of restoring the teeth using adhesively bonded restorations. This type of approach is described on the basis of the following case study.

Fig. 1: Substantial loss of tooth structure, particularly in the anterior region

Pre-operative situation

When he consulted our practice, the patient complained about restricted chewing function and tooth hypersensitivity. In addition, he was dissatisfied with the appearance of his teeth. The dental examination revealed large carious lesions and various defective fillings. All the teeth showed severe signs of erosion (Fig. 1). Substantial loss of tooth structure was evident in the anterior teeth in particular. The analysis of the smile line revealed that the length-to-width ratio had been negatively affected. In the relaxed smiling position, the teeth were hardly visible. In addition, the discrepancy between the smile line and the midline was very pronounced.

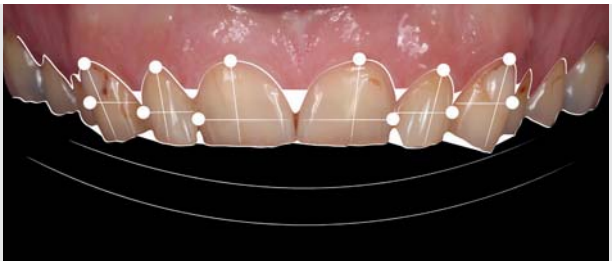
The patient showed considerable loss of occlusal vertical dimension (OVD). A functional disorder (e.g. craniomandibular dysfunction) was not diagnosed. The aim of the extensive treatment was to reconstruct the proportions, function and esthetics of the teeth. Therefore, the occlusion needed to be redefined and the vertical dimension adjusted.

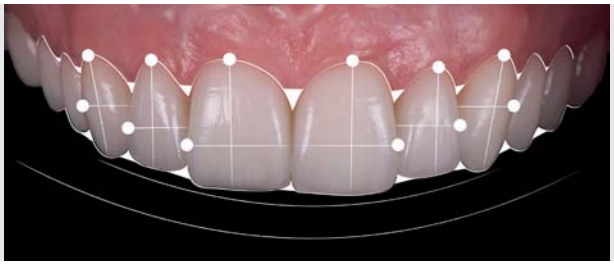
Creation of the mock-up

In order to obtain a sound basis for the treatment planning process, the Face Hunter scanner was used to produce a digitalized picture of the patient's face. The three-dimensional view of the pre-operative situation offers an advantage over conventional photographs in that it enables the envisaged situation to be examined from different aspects thereby providing a realistic overall picture. A digital wax-up with heightened occusal plane was created with the PlaneSystem®. In this step, the tooth positions, lengths, sizes and shapes were determined on the basis of functional and esthetic criteria. The "Digital Articulator" module was used to check the static and dynamic occlusion. The digitally calculated movement paths correlated with the guiding surfaces of the teeth. In the process, the extraoral esthetic parameters were also checked.

Fig. 2: A digital wax-up served as the basis for the creation of the PMMA mock-ups.

Fig. 3: Try-in of the mock-up in the mouth





Figs 4 and 5: Comparison of the esthetic analysis of the initial and the target situation

Features such as the bipupillary line, the smile line and the midline are important references for restoring facial harmony.

The segments designed with the Zirkonzahn software were used to construct a PMMA mock-up by means of CAD/CAM fabrication methods. The mock-up was tried in and deemed to be satisfactory in terms of its function and esthetics (Fig. 2). The new situation and the raised vertical dimension were accepted by the patient (Fig. 3). Therefore, the mock-up served as a template for the remainder of the treatment process (Figs 4 and 5). First, the digital design was used in the creation of the provisional restorations.

Tooth preparation and provisionalization

The restorative procedure involved the entire dental arch in both the upper and the lower jaw. The defective restorations were replaced and the teeth were prepared according to defect-oriented principles (Fig. 6). A minimally invasive approach was taken to prepare the upper anterior teeth for the crowns, the lower anterior teeth for the veneers and the molars for the crowns and onlays. The digitally designed final situation was superimposed on the prepared teeth to show the minimally invasive and additive character of the procedure. Conventional impressions were taken of the situation and sent to the dental laboratory (Fig. 7). Models were fabricated and digitized with a laboratory scanner (S600 Arti, Zirkonzahn). The preparation shade was determined in the laboratory in order to properly establish the individual tooth shades. This is particularly important when all-ceramics are used, since the preparation shade considerably influences the light-optical properties of these materials.

Fig. 6: Defect-oriented preparation of the upper and the lower jaw

Fig. 7: Transfer of the situation by means of conventional impressions

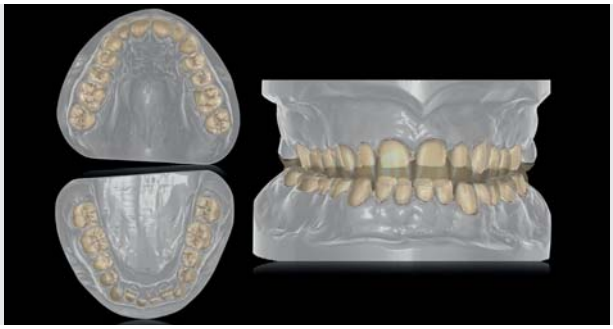


Fig. 8: The digital design of the mock-up for the provisional restorations

Fig. 9: The patient quickly became accustomed to the CAD/CAM manufactured provisionals.

The provisional restorations were fabricated using CAD/CAM technology. The crowns, veneers and onlays were adjusted to the prepared situation in the digital mock-up and then milled to full contour using a tooth-coloured PMMA material (Fig. 8). The fit of the restorations was checked on the model. Then the provisionals were polished and cemented in place with a temporary luting composite. The functional and esthetic factors were checked in the mouth. During the following eight weeks the patient was able to test the new situation and the raised vertical dimension (Fig. 9). At this stage, it was still possible to modify the restorations without any difficulty. However, the patient accustomed himself to the new vertical dimension very quickly and without any complications.

Fabrication of the all-ceramic restorations

The permanent restorations were fabricated with the help of the mock-up data. On the basis of the initial facial scan, the crowns, onlays and veneers were constructed in accordance with the mock-up (Fig. 10). Up to this part of the procedure, all the work had been done using digital means, without a conventional wax-up. This changed when the individual ceramic restorations, especially the veneers, were produced, since their esthetic design required considerable manual skill. In the present case, the plan was to obtain the functional and esthetic results with the press technique. For this purpose, the computer designed-restorations were machined in wax in a 5-axis milling unit (M5 Heavy Metal Milling Unit, Zirkonzahn) and subsequently pressed with the IPS e.max® lithium disilicate

Fig. 10: Construction of the permanent restorations with the help of the initial facial scan and the mock-up

Fig. 11: The individual restorations were machined in wax, pressed with lithium disilicate glass-ceramic and subsequently finished.

Fig. 12: The upper anterior teeth were cut back and then veneered. The veneers, the onlays and crowns for the molars were manufactured in monolithic form.

Fig. 13: Preparation for the adhesive cementation

Figs 14 and 15: Photographic documentation of the result: The function and esthetics of the teeth completely fulfilled the requirements of the patient.

glass-ceramic (Fig. 11). The upper anterior restorations were cut back and then imparted with lifelike characteristics and play of colour. The crowns pressed with LT (Low Translucency) ingots in shade A1 were reduced and then the incisal areas were built up with veneering ceramic (IPS e.max Ceram). The pressed monolithic veneers for the lower anterior teeth as well as the onlays and the crowns for the posterior teeth showed adequate esthetics (ingot shade: MT A1). These monolithic restorations were polished to a high gloss and then individualized with stains (IPS e.max Shades/Essence & Glaze). On the model, the all-ceramic restorations looked very natural in terms of their colour and their shape (Fig. 12).

Fig. 16: The happy patient

Adhesive cementation

In preparation for their placement the inner surfaces of the individual ceramic restorations were conditioned and etched with 4.9 per cent hydrofluoric acid (IPS® Ceramic Etching Gel) for 20 seconds. The clean prepared teeth were conditioned with the Syntac® Classic system, which comprises a primer, an adhesive and Heliobond. The lithium discilicate glass-ceramic restorations were adhesively bonded with a dual-curing luting composite (Variolink® Esthetic DC) in accordance with the instructions of the manufacturer (Fig. 13).

The restorations showed excellent marginal adaptation after their adhesive cementation. The transitions to the natural tooth structure were virtually invisible. In terms of their shape and function, the restorations fully corresponded to the result realized with the help of the provisional restorations (Figs 14 to 16). The permanent restorations were fabricated using CAD/CAM technology and the press technique. The thin, defect-oriented, individual restorations provided an esthetic, functional and reliable solution for restoring the dentition.

Conclusion

Digital technology – in the form of a face scanner for example – is of immense help in the treatment planning process. The minimally invasive approach used in this case is easy to implement with the help of CAD/CAM fabrication methods. The creation of a virtual wax-up, a CAD/CAM mock-up, provisionals and wax models for pressing the lithium disilicate restorations all contributed to achieving a predictable, esthetic, cost-effective and efficient result. The intraoral pictures taken three months after the treatment show the stable occlusion and the excellent condition of the periodontal tissue.

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Esthetic harmony despite hypodontia

Teamwork – from treatment planning to provisionals and the all-ceramic restorations
Dr Luis Roberto Sanchez Ramirez, San Pedro Garza Garcia/Mexico, and Alen Alić, Karlovac/Croatia

IPS e.max Smile Award 2016: The winning entry in the "America" category describes the procedure used to restore esthetics and function in a patient showing tooth agenesis of the lateral upper anterior incisors. The consistent approach to planning and implementation, the outstanding functional and esthetic result and the exceptionally illustrative documentation of this case set it apart from the other projects.

Video of the winning entry

Hypodontia (tooth agenesis) of the lateral incisors is quite a common dental anomaly. In planning the treatment, various diagnostic considerations should be taken into account, and the different restoration options should be examined from an interdisciplinary perspective. Depending on the initial situation and the patient-related factors, various possibilities are available for redressing this deficiency: for example, adhesive bridges, orthodontic measures and implant-supported restorations. The aim in every case is to satisfy the patient's individual esthetic and functional requirements in the best possible way.

Pre-operative situation

The patient treated in this case showed missing lateral incisors. The oral hygiene of this esthetically conscious patient was excellent. Her gums were in outstanding condition, and

Figs 1a and b: Patient with agenesis of the lateral incisors. Disharmony of the tooth shape and imbalances and deviations of the tooth shade after the restoration of the upper anterior teeth

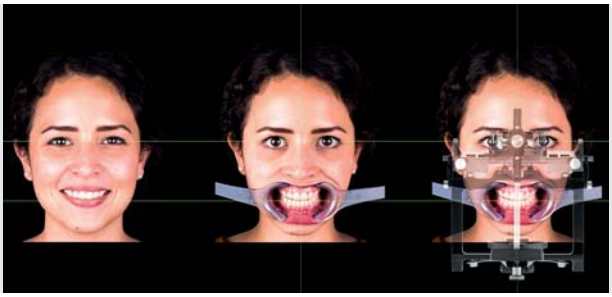

Fig. 2: Determination of the vertical and horizontal reference lines

Fig. 3: Virtual outline of the desired tooth shapes

Fig. 4:
Transfer of the digital plan to the wax-up

Fig. 5:
After the removal of the old restorations

Figs 6a and b:
Photographic determination of the tooth shade with and without a polarizing filter

Fig. 7:
Provisional restoration made of composite resin (for soft tissue conditioning and other purposes)

Figs 8 and 9:
Transfer of the plan to the alveolar model and pressing of the frameworks for teeth 14 to 24

she did not have any carious lesions. Her skeletal and craniofacial development was completed. Three years before the patient first consulted our practice, she had undergone restorative treatment for her condition. At that time, teeth 13 to 24 were treated with ceramic restorations (Figs 1a and b). Nevertheless, the patient was dissatisfied with the shapes, proportions and shades of these restorations. She wished for a solution that would harmoniously blend into her face. In the old restoration, wide anterior teeth were used to compensate for the missing teeth 12 and 22. However, the dimensions of the second and third incisors were comparatively large. The teeth looked disproportionately wide. Furthermore, they lacked the contours, ridges and angles that impart teeth with a natural appearance. In addition, the restorations showed light-optical defects. The teeth looked too dark, and they were relatively opaque. These characteristics did not match those of the naturally light teeth of the patient, which showed high translucency in the incisal region in particular. As a result, the decision was taken to fabricate new restorations for the upper anterior teeth of the patient.

Treatment planning: esthetic and functional parameters

First, a tooth shape had to be chosen which would best match the facial proportions. The aim of the new restoration was to achieve a facial and oral balance.

Objective initial assessment: The esthetic parameters were established by evaluating the facial proportions with the help of the Photoshop Smile Design software. For this purpose, a series of standardized photos were taken. Standardized refers to the fact that the intraoral, close-up and portrait pictures were taken under the same conditions. In the "en-face" images it was important to carefully align the camera and the patient's head. The photos were imported into the Photoshop image processing software. Subsequently, horizontal and vertical reference lines were drawn and the portrait picture was transferred to the virtual articulator (Fig. 2). The photo analysis highlighted the inharmonious appearance of the "white esthetics". The wide teeth did not match the face of the patient and looked unnatural. The desired tooth shape was traced on the close-up picture. In order to compensate for the missing second incisors and to achieve and even arrangement of the teeth, the new restoration needed to extend beyond the anterior teeth, and therefore, the molars would have to be included. The lateral incisors and the canines were made to look narrower but more pronounced, and they were adjusted to the buccal corridor (Fig. 3). The virtual outlines helped the patient to understand the changes that would be taking place. Since the photos only provided a one-dimensional impression of the result, a three-dimensional wax-up was created of the virtual design (Fig. 4). The teeth looked strong, and selectively created ridges and effectively placed concave and convex surfaces imparted the teeth with a natural-looking shape.

Preparation and shade selection

The existing restorations were removed and the teeth were suitably prepared in the transitional areas (Fig. 5). The aim

Figs 10a to h: Ceramic layering of the anterior teeth

Fig. 11: Evaluation of the surface morphology with the help of gold powder

was to treat teeth 15 and 16 as well as 25 and 26 non-invasively. In view of the prospective adhesive cementation, the prepared areas were coated with a fine layer of dentin bonding agent (immediate dentin sealing). The dentin of teeth 11, 13, 14 as well as of teeth 21, 23 and 24 was sealed according to the UCLA (University of California) guidelines. The tooth colour was determined on the basis of photos taken of the prepared teeth.

In the fabrication of all-ceramic restorations in particular, it is important for the dental technician to know the colour of the prepared tooth.

A close-up picture was taken of the teeth and the shade samples, including a standardized grey card (Figs 6a and b). One photo was taken with a polarizing filter, which would allow the tooth shade to be evaluated without the interference of reflections, etc.

Impressions and provisional restorations

The double cord technique was used to take the impressions with an addition silicone (light body and heavy body). A functional and esthetic provisional restoration was produced on the basis of a wax-up or mock-up using the Bonded Functional Esthetic Prototype (BFEP) technique (Fig. 7). A flowable, high-strength composite resin was used for this purpose. Each tooth was individually treated. This would enable the patient to floss between the teeth. During the two-month wear period, the soft tissue was suitably conditioned and the functional and esthetic situation was evaluated.

Laboratory fabrication of the all-ceramic restorations

In the dental lab, an alveolar model was produced from the impression. With this type of model, the dies can be fabricated using different materials. The availability of these options is immensely helpful in the fabrication of veneers in particular. The dies can be individually created using the material that is most useful in any given step of the fabrication process: for example, plaster (master cast), refractory die material (dies for layering non-prep veneers) or composite resin (dies for evaluating the shade) (Fig. 8). In this case, the decision was taken to use a model with individual dies (without gingival portions) and an uncut model with gingival portions for the assessment of the contacts.

Treatment plan

The plan was to treat teeth 14 to 24 with lithium disilicate frameworks, which would serve as a basis for the veneering ceramic. The non-prep veneers on teeth 16 and 15 as well as on teeth 25 and 26 would be layered on refractory dies.

Fabrication

Teeth 14 to 24 were waxed up on the basis of the mock-up and then cut back by about 0.5 mm. They were invested and then the copings were pressed (IPS e.max® Press, shade LT BL3) (Fig. 9). The veneers for the vestibular parts of the molars were layered on refractory dies according to the envisaged tooth shape (mock-up). IPS e.max Ceram was used for this purpose (Figs 10a to h). The crown copings for the anterior teeth were veneered on the model (with gingival mask). Since the frameworks had been carefully reduced, this task could be carried out quickly and accurately. Nevertheless, the shape and layering scheme are not the only factors that determine the esthetic outcome of a restoration. The surface morphology must also be properly reproduced. Therefore, delicate concavities, a fine micro-texture and lifelike macro-texture were incorporated into the restoration. For visualization purposes, the restorations were sprayed with gold powder and then the result was evaluated (Fig. 11). The gloss level was individually adjusted by mechanical polishing. Finally, the proximal contacts were checked on the uncut model.

Figs 12a and b: Conditioning of the ceramic surface for the adhesive cementation of the crowns and veneers

Fig. 13: The placed restorations: The tooth shape and shade seamlessly blend into the oral environment.

Fig. 14: The picture of the teeth framed by the lips clearly shows the success of the treatment. The teeth look strong and healthy. The agenesis of the lateral incisors has been successfully managed.

Fig. 15: Optimum management of hypodontia

Fig. 16: The satisfied patient

Placement

After the try-in, the individual ceramic units were prepared for the adhesive cementation process. The inner surfaces of the restorations were etched with hydrofluoric acid and then silanized (Figs 12a and b). The tooth surfaces were conditioned according to the UCLA protocol: chlorhexidine solution (disinfection), etching with phosphoric acid, application of the primer and the bonding agent, cementation of the restoration. Variolink® II was used for this purpose, since it is an esthetic and very reliable luting composite. The outcome showed healthy soft tissue and an overall harmonious appearance.

Result

The restorations successfully concealed the agenesis of the two lateral incisors. The patient was highly satisfied with the result. The restorations seamlessly blended in with the oral and facial situation in terms of their shape, shade and function (Figs 13 to 16). Due to very careful planning – by means of the Photoshop Smile Design program and the physical mock-up – the problem of disharmony was successfully solved. The teeth look strong and strikingly beautiful. The light-optical properties of the natural teeth have been effectively reproduced. The restorations show a lifelike interplay of colours emerging from within, with just the right level of translucency, transparency and opacity.

Conclusion

In general, the treatment of anterior hypodontia requires an interdisciplinary approach. In the case presented, the patient was treated with all-ceramic restorations (IPS e.max) to attain the desired result. The close collaboration of the dentist and the dental technician and a carefully developed restorative treatment plan are integral requirements for this type of treatment.

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Paring down a complex case

Fabrication of an extensive all-ceramic restoration for the upper and the lower jaw
Dr Tetsuya Uchiyama, Tokyo, and Michiro Manaka, Saitama/Japan

The IPS e.max Smile Award 2016: This prize-winning entry in the "Asia, Pacific" category describes the case of a patient who was treated with tooth-supported and implant-borne restorations. This initially complex case was expertly solved by using a straightforward treatment approach and establishing a uniform colour base for the all-ceramic restorations.

The abundant variety of solutions offered by contemporary dentistry – diverse materials, different technologies, customized approaches – is very much appreciated by patients and clinicians alike. Nevertheless, complex cases continue to present many challenges. In prosthetic dentistry in particular, extensive restorations in the upper and lower jaw are often necessary. In these cases, it is important to obtain a full view of the situation and to analyze it in detail and then to develop a treatment plan. The main aim is to pare down the complex situation to a simple and sound base for the fabrication of the restorations. Well-grounded planning is the key element in this process.

Complex initial situation

The sixty-six-year-old patient complained about her inability to chew properly and the unattractive appearance of her teeth. In the upper jaw, she had various defective metal-ceramic restorations, some of which had already become loose (Fig. 1). In the lower jaw, a free-end gap extended from tooth 35 to 37. The crown on tooth 34 was also loose. The gingival margin of tooth 13 had clearly shifted towards the apical aspect. The Wilson curve (transversal curvature) deviated, which added to the general disharmony. The shade of the different restorations varied quite considerably. Furthermore, the light-optical properties of the individual restorations did not match properly. The patient asked for restorations that would look and function like natural healthy teeth.

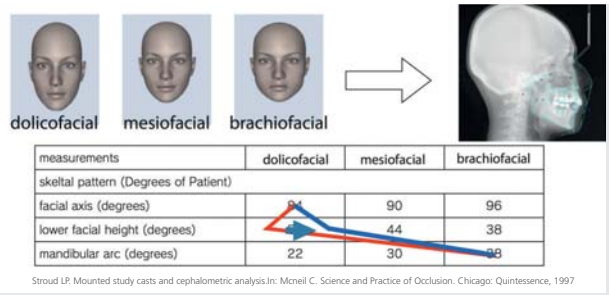
Treatment goal

The main aim was to establish a stable occlusal situation that would enable natural chewing functions and a harmonious esthetic maxillofacial situation. For this purpose, the existing crowns and bridges had to be replaced and the gingival contour had to be adjusted. Tooth 24 had to be replaced by an implant, which would function as an additional abutment. Further treatment with implants was planned for the lower posterior region.

From wax-up to provisional

The diagnostic wax-up is generally considered to be an indispensable part of complex treatment planning. The loss of tooth substance, that is, the vertical dimension of occlusion is verified in wax. Then the teeth are adjusted on the model using additive (in some cases subtractive) means to achieve the desired situation.

Fig. 1: Pre-operative situation: various defective restorations, impaired esthetics and an untreated gap in the lower jaw



measurements	dolicofacial	mesiofacial	brachiofacial
skeltal pattern (Degrees of Patient)			
facial axis (degrees)	84	90	96
lower facial height (degrees)	50	44	38
mandibular arc (degrees)	22	30	38

Stroud LP. Mounted study casts and cephalometric analysis.In: Mcneil C. Science and Practice of Occlusion. Chicago: Quintessence, 1997

Fig. 2:
Evaluation of the esthetic facial parameters

Fig. 3:
The diagnostic wax-up

Fig. 4:
Transfer of the wax-up details to the provisional restoration using the cross-mounting method

On the basis of the wax-up, the patient is shown the possibilities but also the limitations of the anticipated result.

The treatment plan is discussed with the patient and modified if necessary.

In the present case, the diagnostic wax-up served as the foundation for all the subsequent working steps. The horizontal and vertical esthetic lines and planes were determined and the upper and lower facial heights were evaluated by means of a X-ray image (Fig. 2). In addition to the clinical and esthetic diagnosis, a manual functional and structural analysis (MFA) provided important reference points for the treatment plan. For the waxing up procedure, the incisal plane was lowered in the articulator. The incisal edges were slightly reduced (1 mm) to obtain an ideal lower face height. In addition, the angle of the occlusal plane was tilted (6°) anticlockwise. The chewing surface was successively modelled until optimum occlusal conditions were achieved (Fig. 3). The cross-mounting method – the upper wax-up was articulated against the lower jaw and vice versa – was used to fabricate the provisional composite restorations (Fig. 4).

When the old restorations were removed, an additional challenge presented itself (Fig. 6). Metal build-ups and various fillings in the abutment teeth created a rather patchy overall impression. As a result, the appearance of the abutment teeth had to be harmonized before the permanent restorations were placed.

Surgical treatment

The patient was given a local anaesthetic. Then an implant was inserted in the gap of tooth 14, and tooth 13 was extracted. The gingival contours of tooth 13 needed to be improved significantly. Therefore, targeted soft tissue conditioning measures were initiated. For the next few months the patient had to wear the temporary restorations, which had previously been fabricated. The area around the implant was able to heal properly during this period. In addition, the patient was able to accustom herself to the new functional and esthetic situation.

Figs 5a and b: The long-term temporary composed of three segments

Fig. 6:
Situation after the removal of the old restorations

Fig. 7:
The teeth prepared for the placement of the all-ceramic restorations

Figs 8a and b:
Impression of the emergence profile of tooth 14

Fig. 9:
Situation in the upper jaw after tissue control is completed

Tooth preparation

The shape and shade of the prepared abutment teeth had to be adapted. The two lateral incisors and the canines in the upper jaw were non-vital and discoloured. When stained areas of prepared teeth have to be concealed and tooth shades are suitably adjusted, it is important to visualize the completed crown for each of the individual teeth (Fig. 7). Changing the perspective from "full view" (maxillofacial) to "detailed view" (soft tissue) simplifies the visualization process and tooth preparation.

Impressions and provisional restorations

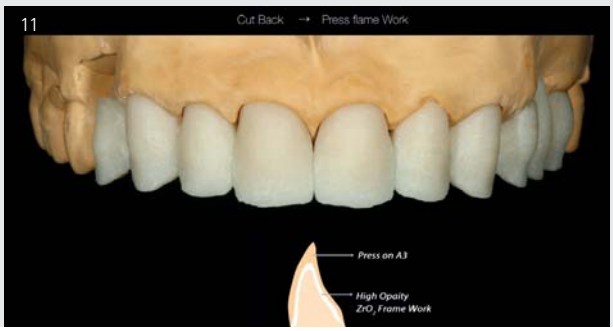
The periimplant soft tissue contour around tooth 14 was optimally shaped by the provisional restoration. As a result, an impression could be taken of the emergence profile (Figs 8a and b). The impressions of the prepared teeth in the upper and lower jaw were taken with the double-cord technique, and the master casts were produced in the laboratory. The long-term temporary was fabricated in three segments. The first segment comprised teeth 23 to 12; the second segment, the restored posterior teeth 13 to 17 and the third segment, the lower teeth 44 to 47 (Figs 5a and b). Once the first segment was finished, the incisal pin of the articulator was lowered in order to create a space of approx. 1 mm in the anterior region. This "gap" was closed with the provisionals of the other two segments. The temporary restoration was now ready for placement in the mouth (Fig. 9).

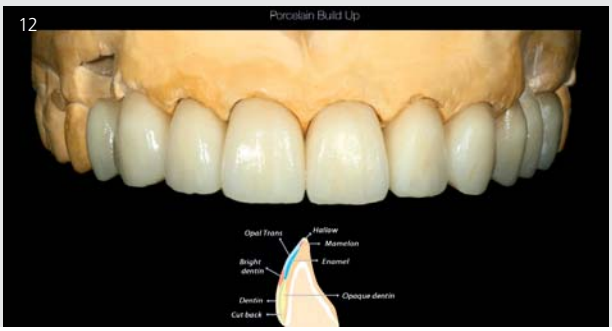
After the provisionals had been placed, their functional and esthetic parameters were checked and the patient was released from the practice. During the subsequent months she managed very well with the long-term temporary and she was satisfied with the esthetic aspects. The implants that would replace tooth 35, 36 and 37 had not yet been inserted at this stage. Experience has shown that a step-by-step treatment approach minimizes the risk of error. Therefore, the implants were inserted eight months later.

Technical considerations related to the materials selection

Due to the focused approach, the complex initial situation was reduced to a comparatively straightforward case which

Fig. 10:
Framework: zirconium oxide copings





Figs 11 and 12:
IPS e.max ZirPress was pressed to the zirconium oxide copings. Subsequently, the restorations were veneered.



Figs 13a to c: After the placement: Successful functional and esthetic integration of the all-ceramic restorations

Fig. 14: The patient is visibly satisfied with the result.

Fig. 15: Stable situation and excellent esthetics three years after the placement of the restorations

could be treated with permanent all-ceramic restorations. The main challenge for the dental lab technician was to effectively conceal the differently coloured abutment teeth. The objective was to cover the non-vital and stained teeth with zirconium oxide frameworks. In order to fulfil all the functional and esthetic requirements, the decision was taken to press ceramic materials onto the frameworks and then customize the restorations with layering ceramics. This approach may sound somewhat complicated, but it would ultimately help to reinforce the stability and reliability of the treatment result.

Fabrication of the restorations

First, the provisional restoration, or rather its functional characteristics had to be "copied". The cross-mounting method was used for this purpose. Subsequently, a precision wax-up was fabricated and digitalized. It was correspondingly cut back prior to the CAD/CAM fabrication of the zirconium oxide frameworks. In the next step, these zirconium oxide copings which were to conceal the discoloured tooth structure (Fig. 10) were covered with pressed ceramic. The press technique allows the wax-up and its functional details to be reproduced in ceramic with utmost precision. In preparation for the ceramic press process, the restorations were built up in wax on the copings and then pressed with the fluorapatite glass-ceramic IPS e.max® ZirPress, shade A3. Next, they were cut back as required, ensuring the full contour of the functional parts and the incisal area. Finally, the restorations were layered with veneering ceramic (IPS e.max Ceram) (Figs 11 and 12). The teeth were characterized in accordance with the age-related requirements of the patient using Dentin, Incisal, Impulse and Mamelon materials. The all-ceramic restorations were tried in after the first firing and then completed.

Result

After the last try-in, the restorations were permanently placed according to the established protocol. The stained tooth structure was optimally concealed. The healthy natural soft tissue successfully adapted to the ceramic surface. The implants healed in completely: The X-ray showed a stable situation. The vertical dimension, incisal edge contour and occlusal plane corresponded to the conditions established during the provisional phase (Figs 13a to 15). The shape and shade of the ceramic restorations successfully matched those of the natural anterior teeth in the lower jaw and harmonized with the face of the patient.

Conclusion

Comprehensive restorative therapy demands a clear and well-organized treatment strategy. The route and the goal must be defined right at the beginning in order to establish a sound and straightforward basis for the treatment procedure even in complex cases. This approach simplifies the treatment for all the parties involved and also meets their highest demands.

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Enhanced gingival esthetics for natural looking complete dentures

Optimizing conventional complete dentures with an innovative veneering material

Dr Jiro Abe and Kyoko Kokubo, Tokyo/Japan

Stability, function and esthetics: when fabricating complete dentures, optimum results can only be achieved if the individual details are successfully combined. In addition to the rehabilitation of functional aspects, the esthetic reconstruction of the teeth and soft oral tissues can considerably enhance a patient's self-confidence.

Treating edentulous patients using conventional complete dentures continues to be a frequently applied therapy option. Yet, populating the edentulous jaw with denture teeth to achieve a functional and esthetic rehabilitation poses a tough challenge to the treatment team. Biomechanical, physiological and geriatric concerns must be considered. True-to-nature replication of teeth and soft oral tissues also play a key part. The objective is to give patients some of their personality back by providing them with natural looking dentures.

Initial situation

Aged 58, this relatively young female patient presented with an edentulous upper jaw. She was wearing a complete denture in the maxillary arch and defective metal-ceramic restorations in the mandibular arch. Her existing teeth were damaged and could not be used as abutments for new restorations. They had to be extracted. The patient was diagnosed with Angle Class III malocclusion. There was a severe anteroposterior discrepancy between the upper and lower arch. Seen in profile, the patient showed a prominently jutting chin and a protruding lower lip (Fig. 1). Her esthetic appearance was impaired. In addition, the patient complained about the poor function and high mobility of the maxillary denture. A flabby ridge and severe bone resorption were present in the anterior part of the maxilla (Fig. 2). The alveolar ridge showed an asymmetrical progression in the mandibular arch (Fig. 3). Following the initial assessment of the patient's oral conditions and consultation on the treatment options available to her, we decided to create new dentures for the maxillary and mandibular jaw. Conventional complete dentures were selected as the treatment option.

Model analysis

We began by taking a closed-mouth impression to create a primary record of the jaw relations. Accurate model analysis provided important information in preparation for the individual functional impression. These steps established the basis for a statically and functionally correct design of the dentures. The median palatine raphe, incisive papilla, first large palatine rugae, tuber maxillae and crest of the alveolar ridge were marked on the maxillary model. On the mandibular model, the crest of the alveolar ridge, Pound's line and the Tuberculum alveolare mandibulae were marked as landmarks. The mucobuccal fold was determined on both models.

Fig. 1: Profile picture of the initial situation (Angle Class III)

Fig. 2: Edentulous upper jaw with a flabby ridge in the anterior region and advanced bone resorption

Fig. 3: Asymmetrical alveolar ridge progression in the mandibular arch

Fig. 4: Articulated models: Angle Class III malocclusion with anterior open bite is clearly visible.

Fig. 5: Customized impression tray and registration device form a unit.

The Angle Class III malocclusion can be clearly seen on the articulated models (Fig. 4).

Individual impression-taking and recording of the maxillomandibular relation

High demands are also placed on custom trays, because the functional impression plays a pivotal role in achieving precisely fitting dentures. The objective is to maximize the supporting area of the denture base while taking into account the movements of the muscles. A suction effect must be established between the mucous membrane and denture base. For this purpose, the functional margins need to be fully contoured.

If flabby ridges are present, impressions of the gingiva should be taken using minimum pressure only.

The area of the flabby ridge was marked on the model and covered with a spacer to ease the pressure. Subsequently, customized trays were fabricated. To prevent the denture to shift upwards and forwards, a wide labial rim was created in the upper anterior vestibule. Dorsally, the tray ended at the vibrating line. The custom tray should also provide a suction effect in the mandibular jaw. Relatively voluminous margins were created to achieve this. Sufficient tongue space was provided and the anterior area was given a slightly concave contour. The retromolar pad was only thinly covered and, additionally, a concave buccal shelf was created. A rim was placed on the crest of the alveolar ridge to provide a support surface for the placement of the Gnathometer M used for recording the jaw-to-jaw relation (intraoral needle point tracing). The bite rims of the Gnathometer M acted as the preliminary vertical dimension. An assembly of custom tray and registration device was used to take an impression of the oral situation (Virtual® Heavy Body) and to record the jaw-to-jaw relation (Fig. 5).

Set-up and try-in

Designed for classic occlusal schemes, the SR Phonares® II moulds are ideally suited for complete dentures. The facial meter (alameter) integrated into the SR Phonares II FormSelector assisted in selecting the moulds that were best suited for our patient. The teeth were set up in line with the set-up criteria for the classic occlusion. To prevent the flabby ridge from allowing the denture to move, the upper premolars were positioned close to the centre of the alveolar ridge (Fig. 6). We decided to place premolars in the dorsal area of the mandibular arch to achieve an external seal with the buccal mucous membrane and the lingual wall at closed mouth position (Fig. 7). The requirements of function and stability and patient specific characteristics were considered in the tooth set-up. The patient was in the habit of chewing food with her anterior teeth because of her Angle Class III malocclusion. This should be avoided in the new dentures by providing enough freeway space between the anterior upper and lower teeth at the set-up. A great deal of attention was

Fig. 6: Setting up the maxilla: the premolars are positioned closely to the alveolar crest.

Fig. 7: Setting up the mandible: premolars are also used in the dorsal area.

Fig. 8: Converting the wax-up to PMMA material (IvoBase system)

Fig. 9: Dentures prior to soft tissue customization

Fig. 10: The interplay of different shades of lab composite (SR Nexco) results in a three-dimensional depth effect. Morphological aspects are also considered in the customization of the soft tissues.

given to faithfully mimicking the natural oral soft tissues, as we wanted to provide a maximum level of esthetics already at the try-in stage. Five different shades of wax were used for characterization. By creating vestibular gingival portions that have a delicate yet effective appearance, the customized look can be accentuated. Esthetics, phonetics, occlusal vertical dimension and centric relation were assessed at the try-in of the wax-up and rated as good.

Completion

The wax-up was converted to resin using a proven method. We focused particularly on creating natural looking soft tissues to enable the dentures to integrate unobtrusively into the oral surroundings. Accurately designed as they were, the dentures and prosthetic gingiva were converted to a PMMA resin (IvoBase High Impact) using the IvoBase® system. As polymerization shrinkage was fully compensated, 1 to 1 replications of the wax-ups were attained.

The denture wax-ups were flasked and sprued (Fig. 8). Once the moulds were created and the wax was boiled out, the flasks and teeth were prepared for the injection moulding process. The predosed denture base material was mixed and the capsules containing the mixed material and the flask were mounted on the injection device (IvoBase Injector). Once an appropriate program was selected, the injection process

Fig. 11: Completed maxillary denture

Fig. 12: View from the reverse side: the broad functional margin in the labial vestibule prevents the denture from shifting.

Fig. 13: Customized denture in situ: It's hardly noticeable that the patient is wearing conventional full dentures.

Fig. 14: Compared with the initial situation, the patient looks clearly younger and happier.

started. The result after divesting matched the requirements. Even fine details of the wax-up were exactly reproduced (Fig. 9). The dentures fitted the models accurately and required only minimal reworking.

Customized soft tissue reconstruction using SR Nexco

The three-dimensional soft tissue contours should be customized with shade characterizations. In the same way as different shades of wax are used for the try-in, different shades of resin should be used to reproduce the colour variations found in the natural gingiva. The light-curing lab composite SR Nexco® is ideally suited for this purpose. This material is available in a comprehensive range of Gingiva shades including intensive shade variants. Natural-looking soft-tissue esthetics can be reproduced using a straightforward method. Given its non-sticky consistency, the composite is easy to apply and does not need to be warmed up prior to application. The lab composite offers a "vast playground" for individualized soft tissue creations as it is available in a broad spectrum of SR Nexco Stains and SR Nexco Paste Effect materials. Variations in the degree of soft tissue thickness, blood vessel density and pigmentation can be easily replicated to resemble the characteristics of the natural gingiva. The veneering material is optimally coordinated with the IvoBase denture base material.

We began by applying SR Nexco Paste Basic Gingiva BG34 extensively onto the denture base. A natural depth effect was produced with intensive SR Nexco shades, i.e. SR Nexco Paste Intensive Gingiva. Papillae and alveolar spaces were faithfully replicated using these materials. Next, the lighter and more transparent SR Nexco Paste Transpa was applied to enhance the optical colour depth effect. This method resulted in a natural looking appearance. The interplay of different shades, convex and concave surfaces in the alveolar area and subtle stipplings allowed us to achieve a three-dimensional depth effect quickly and easily (Fig. 10). The individual layers were light cured for 20 seconds each. Intermediate curing can, for instance, be performed with a Quick curing light. Prior to final polymerization in a light furnace, e.g. Lumamat 100, a glycerine gel (SR Gel) was applied onto the denture base in a covering but not too thick a coating to minimize the formation of an inhibition layer. Only minor shape corrections were necessary before polishing the dentures. Tungsten carbide burs are best used for this step – the inhibition layer should be removed from the entire surface. Finishing was achieved by first smoothing the surfaces with rubber polishers, followed by mechanical high-gloss polishing at low rotational speed using a goat's hair brush, leather buff and Universal Polishing Paste (Figs 11 and 12).

Result

The patient attained a "new" esthetic appearance due to the natural esthetics of the upper and lower dentures. Her smile told us that she got her self-confidence back, which was the most beautiful reward for our work. The dentures were characterized by a dynamic interplay of shades and natural light reflections, nuanced gingiva surfaces and strong, healthy looking teeth (Fig. 13). They showed a stable fit and provided the desired suction effect. A phonetic and functional assessment of the criteria confirmed the success of the treatment. Compared to the preoperative situation, the new dentures imparted a clearly more youthful appearance to the face of the patient (Fig. 14).

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Realizing efficient and predictable posterior quadrant restorations

Combining selective etching, universal adhesive and bulk-fill composite

Michael R. Sesemann, DDS, Omaha/USA

Efficiency and long-lasting stability of the result are important requirements that are placed upon direct restorative procedures with composite. In this context, a system of well-coordinated materials is the definite key to success.

It is not uncommon for middle-aged and older patients to present with multiple failing amalgam restorations in a single quadrant. Many such restorations can be replaced conservatively with direct composite. Unfortunately, however, many of the placement and accompanying adhesive protocols required for predictability can be time-consuming and technique sensitive. Therefore, it is important to understand the historical development of adhesive dentistry when considering today's etching and adhesive protocol options.

Fig. 1: Preoperative view showing multiple failing side-by-side amalgam restorations in the maxilla

In the beginning

Conceptualized more than 50 years ago, Buonocore proposed bonding to enamel and dentin by first treating those surfaces with phosphoric acid before applying resins. Although he considered resin tag formation in the micro-porosities of etched enamel to be principally responsible for adhesion to enamel, bonding to dentin was less predictable due to dentin's composition, water content and smear layer. Not surprisingly, the first dental adhesives were resins that only bonded to enamel; there was little to no dentin bonding. On-going changes in material composition, adhesive mechanism, application method and overall adhesive techniques fuelled the evolution of adhesive dentistry and the introduction of increasingly esthetic restorative materials. They also led to different adhesive etching products and protocols.

"Total-etch" or "etch-and-rinse" technique

In "total-etch" or "etch-and-rinse" techniques, both enamel and dentin are etched with phosphoric acid to remove the smear layer and condition the preparation prior to bonding, with enamel being etched longer than dentin. The etchant and smear layer are then rinsed off with water and dried. Because dentin should remain moist and slightly glossy in appearance, care must be taken to not over-dry the dentin. This prevents collagen fibrils from collapsing, which would create a less permeable surface for hydrophilic monomers in the adhesive, as well as a weak interface, potentially leading to a poor bond and postoperative sensitivity. Although well-established and clinically proven, total-etch adhesives and their associated multi-step techniques are often considered to be technique sensitive.

Selective-etch technique

With selective etching, only the enamel edges of the preparation are etched with phosphoric acid and then rinsed with water. The dentin is conditioned afterwards with either a primer or all-in-one self-etching adhesive; the smear layer is only modified, not removed by rinsing with water after primer application.

> Using the selective-etch technique could be problematic if the dentin is inadvertently etched, then "etched" again with a self-etching adhesive.

This over-etching of the dentin could result in reduced bond strength and postoperative sensitivity.

Self-etch technique

Intended for adhesive bonding without separate etching, the self-etch technique relies on adhesive materials containing acidic monomers that etch and prime enamel and dentin. Demonstrating a milder pH level than total-etch products, self-etch adhesives pose less risk for excessive dentin demineralization, and because the technique sensitive step of precisely drying the dentin is eliminated, collagen-fibre collapse is prevented. Combined, these attributes reduce the likelihood of postoperative issues.

Realizing predictable efficiency today

Manufacturers have successfully increased the adhesive portfolio by introducing universal adhesives that promote high bond strength to enamel and dentin, and which can be used on both dry and moist dentin. Because they are designed to work with or without phosphoric acid, universal adhesives (e.g. Adhese® Universal) are suitable for selective-etch techniques, without fear of over-etching the dentin.

Fig. 2: View of the completed Tetric EvoCeram Bulk Fill direct composite restoration for tooth 17

Fig. 3: Adhese Universal adhesive was applied to the preparation for tooth 15. Due to hygienic reasons, the manufacturer recommends using the VivaPen Protective Sleeve for intraoral application.

Materials of choice

When replacing multiple failing amalgam restorations in a single quadrant using direct composite, I prefer using the selective-etch technique because it delivers the "best of both worlds". It provides strong micro-mechanical retention at the enamel margin with less probability of postoperative sensitivity, since the dentinal tubules are not completely opened.

My preferred adhesive for such techniques is Adhese Universal, which is available in traditional bottle and unique VivaPen® delivery. For me, the ergonomic, pen-like VivaPen design and angled brush cannula enhance comfort, control and speed during direct intraoral application while reducing material waste. Containing 2 millilitres of adhesive, the VivaPen can accommodate approximately 190 single-tooth applications, which is almost 3 times the applications per millilitre compared to conventional bottle delivery. As a result, the Adhese Universal VivaPen cost per application is considered to be lower than that of all other leading universal adhesives.

Also contributing to more cost-effective and time efficient direct posterior restorations is the use of a bulk-filled composite (e.g. Tetric EvoCeram® Bulk Fill, Tetric EvoFlow® Bulk Fill). Because they can be placed in a single increment or layer of up to 4 mm, then fully cured, they help eliminate time consuming techniques.

Case presentation

A 51-year-old male patient presented with multiple failing amalgam restorations (teeth 14 through 17) that exhibited marginal leakage and required replacement (Fig. 1). Rubber dam isolation was established. The existing amalgam restorations and any decay was removed using a carbide bur and the preparations were refined using a diamond bur. Following this, the preparations were cleaned and disinfected with 2 % chlorhexidine gluconate antibacterial scrub.

First, tooth 17 was restored. A segmented matrix set-up with two 3D-XR rings (Garrison Dental Solutions) and 5.5-mm Slick Band was placed to facilitate predictable and ideal interproximal contacts. The preparation enamel was selectively acid-etched with 37 % phosphoric acid for 20 seconds. After a universal adhesive (Adhese Universal) had been applied and light-cured, a layer of Tetric EvoFlow Bulk Fill in shade ^{IV}W was placed, then light-cured for 10 seconds. The cured Tetric EvoFlow Bulk Fill layer exhibited dentin opacity (Fig. 2). The restoration for tooth 17 was completed with a capping layer using Tetric EvoCeram Bulk Fill, which was smoothed with a modelling instrument designed for composite materials and light-cured for 10 seconds. Next, the restoration was contoured using a fine diamond and polished using discs and points. The cavity of tooth 14 was also conditioned with universal adhesive (Fig. 3). Then a single increment of Tetric EvoCeram Bulk Fill composite in shade ^{IV}A was placed (Fig. 4) and free-hand contoured utilizing a thin, long-bladed composite instrument (Fig. 5). The composite was then cured for 10 seconds, after which it was contoured using a fine diamond (Komet Brasseler, no. 8368-016) (Fig. 6). Initial post-curing polishing of the restorations was completed using a silicon dioxide disc (3M Soflex), followed by polishing with a Brownie point (Komet Brasseler). Interproximal areas were polished using a finishing strip (Epitex Medium, GC America) (Fig. 7).

Fig. 4: A single increment of Tetric EvoCeram Bulk Fill composite was placed in the tooth 14 preparation …

Fig. 5: … and free-hand contoured utilizing a thin, long-bladed instrument.

Fig. 6: Post-cure contouring of the restoration was completed using a fine diamond.

Fig. 7: Interproximal polishing was completed using a finishing strip.

Fig. 8: The preparation enamel in tooth 16 was selectively acid-etched.

Fig. 9: An initial layer of Tetric EvoFlow Bulk Fill was placed into the cavity.

Fig. 10: Finishing of the tooth 15 restoration

Fig. 11: Polishing of all restorations in the quadrant using a silicone brush and diamond paste

Fig. 12:
The occlusion was checked after occlusal adjustments had been made.

Fig. 13:
Postoperative view of the completed composite restorations

Then restoration of tooth 16 began by placing a segmented matrix set-up with two 3D-XR rings and 5.5-mm Slick Band, after which the preparation enamel was selectively acid-etched (Fig. 8). A layer of Tetric EvoFlow Bulk Fill in shade ^{IV}W was placed up to the promixal box and to the pulpal floor and then light-cured for 10 seconds (Fig. 9). Then Tetric EvoCeram Bulk Fill composite in shade ^{IV}A was extruded into the preparation as the second layer. The restoration was contoured using a fine diamond and polished using discs and points. Restoration of the quadrant continued by conditioning the tooth 15 preparation. Also for this restoration, Tetric EvoFlow Bulk Fill in shade ^{IV}W was applied as the initial composite layer and supplemented with Tetric EvoCeram Bulk Fill composite as the capping layer. After light-curing, the restoration was finished and polished using a carbide finishing bur (no. 7408-023, Komet Brasseler) (Fig. 10).

Polishing of all restorations in the quadrant was completed with a silicone brush and diamond paste (Fig. 11). After removing the rubber dam, the occlusion was checked (Accufilm Red/Black, Parkell) (Fig. 12).

Conclusion

The combination of selective etching using a universal adhesive and placing bulk-fill composite facilitates restoring various teeth in the posterior region. This method allows virtually invisible restorations to be achieved that are indistinguishable from surrounding dentition (Fig. 13). As Tetric EvoFlow Bulk Fill changes its translucency during polymerization and obtains a dentin-like opacity, the natural translucency of teeth can be more easily mimicked and small stains are even masked. The restorations are also permanently stable and esthetic, yet completed in less chair time, which makes practices more efficient and saves patients time and money. Because the conventional technique-sensitive procedures associated with adhesive direct composite restorations are eliminated, so are the potential complications.

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