REFLECT

2/16

Two approaches and one goal

Fabrication of ceramic veneers

Minimally invasive prosthetic treatment

Complex dental rehabilitation in a patient with tooth agenesis

Digital complete dentures

First experiences with the Digital Denture System

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Dear Reader

At this time of year the dental world is thriving at conferences and meetings around the globe. As an organization we are energized by these opportunities to connect with you, our clients, and appreciate how your skills bring dentistry and dental technology to life.

Recently I had the fortune of traveling to the Chicago Midwinter Meeting. Each year in February, the entire Windy City is abuzz with latest new materials and technologies that strive to elevate dentistry and dental technology. As new technologies continue to develop, Ivoclar Vivadent is focused on Being Digital: the combination of human artistry and automated production creating optimal results for quality esthetic dentistry. As digital technologies continue to evolve, milling machines enhance productivity and consistency. However, we must never lose sight of the fact that we are replacing a patient's tooth structure, and this deserves the human touch.

At www.iweardentures.com and at www.morethanadenture.com Kristi Lind tells her story. A young patient facing life edentulous as a mother of young children, she was restored with implant-supported complete dentures. In Chicago, the Ivoclar Vivadent team had the honour of hosting Ms Lind. She shared her story at the Ivoclar Vivadent Denture Symposium. Kristi has chosen to share her story with the world via her blog. For her this is her opportunity to give back so she can empower patients to seek high quality treatment if they are facing similar struggles.

This month's issue of Reflect showcases human artistry alongside digital fabrication options. It brings together exceptional clinicians from around the world. Our hope is that it inspires you as you restore patient's lives with your incredible talents.

I wish you much pleasure reading this issue of Reflect!

Yours

Sarah Anders
Chief Operating Officer
Ivoclar Vivadent, Inc., USA

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Take advantage of the versatile options offered by digital magazines for tablets and experience the article: "Minimally invasive prosthetic treatment with various ceramic materials" by Dr Marko Jakovac and Michele Temperani (pp. 12-15). Benefit from the interactive photo sequences with additional pictures, and learn more about the products used and the authors.

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Two approaches and one goal

Digital expertise versus manual skill in the fabrication of ceramic veneers
Dr Eduardo Mahn, Santiago/Chile

State-of-the-art CAD/CAM materials are offering clinicians various possibilities of producing certain types of restorations (e.g. ceramic veneers). These can be fabricated directly in the dental practice or conventionally in the lab, for example.

Recently developed restorative materials have opened up a myriad of exciting possibilities for dental practitioners. In the restoration of anterior teeth, clinicians have to select the most appropriate material for the case at hand on the basis of specific criteria. In situations where teeth show signs of erosion, abrasion, abfraction or a combination of these phenomena, practitioners will tend towards using ceramics or composite resins, depending on how much intact tooth structure remains available. Traditionally, composites are used for Class III, IV and V defects. However, ceramic veneers are preferred in cases where a large amount of tooth structure is missing or a major change is planned (e.g. smile makeover).

The challenge

When two central incisors need esthetic enhancement, the choice of approach is not so clear. Irrespective of the material used a minimally invasive route involving very little preparation of the tooth structure can be taken nowadays due to the high strength of modern materials (e.g. lithium disilicate glass-ceramic). Nevertheless, it is important to remember that minimal preparation is an option only if the teeth are properly aligned. As long as the desired changes of the tooth shape and shade are small, preparation can be limited to the enamel. In many cases, however, orthodontic treatment is needed before the tooth position and/or shape can be optimized by means of restorative procedures. This minimally invasive approach requires the dental practitioner to convince the patient of the necessity of undergoing preliminary orthodontic treatment.

The solution

It is our aim to remove as little of the tooth structure as possible in every case that we treat. With modern materials such as lithium disilicate or leucite-reinforced ceramics, we can confidently press or mill veneers that are as thin as 0.6 mm and even 0.3 mm. One of the main advantages offered by this type of ceramic is its wide range of applications. Until a few years ago, the treatment with indirect restorations required at least two appointments.

With the advent of CAD/CAM technology, clinicians now have the possibility of making semi-direct restorations.

Ceramic materials such as IPS Empress® CAD allow dental practitioners to produce polychromatic monolithic veneers and crowns in less than one hour, without having to glaze them. Nonetheless, many dentists still believe that dental technicians with their well-honed manual skills produce better esthetic results than a machine, and they do not see the need to embrace digital technology. As a result of this point of view and the high acquisition costs of the milling machines some clinicians are reluctant to invest in this technology. On the basis of the present clinical case study we would like to highlight the following aspects: the importance of having the right treatment plan, the possibilities currently available for the fabrication of veneers, the potential of the press and CAD/CAM techniques and the latest improvements made in the field of cementation.

Fig. 1: Initial situation: The patient was referred to an orthodontist.

Fig. 2: One year later when the patient returned to the practice, the teeth showed unsatisfactory composite veneers.

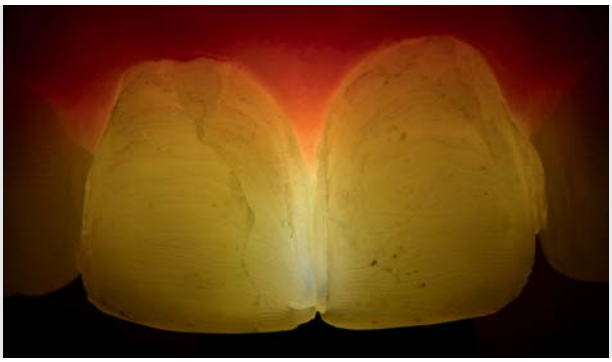

Fig. 3: The veneers were removed and the teeth were transilluminated to identify any composite residue.

Fig. 4: The two-cord technique was used for the impression. The retraction cords remained in the sulcus.

Clinical case

Patient history

A thirty-one-year-old female patient came to our office because she was dissatisfied with her anterior teeth. She complained about the misalignment of the upper and lower central incisors (Fig. 1). A detailed clinical examination revealed that the composite restorations in these teeth were defective. As a result of erosion, a considerable amount of tooth structure had been lost. In addition, the misalignment of tooth 21 and 41 in particular was quite obvious. The treatment plan presented to the patient included initial orthodontic treatment followed by minimal preparation of the two central incisors for two ceramic veneers. The patient was subsequently referred to an orthodontist for treatment. Unfortunately, it took more than a year before she presented to the practice again. At this consultation, we were quite surprised to find that the two central incisors had been restored with poorly finished direct composite veneers (Fig. 2). Many clinicians simply underestimate the challenging nature of this type of restoration, and this was a case in point. In addition to preventing any contamination of the working field, the clinician must also accomplish the arduous task of creating an appropriate emergence profile, proper contours and contact areas and producing a suitable micro and macro-texture, and all this within a single appointment.

The treatment

The composite veneers had to be removed and replaced with new ones. In this particular case, the advantages of using the indirect technique were obvious. The patient agreed to have two ceramic veneers made for her. For this purpose impressions were taken and a master cast was produced. This working model provides the dental technician with the opportunity to evaluate the situation in detail. He or she has the time to think about possible ways of correcting the misalignment. Dentists do not have this "luxury" of time when they are treating a patient in the dental chair. They have to finish the restorations as quickly as possible in order to prevent contamination of the treatment field and keep chair time to a minimum for the comfort of the patient. In the present case, an additional hurdle had to be overcome: Any composite material that might have remained on the tooth structure had to be clearly identified and carefully removed without damaging the healthy tooth structure. Transillumination with white LED light came in useful for this purpose (Fig. 3). Next, the teeth were prepared, retraction cords were placed and an impression (Virtual®) was taken (Fig. 4). The patient was provided with a temporary restoration, which was made with a temporary crown and bridge material (Telio® CS C&B, shade A1) and cemented with a dual-curing luting composite (Telio CS Link) (Fig. 5).

Fig. 5: Temporary restoration

Fig. 6: Try-in of the IPS e.max Press HT A1 veneers (fabricated in the laboratory)

Fig. 7: Try-in of the polished IPS Empress CAD Multi A1 veneers (fabricated in the dental office)

Fabrication of the restorations

Two different routes were pursued in the fabrication of the veneers. We instructed our lab technician to make two ceramic veneers using the press technique with IPS e.max® Press (shade HT A1, stained). At the same time, we milled two ceramic veneers with our in-office CAD/CAM machine using an IPS Empress CAD Multi block (shade A1). The veneers made in the dental office were not glazed, just polished. Figures 6 and 7 allow the results to be compared from a facial perspective. This experiment illustrates the esthetic potential of modern ceramics. Both types of restorations blend in beautifully with their surroundings.

The appearance of the veneers produced with the help of CAD/CAM technology came very close to that of the manually manufactured version. Nevertheless, in the end we opted for the lab-fabricated veneers (IPS e.max Press) with the consent of the patient, since we were able to achieve a slightly better match to the neighbouring teeth by staining the restorations.

Placement

Figures 8 and 9 show the try-in pastes (Variolink Esthetic LC) on the prepared teeth. The most suitable composite cement was determined on the basis of two differently coloured pastes. Two extreme options were compared: Light+ and Warm+. The difference was clearly visible when the pastes were applied. Even though the darker shade (Warm+) was very close to that of the natural tooth structure and would have worked well with the veneers, we ended up choosing the lighter shade. This was a typical decision. In most cases,

Figs 8a and b: Try-in of the veneers with a light try-in paste (Light+)

Figs 9a and b: Try-in of the veneers with a dark try-in paste (Warm+)

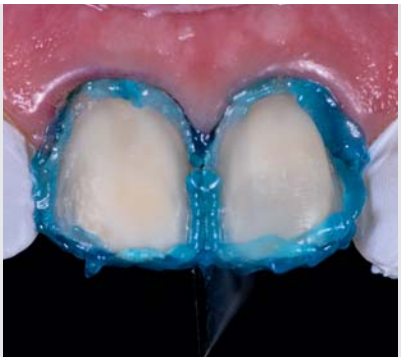

Fig. 10: Enamel etching with phosphoric acid

Fig. 11: Application of a single-component adhesive (Adhese Universal)

Fig. 14: The result: The patient with the ceramic veneers in place

Fig. 12: Removal of excess composite cement

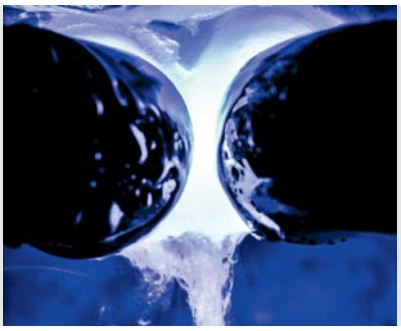

Fig. 13: Light-curing with Bluephase Style polymerization lights with water cooling

we tend to prefer the lighter version, since it provides a better contrast to the tooth structure and therefore renders the removal of excess cement easier and faster. Before the veneers were seated, retraction cords were placed and the enamel was etched; the dentin remained unetched. Adhese® Universal was used as the bonding agent to place the veneers (Figs 10 and 11). Then the excess luting composite was carefully removed and a glycerine gel (Liquid Strip) was applied (Fig. 12). This gel prevents the formation of an oxygen inhibition layer at the margins. The luting composite was cured with two curing lights (Bluephase® Style) simultaneously and cooled with plenty of water (Fig. 13). Figure 14 shows the harmonious result produced by the lithium disilicate veneers (IPS e.max Press).

Conclusion

State-of-the-art restorative materials have immense potential. Depending on the particular requirements of the patient and the indication, they allow a suitable treatment option to be found quickly and easily. The case presented here shows that highly esthetic ceramic veneers can be fabricated with minimal effort using in-office equipment (IPS Empress CAD Multi). Nevertheless, pressed ceramic veneers were chosen for this patient, since they offered the possibility of applying stains, through which a very close match to the neighbouring teeth could be attained. In principle, however, highly esthetic results can be achieved with both approaches if the appropriate treatment protocol is followed.

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Complex esthetic and functional rehabilitation using glass-ceramic materials

Long-term documentation of a restoration worn for more than eleven years

Prof. Dr Daniel Edelhoff, Munich, and Oliver Brix, Bad Homburg/Germany

Given the enamel-like properties of glass-ceramic materials, minimally invasive treatment options provide a reliable method to restore the function, esthetics and biomechanical characteristics of the dentition while minimizing the damage to the biological structures.

Resin-bonded single-tooth glass-ceramic restorations such as veneers and onlays have been routinely used for many years in dentistry. Nonetheless, their use for complex rehabilitations – e.g. in patients with generalized hard tissue defects – is still critically discussed. These reservations can be increasingly abandoned in view of the beneficial preliminary results reported in controlled clinical studies and the experiences gained in specialist practices. It is essential for the long-term and reliable application of this method to accurately coordinate the stages between the dentist and technician and allow the patient to be actively involved. These stages consist of a careful treatment planning process including a study wax-up/mock-up (esthetic evaluation), adequate pre-treatment phase including a functional "test drive" (functional evaluation), selection of correct materials, combined with a preparation and placement technique appropriate for the materials selected, and implementation of an adequate occlusal design. This case report first describes the use of glass-ceramic restorations for the complex rehabilitation of a patient with extensive loss of tooth structure and then evaluates the restorations after they have been in situ for more than eleven years.

Fig. 1: Preoperative situation: severely impaired esthetic appearance due to a loss of vertical dimension of occlusion (VDO) and the formation of a reverse smile line due to extensive loss of tooth structure

Pre-operative situation

A 40-year-old female visited the practice with the request to have her severely worn dentition restored. She said that she had begun to experience increased sensitivity to thermal and chemical stimuli and complained about the unfavourable esthetic impact of her teeth (Fig. 1). When we recorded her dental history, she told us that she had become aware of an untoward change in her anterior teeth and in the fullness of her lips, particularly when she was looking at photographs of herself. The clinical findings and dental history showed a large and, at times, substantial destruction of her tooth structure and extensive changes in the proportions of her teeth. These changes were primarily caused by abrasive processes and resulted in a reduction of the vertical dimension of occlusion (VDO). The functional analysis of the dentition did not reveal anything unusual. However, the loss of canine guidance and the rise of anterior and posterior group guidance were conspicuous (Figs 2a and b). The special challenges of this case were: high complexity of the rehabilitation, the patient's request for a prompt and minimally invasive improvement of her situation, the need for creating an appropriate tooth morphology and therefore for reconstructing the VDO as well as the permanent placement of the restorations on damaged tooth structure.

Treatment planning

Fillings were placed on the teeth, some of which were severely damaged, using an adhesive composite system (Syntac®, Tetric Ceram®) before planning of the permanent restoration was commenced. This enabled us to better assess the extent of the destruction and obtain a better idea of where the potential preparation margins would be located.

Fig. 2a: Lateral view from the left at dynamic occlusion: traumatic contacts during functional movements have led to extensive loss of enamel and exposure of dentin.

Fig. 2b: Lateral view from the right at dynamic occlusion: loss of canine guidance and severe destruction of maxillary and mandibular anterior teeth.

The amount of exposed dentin is an important indicator for estimating the degree of hard tissue destruction.

To achieve an esthetic and functional rehabilitation, the following treatment goals were defined:

- create an adequate tooth morphology on the basis of a suitable width-length relationship of the teeth,
- establish an anterior canine-protected dynamic occlusion and
- rebuild the vertical dimension of occlusion (VDO).

The destructive processes to which the damaged teeth had been exposed should be halted and a lastingly stable occlusion should be created. The patient wanted a long-lasting rehabilitation based on a minimally invasive procedure and tooth-coloured restorations.

Final restoration was to be achieved using adhesively bonded glass-ceramic veneers and onlays. Glass-ceramic crowns would be used for those teeth that were severely damaged (13 to 23). In view of the fact that these extensive esthetic and functional modifications had to be combined with a re-adjustment of the VDO, the clinical team decided on the following treatment plan:

1. Fabrication of a study wax-up to assist in the creation of an adequate esthetic and functional tooth morphology
2. Intraoral evaluation of the wax-up (mock-up) by the patient with the help of a diagnostic matrix
3. Transfer of the increase in the VDO as determined with the wax-up to a stabilization splint for functional evaluation
4. Tooth preparation guided by the diagnostic matrices and reciprocal determination of the maxillomandibular relationship with a split stabilization splint
5. Trial of the direct temporaries on the basis of the outer contours established in the wax-up
6. Impression-taking and prompt fabrication of the permanent glass-ceramic restorations in the lab
7. Try-in and permanent adhesive placement of the glass-ceramic restorations

Clinical implementation and long-term evaluation

Crowns made of lithium disilicate ceramic in the layering technique (IPS e.max® Press/Ceram) were used for the upper anterior region because of the high degree of tooth destruction present (large composite fillings, Fig. 3a). In the lower anterior region, glass-ceramic veneers layered on refractory dies (IPS d.SIGN®) were inserted (Fig. 3b). Full-contour onlays pressed from leucite-reinforced glass-ceramic

Fig. 3a: Frontal view at protrusion: traumatic contacts have led to substantial changes in the morphology of the teeth.

Fig. 3b: Frontal view at protrusion following the restoration: the function and esthetics of the dental morphology has been restored.

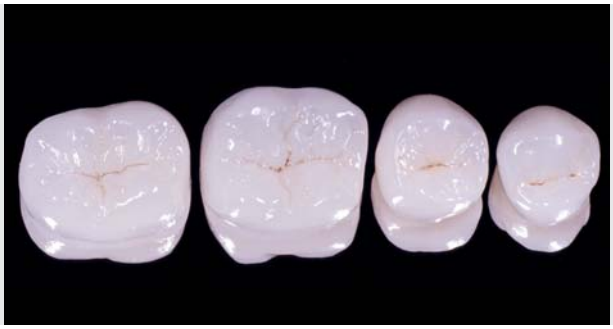

Fig. 4: Onlays made of leucite-reinforced glass-ceramic (IPS Empress Esthetic). The minimum layer thickness of the occlusal surface is 1.5 mm.

Fig. 5: Adhesive placement of the restorations in the mandible using the total-etch technique and rubber dam isolation

Fig. 6a: Onlays on teeth 34 to 37 after adhesive cementation in 2004 (cf. Fig. 4)

Fig. 6b: Onlays on teeth 34 to 37 in the summer of 2015, after having been in situ for eleven years (cf. Fig. 6a)

and customized using the staining technique were placed in the posterior region (IPS Empress® Esthetic). The onlays exhibited a minimum occlusal thickness of 1.5 mm (Fig. 4). Cementation was achieved with a multi-component adhesive system in conjunction with the total-etch technique (Syntac) and a dual-curing low-viscosity luting composite, using where possible rubber dam isolation (Fig. 5).

Recall after more than eleven years

At a follow-up examination conducted more than eleven years after the restorations had been placed, 15 posterior onlays were retained in an undamaged state

Fig. 7a: Preoperative situation: mandibular anterior teeth showing substantial changes in proportion and exposure of dentin due to a reduction in VDO.

Fig. 7b: Layered veneers (IPS d.SIGN) in the mandibular anterior region after adhesive cementation

Fig. 7c: Mandibular veneers in the summer of 2015: a severe wear facet has formed on tooth 43 over the eleven years since the veneers were placed (cf. Fig. 8b).

Figs 8a to f: Portrait pictures taken more than eleven years after the placement of the restorations. The esthetic and functional requirements of the patient have been and continue to be fully satisfied.

(Figs 6a and b). However, cracking had been noticed on the glass-ceramic onlay of tooth 24 after more than six years of clinical performance and for this reason the onlay had subsequently been replaced. Close inspection of the mandibular anterior veneers revealed a severe wear facet on veneer 43 (Figs 7a to c). Similar to the other veneers, this area was in direct contact with the lithium disilicate crowns on the maxillary anterior antagonists during dynamic occlusion.

Conclusion

Given the enamel-like properties of the glass-ceramic material, the minimally invasive methods used for this case provide a long-lasting approach to restoring the function, esthetics and biomechanics of the dentition while minimizing the damage to the biological structures (Figs 8a to f) [4, 6]. Beneficial clinical long-term results have been described and confirmed in several studies [3, 8]. Parafunctions, endodontically treated teeth and an adequate amount of enamel have, among others, been flagged as risk factors influencing the success of these restorations [3, 22]. Against such a background, the additive wax-up technique used here proved to be beneficial. Together with a diagnostic matrix, this technique enables a conservative approach to tooth preparation and helps preserve the remaining enamel during preparation. In addition, an in-vitro investigation has shown encouraging data regarding the stress distribution in ceramic onlay restorations [13]. It is, however, important to note that preparations should have soft and rounded transitions to prevent stress peaks from occurring [1]. In recent years, the authors of this report have mainly used glass-ceramic onlays based on lithium disilicate in conjunction with the staining technique [5, 7]. Given its increased strength, this material allows the minimum thickness to be reduced by one third to just over one millimetre, further increasing the amount of tooth structure that can be preserved during preparation. Given their extremely high strength and optimal marginal integrity, glass-ceramic onlays appear to be ideally suited for restoring the function, esthetics and biomechanical properties of abraded and eroded posterior teeth. They offer an opportunity to circumvent traditional prosthetic measures that are more invasive and involve higher biological costs [6].

Literature available from the editors on request

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Tablet version available

Minimally invasive prosthetic treatment with various ceramic materials

Complex dental rehabilitation in a patient with tooth agenesis

Dr Marko Jakovac, Zagreb/Croatia, and Michele Temperani, Florence/Italy

In cases where a full mouth reconstruction is required, it is essential to follow a systematic procedure and use carefully coordinated materials. The following case study describes the treatment of a patient with tooth agenesis.

New materials and innovative techniques for modern esthetic and minimally invasive dentistry are coming to the market every day. As a result, patient-focused treatment protocols are continuously improving. If complex treatment is indicated, however, personal aspects in addition to the functional and esthetic requirements of the patient need to be addressed – for example, psychological stress or financial constraints. In this article, we will explore the possibilities of providing minimally invasive treatment, taking these factors into consideration.

Case study

The twenty-three-year-old patient showed severe hypodontia (tooth agenesis) with a total of 14 missing teeth (Fig. 1). Seven teeth were missing in both the upper and the lower jaw. Severe hypodontia of this kind usually results in a very low vertical dimension of occlusion. In some cases, it disturbs the chewing function. At the beginning of this type of treatment, psychosocial aspects have to be taken into consideration. In the present case, the patient did not smile during the first appointment, and he covered his mouth with his hand when he spoke. Due to the financial constraints of the young candidate and his fear of an operative intervention (treatment with implants), it was decided to pursue a conventional prosthetic treatment approach. According to the treatment plan, the upper anterior teeth would be restored by means of an all-ceramic bridge and the lower anterior teeth with lithium disilicate veneers. The decision was taken to treat the posterior teeth with metal-ceramic restorations.

Fig. 1: Patient with hypodontia: portrait picture of the initial situation. A total of fourteen teeth were missing in the upper and lower jaw.

Clinical examination and treatment planning

The first part of the oral rehabilitation process involved a clinical examination in which the facial and dental conditions were analyzed. This investigation showed a substantially reduced vertical dimension of occlusion. The patient was missing 14 permanent teeth. Furthermore, several deciduous teeth were still in place. Tooth 36 had been destroyed by caries, making its extraction inevitable.

In order to provide the dental technician with the information required for waxing up a restoration, details related to the vertical dimension of occlusion and facebow records must be supplied in addition to the impression. If the vertical dimension of occlusion needs to be increased, the correct centric position has to be evaluated first. In this case, an anterior Lucia jig made of a thermoplastic material was used as a registration aid (Fig. 2). A facebow was used to establish the relationship of the maxillary jaw to the horizontal reference plane or bipupillary line. In the fabrication of

Fig. 2: Anterior Lucia jig for the evaluation of the centric relation

Fig. 3: Capturing a protrusive bite record with Virtual CADbite

Fig. 4: Wax-up: ideal functional and esthetic position and adjusted occlusal plane and Spee's curve

Fig. 5: Mock-up fabricated with the help of the wax-up for the intraoral examination of the functional and esthetic components

Fig. 6: The prepared upper anterior teeth

Fig. 7: The prepared lower anterior teeth

extensive restorations, the protrusive and the laterotrusive positions have to be recorded in order to make any necessary adjustments in the articulator. An addition silicone, for example, Virtual® CADbite can be used for this purpose. In most cases, this type of material produces faster and more accurate results than wax. When wax is used for bite-taking, the patient has to be shown how to move into the protrusive or laterotrusive position. Experience has shown that it is easier to let the patients produce these movements of their own accord and stop them when they arrive at the "right" position (Fig. 3). Virtual CADbite is injected while the teeth are in this closed position.

Wax-up and mock-up

The following minimum documentation was required for the fabrication of the wax-up: precision impressions of the upper and lower jaw, a facebow transfer record, a centric bite record in wax with the predetermined vertical dimension of occlusion, portrait pictures of the patient as well as close-up pictures of the situation when the patient is smiling. This information was used to build up the restoration in wax and bring the teeth into their ideal functional and esthetic position. Furthermore, the occlusal plane and the Spee's curve were adjusted (Fig. 4). For the purpose of checking the laboratory work intraorally, a mock-up of the wax-up was made (Telio® CS C&B) (Fig. 5). All the functional and esthetic parameters were then checked in the patient's mouth.

This stage of the treatment is very important for many reasons. Patients are given the opportunity to actively participate in designing their new smile, which is a very motivating experience. In addition, the functional wax-up, the maximum intercuspation, the new vertical dimension and the protrusive and laterotrusive movements can be tested in a realistic situation. Moreover, the mock-up serves as a model for the provisional restoration. Therefore, it should be produced with the highest of accuracy. Once the patient is completely satisfied with the proposed result and the mock-up fulfils all the clinical criteria, the actual treatment can begin.

Preliminary treatment

At present, the preparatory measures for minimally invasive procedures and the topic of tooth preparation are receiving

a lot of attention. Nevertheless, there are some other aspects that should not be neglected. For example, the properties of the materials used strongly influence the result. State-of-the-art materials are offering increasingly sophisticated solutions. Before using any new materials, it is important to learn more about the application recommendations of the manufacturer. Excellent planning and a carefully crafted mock-up will reduce the preparations needed for the fabrication of the final restoration. With the help of the mock-up, for example, the teeth can be suitably prepared for veneers or even crowns. The use of optical appliances such as dental loupes and microscopes also makes work easier and more accurate.

In the present case, the teeth were first cleaned very thoroughly. The necessary extractions were performed and one tooth was endodontically treated. Then the teeth were prepared and readied for the prosthetic treatment (Figs 6 and 7). The long-term temporary was fabricated using CAD/CAM equipment. Therefore, the wax-up was digitized with the help of a laboratory scanner. This information provided a basis for the computer-aided design of the provisional. The CAD/CAM-fabricated provisional made of tooth-coloured composite (Telio CAD) also served as a test object or blueprint during the healing process. Its function and esthetics were closely examined and adjusted in detail (Fig. 8).

Fabrication of the permanent restoration

The final prosthetic phase started after the long-term temporary had been worn for an adequate period of time. Before impression-taking, the teeth were prepared again and polished.

Generally, precision impressions for the master cast should be taken with polyether or addition silicone using a customized tray.

It is very important to transfer the vertical dimension of occlusion and the information about the tooth-to-tooth relationship from the provisional to the final restoration with great care. The "cross-mounting" technique is suitable for this purpose. This method entails first making a bite record of the prepared teeth in the upper and lower jaw. Subsequently, a second record is taken of the provisional restoration in the upper jaw and the prepared teeth in the lower jaw. A third record is captured of the prepared teeth in the upper jaw and the provisional restoration in the lower jaw.

The dental technician required the following minimum information in order to fabricate the restoration: precision impressions of the upper and lower jaw, precision impressions of the provisionals, a facebow transfer record and three bite records ("cross-mounting"), and recent portrait pictures of the patient wearing the provisionals as well as photos of the patient smiling.

The aim at this stage was to "copy" the shape and occlusal plane of the provisionals and to accurately transfer this information to the final restoration. For this purpose, the master

Fig. 8: The CAD/CAM-fabricated long-term provisional (Telio CAD) in the mouth

Fig 9: The CAD/CAM-fabricated framework on the model of the upper jaw

Fig. 10: Metal-ceramic posterior bridge (IPS Style); all-ceramic upper anterior bridge (IPS e.max Ceram); veneers on the lower anterior teeth (IPS e.max Press)

Fig. 11: Upper anterior restoration after placement with an esthetic luting composite (Variolink Esthetic DC)

Fig. 12a: The permanently placed restoration in the mouth …

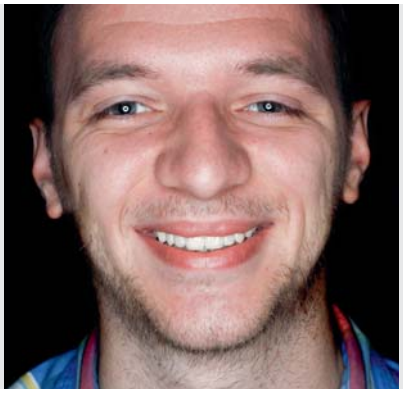

Fig. 12b: … and a portrait picture of the patient.

casts were placed in the articulator after the "cross-mounting" process. Since the final situation had been successively attained by means of the provisionals, the frameworks could be fabricated relatively easily.

As a result of using the CAD/CAM approach, the final restoration could be visualized, modified and/or duplicated with the assurance that all the design guidelines would be observed. The Wieland Precision Technology (WPT, Naturns, Italy) milling centre was responsible for fabricating the frameworks for the metal-ceramic restorations in the posterior region as well as the ziroconium oxide framework for the upper anterior teeth (Fig. 9). The framework was tried in to confirm the correct fit of the restoration. Most of the inaccuracies that usually occur are due to errors made during impression taking, casting or model fabrication. The veneers for the lower teeth were also made with the assistance of digital technology. They were subsequently pressed with lithum discilicate glass-ceramic (IPS e.max®).

The metal frameworks were veneered with the new PFM system IPS Style®. It allowed us to achieve the desired natural-looking, translucent shade without having to sacrifice on brightness. The IPS Style ceramic offers a major advantage in that it can be optimally combined with IPS e.max Ceram. As a result, the veneers on the metal frameworks could be optimally adjusted to the bridge in the upper jaw. After the first bake, the restoration was tried in. At this stage, the need for smaller adjustments of the ceramic was identified. Subsequently, the restorations were glaze fired and polished. The veneers were completed by firing on a thin layer of IPS e.max Ceram A1, followed by a thin glaze layer (Fig. 10).

Before the restorations were seated, the teeth were cleaned and a rubber dam (OptraDam® Plus) was placed. Luting composites such as Variolink® Esthetic are suitable for the placement of this type of restoration. This cement exhibits excellent adhesive properties and clinically beneficial characteristics such as easy removal of excess and long-term shade stability. The system offers an additional advantage in that the shades of the dual-curing (DC) and the light-curing (LC) luting composite are the same. The DC cement is used for crowns and bridges (Fig. 11) and the LC cement for veneers. Furthermore, we used Monobond® Etch & Prime to condition the veneers (adhesive cementation). After gentle sandblasting, the zirconium oxide and metal-ceramic restorations were prepared for placement by applying Monobond Plus. Glycerine gel (Liquid Strip) was applied in order to prevent the formation of an inhibition layer. The final result completely satisfied all the parties involved. The situation which was established during the treatment phase was exactly transferred to the final restoration (Figs 12a and b).

Conclusion

In extensive cases, it is particularly important to develop a well thought-out plan including all the treatment steps, which needs to be carefully followed at all times. In the described case, various ceramic materials were cleverly combined to produce a harmonious result. Excellent communication between the dentist and the dental technician together with well-coordinated state-of-the-art materials systems provided the basis for this highly satisfactory outcome.

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Digital complete dentures

First clinical and technical experiences with the Digital Denture System (Wieland Dental)
Dr Piero Venezia and Pasquale Lacasella, Bari/Italy

CAD/CAM technologies for dentistry were first introduced in the 1980s. At the time, they were mainly geared towards fixed prosthetics. This has now changed as some manufacturers have been developing software and hardware solutions for the digital manufacture of complete dentures in recent years.

Until a few years ago, the idea of using CAD/CAM processes to manufacture removable dentures appeared to be hardly realistic even though CAD/CAM technologies had already become an indispensable component of the workflow for fixed superstructures on natural teeth and implants. Recently, digital tools enabling the rapid and predictable treatment of edentulous patients have become available. This report describes a digital system (Digital Denture System, Wieland Dental) that allows complete dentures to be created in only three appointments. Digital denture design and denture base milling considerably streamline the workflow compared to conventional methods. At the same time, digital dentures ensure a high standard of quality in terms of esthetics and function.

Case study

A 70-year-old female was wearing a complete maxillary denture and had suffered an avulsion of the anterior mandibular teeth four weeks before her first visit. Lack of support in the posterior mandibular region and continued pressure in the anterior maxillary region had led to severe atrophy. The clinical situation was therefore akin to the dental condition described as "combination syndrome" (Figs 1 and 2). Since the patient wanted a rapid and cost-effective rehabilitation with removable dentures, we opted for the "Digital Denture System" protocol.

First appointment

For the preliminary impression, a prefabricated impression tray was coated with a tray adhesive (Virtual® Tray Adhesive) and the impression material was mixed with the catalyst (Virtual Putty Regular Set). After the primary impression has been taken, the areas where excessive compression is present may be slightly reduced with the help of a micromotor handpiece. Next, the secondary impression was taken with a low-viscosity silicone (Virtual Light Body Regular Set) (Fig. 3). To determine the preliminary maxillomandibular relation and occlusal plane, two reference points, one on the chin and one on the nose, were marked and the distance between the two points was measured. The vertical dimension of occlusion was determined by subtracting approx. 2 to 3 mm from the

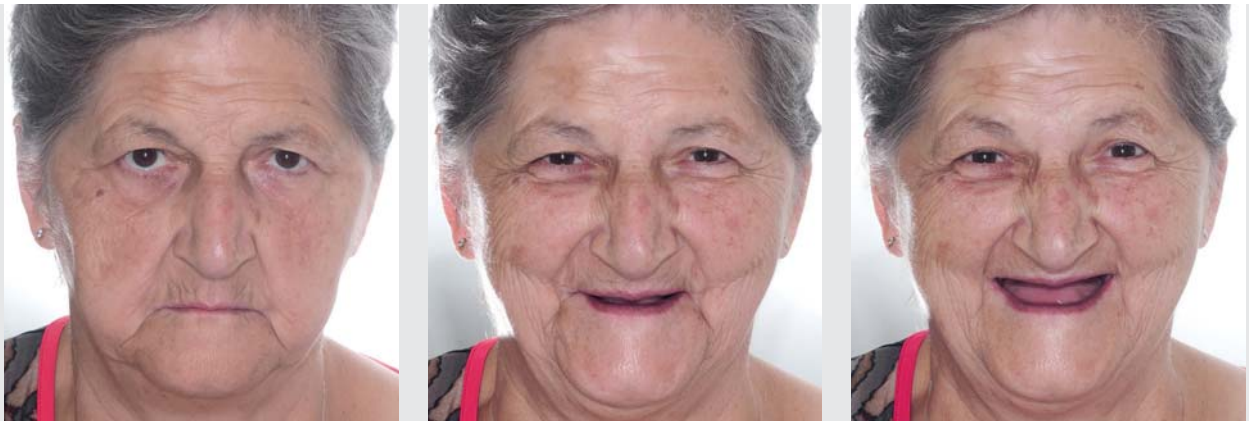


Fig. 1: An edentulous patient requiring a prompt and cost-effective rehabilitation of her upper and lower jaw

Figs 2a and b: Intraoral view: resorbed alveolar ridges and a clinical situation similar to a combination syndrome

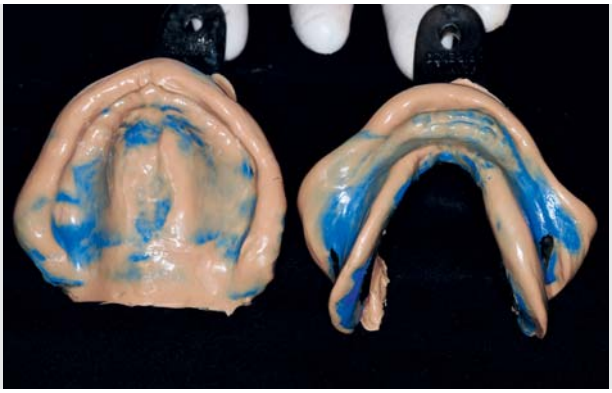


Fig. 3: Double-mix impression of the upper and lower jaw

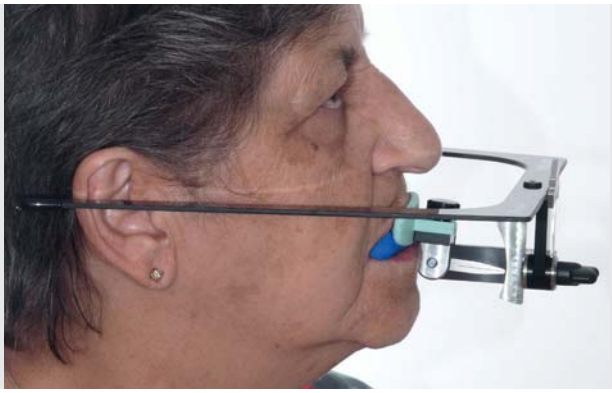
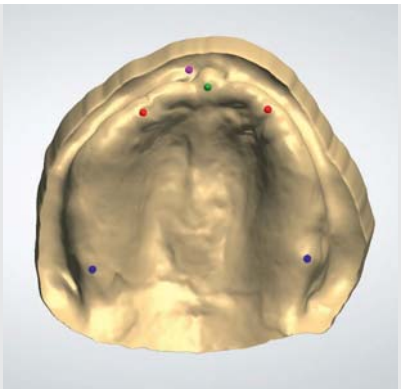


Fig. 4: UTS CAD device to determine the occlusal plane

interocclusal rest position, which corresponds to the freeway space. A Centric Tray was used to record the maxillomandibular relationships. This device consists of an acrylic arch with a retention rail. The Centric Tray was loaded with impression material (Virtual Putty Regular Set). We asked the patient to slowly close the jaws to the preliminary vertical height. After the impression material had set completely, an UTS CAD device (Wieland Dental) was attached to the handle to establish the occlusal plane. The UTS CAD is a registration device to measure the angle of the occlusal plane in relation to Camper's plane (CP) and the bipupillary line (BP). Once measured, the angles were transferred to the CAD software to reproduce the virtual position of the occlusal plane for the design of the 3D Bite Plate (Digital Denture Professional Add-on, Wieland Dental) and the denture. The Centric Tray was attached to the adaptor of the UTS CAD and then the lateral braces of the bow were aligned to Camper's plane (Fig. 4). Next, the front part of the basic bow was aligned to the bipupillary line and the BP screw was fastened to secure the registration joint. The angle values of the patient were filled into the order form and then the form, impression and Centric Tray record were all forwarded to the lab.

In the lab

The impressions and the Centric Tray record (preliminary bite registration) were scanned using the Digital Denture Professional software add-on – based on the Denture Digital Design software (3Shape) – and the ScanIt Impression (3Shape) soft-



Figs 5a and b: Base for the next design steps: anatomical impression of the jaws and digitized preliminary registration

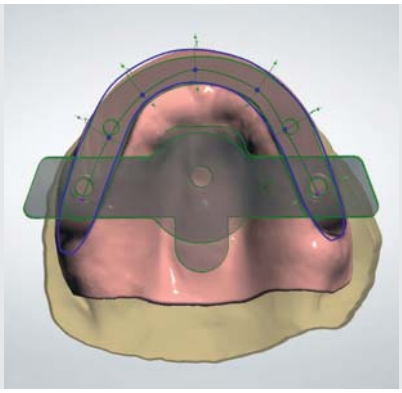


Fig. 6: Design of the 3D Bite Plate taking the needle point tracing device (Gnathometer CAD) into account

Fig. 7: CAD/CAM-milled 3D Bite Plates ready to be connected to the needle point tracing appliance

Fig. 8: Functional impression with Virtual Light Body

Fig. 9: Needle point tracing: centric position verified by the patient

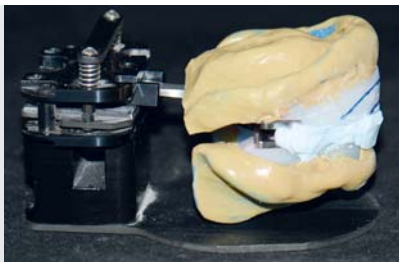


Fig. 10: The exactly aligned impressions (immobilized records) are digitized using a lab scanner.

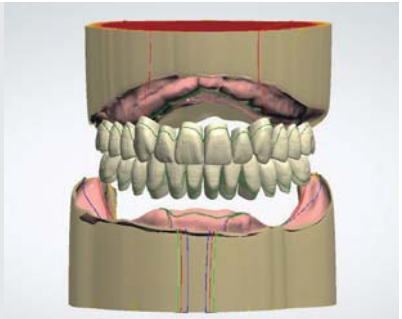


Fig. 11: CAD tooth setup: an extensive software library of denture teeth assists in the process.

ware add-on. CP and BP angle modifications can be implemented with the above mentioned add-on. The program brings the two scans together and produces two virtual models of the edentulous jaws, which are aligned according to the clinical situation (Figs 5a and b).

The dental technician created a 3D Bite Plate for the functional impression and the needle point tracing record. The models were aligned to each other on the basis of the preliminary impression. Next, the dimension of the bite rims had to be established (Fig. 6). The 3D Bite Plate design allows for insertion of both the bite rim supports for functional impression-taking and the registration plates of the Gnathometer CAD device (Wieland Dental) for needle point tracing. The CAD data sets of the 3D Bite Plates were sent to a Zenotec select ion milling unit (Wieland Dental) for machining (Fig. 7).

Second appointment

Prior to taking the functional impression, the bite rim supports were inserted into the 3D Bite Plates. For the registration, the bite rim supports were simply replaced by the registration plates. A vinyl polysiloxane material (Virtual Monophase) was used for functional border moulding. For this purpose, the material was applied to the margins of the maxillary plate. Once the plate was seated in the oral cavity, the muscles were activated. Next, an adhesive varnish (Virtual Tray Adhesive) was dispensed onto the inner surface of the tray. Once dried, Virtual Light Body impression material was applied and the 3D Bite Plate was seated in the mouth (Fig. 8).

The patient was asked to carefully close against the opposing jaw. After that, the UTS CAD appliance was used to check the parallelism of the occlusal plane to the bipupillary line and Camper's plane.

To determine the maxillomandibular relations, a Gnathometer CAD was used. This appliance is designed for taking needle point tracing records in edentulous patients. The bite rim supports were removed and the Gnathometer CAD mounted. Colouring material (crayon, felt tip pen) was applied to the lower registration plate and the patient was asked to perform retrusive, protrusive and lateral movements. The coloured registration plate showed the typical gothic arch tracing record produced by the tracing stylus. The perforation of the fixing plate was aligned with the arrow head of the arch (centric relation) and secured in position.

The patient was asked to occlude. This allowed us to check if the centric relation was established correctly (Fig. 9). The three-dimensional maxillomandibular record can be immobilized with a suitable material (e.g. CADBite). Lastly, the patient's esthetic lines (midline, canine-to-canine line, smile line, lip closure line) were marked on the record. The immobilized record was then forwarded to the lab, together with information about the tooth selection and CP and BP values.

In the lab

Both sides of the record can be digitized in their exact position thanks to the denture scan holder (3Shape) (Fig. 10). The digitized jaw models were aligned with each other on the basis of the registered relations and the occlusal plane was established using the data captured with the UTS CAD.

The dental technician defined the extension of the denture and selected an appropriate tooth mould from a software library of denture teeth (Fig. 11). The Digital Denture Professional software add-on contains several examples of functional setups for select Ivoclar Vivadent and Candulor denture teeth. This saves considerable time. The functional parameters and mandibular dynamics can be verified in a virtual articulator similar to the Stratos 300 and possible interferences can be identified.

Third and fourth appointment

The third appointment is optional. Here, a prototype was tried in on the patient to check the esthetics, phonetics and function of the prospective final dentures (Fig. 12). Fine adjustments, such as corrections to the midline or reduction of the vertical dimension were communicated to the lab.

Fig. 12: Try-in of the prototype to check the functional parameters

Fig. 13: Complete dentures created with CAD/CAM

Fig. 14: The patient is clearly happy with her digitally produced set of dentures.

The needle point tracing record with the verified centric position and correct alignment of the occlusal plane delivers essential information for the denture tooth setup.

In the lab

The denture design was approved for CNC production. A transfer template was computed automatically to facilitate the correct placement of the denture teeth. The CNC milling machine then finished the denture bases. The dentures were removed from the disc and polished (Fig. 13).

Fourth appointment

Intraoral evaluation of the complete dentures and subsequent modifications are carried out in the same way as the procedures for conventional dentures. Hardly any alterations were necessary in this case. The dentures provided a firm and reliable fit and harmoniously integrated into the patient's overall facial appearance (Fig. 14).

Conclusion

Scanning technologies, combined with CAD/CAM processes, substantially reduce the workload associated with the fabrication of complete dentures. Virtual setup and design facilities (CAD) and denture milling procedures (CAM) eliminate the lengthy processes involved in model articulation and flasking. As polymerization shrinkage does not occur, the dentures exhibit a high accuracy of fit. The system described in this report meets the demographic and economic requirements for the production of straightforward, fast, cost-effective and high quality dentures for edentulous jaws.

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Screw-retained bridges: pressed-over or veneered?

The implant restoration for the edentulous jaw
Cristian Petri, Cluj-Napoca/Romania

Either – or? Why not both? If the individual layering technique is combined with the press technique, esthetic restorations can be fabricated in an efficient way.

When producing implant-supported bridges, the occlusal screw retention is an increasingly important factor. Due to the restorative possibilities provided by the material zirconium oxide and the development of CAD/CAM systems, this type of restoration is already very common. Occlusally screw-retained bridges allow the dentist to access the connection point between the superstructure and the implant. This enables for example, the peri-implant situation or the fit of the abutment to be checked. As a result, we can predict good results over a longer period of time. In addition, the process of inserting the restoration is made easier, and regular monitoring of the superstructure is possible.

Basically, the way an implant restoration is fabricated, in terms of the angle of inclination of the implants, the type of connection elements and the processing method used, depends on which technique is selected for the esthetical veneer.

Quite often, a cemented restoration is chosen when the screw channel opening for securing the abutment to the implant is located on the vestibular side – where it is

Fig. 1: Implant model. The diverging implants in the anterior region were ideally aligned using the “no-Hex” abutments.

Fig. 2: A silicone matrix of the wax-up was used to check the amount of space available for the framework and veneers.

Fig. 3: Close-up view of the implant abutments. Angled "no-Hex" abutment in the anterior region and titanium bases in the posterior region.

visible. There is however, a way of creating a screw-retained restoration without compromising the esthetics.

Patient case

After the insertion of eight implants in the edentulous maxilla and a four-month healing period, the practice sent us the implant impressions. The implant axes were quite strongly divergent from one another (Fig. 1). We were asked to produce a zirconium oxide bridge. The dentist also wanted to be able to remove the restoration if necessary. Based on these requirements, there was only one type of screw-retained implant restoration we could make. After casting the model and setting the intermaxillary relation, the wax-up was produced. This wax-up served as a guide for the subsequent steps.

A silicone matrix was made according to the wax-up. This gives an accurate idea of how much space is available for the abutments, the framework and the veneers (Fig. 2). In an implant-supported restoration in the anterior region, the location of the screw opening can impair the esthetical appearance of the final result. The other challenge, which this case posed, was to create an esthetical, screw-retained restoration, despite the diverging implant positions. There was only one solution to achieve satisfactory esthetics: Multi-unit elements in the posterior region and "no-Hex" abutments (conical cementation) for the implants in the anterior region (Fig. 3). The plan comprised placing a zirconium oxide secondary framework over the top of the prepared substructure in the anterior region. An acrylic guide was made so that the "no-Hex" abutments could be transferred and inserted into the mouth precisely.

Amongst other things, the wax-up was used as a guide for the esthetical design. The wax-up was digitalized together with the model and the abutments in the laboratory scanner. The data for the framework construction was imported to the CAD software. The framework was milled from a zirconium oxide disc (Fig. 4a) and then sintered at 1,500°C. The thread hole, for screw-retention of the secondary structure, was drilled with a special thread cutter into the material whilst in a half sintered state (Fig. 4b). In order to check our progress and determine the next steps, the zirconium oxide framework was checked and the wax-up was transferred to the anterior region. For this we used the light-cure laboratory composite SR Nexco®. Minimal differences to the wax-up were corrected by the dentist in the practice (Fig. 5).

After sintering, the zirconium oxide framework was slightly trimmed. Next a regeneration bake was carried out. The prosthetic gingiva was completed with SR Nexco Paste Gingiva composite. Mechanical retention is necessary in order to achieve an ideal bond with the zirconium oxide framework. This was achieved with an application of glaze material,

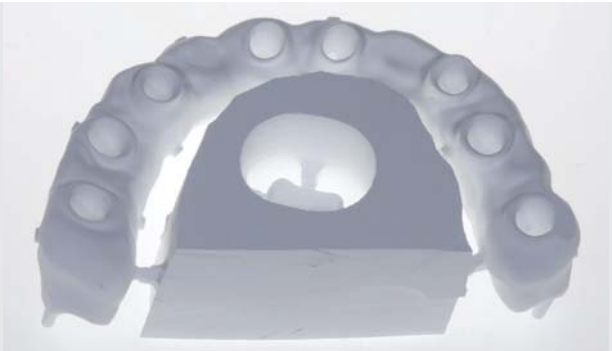

Fig. 4a: The milled zirconium oxide framework

Fig. 4b: The opening for the screw was cut with a thread cutter.

Fig. 5: The wax-up was checked in the mouth and transferred into the laboratory composite SR Nexco.

Fig. 6: Applying mechanical retention to the prosthetic gingiva

Fig. 7: The framework was covered with IPS e.max ZirLiner in the posterior teeth region.

Fig. 8: The wax crowns were adapted to the framework ...

then sandblasting with Al_2O_3 (Fig. 6). The manufacturer recommends the use of SR Link. After trimming, the zirconium framework was sandblasted with Al_2O_3 in order to improve the mechanical retention. This was then simply knocked off and the metal composite bonder SR Link was applied immediately thereafter with a clean, disposable brush.

The areas to be over-pressed with the fluor-apatite glass-ceramic IPS e.max® ZirPress were covered with IPS e.max Ceram Zirliner. After this, a ZirLiner bake was carried out (Fig. 7). On the one hand, the IPS e.max Ceram ZirLiner is used to create a good bond between the framework and the over-press ceramic. On the other hand, it helps to adapt the framework colour and fluorescence to the actual tooth shade. The fully contoured, single crowns were placed onto the primary zirconium oxide framework and the edges waxed (Fig. 8). Subsequently the wax structure was replaced with the IPS e.max ZirPress ceramic (shade A2) (Fig. 9). The posterior teeth were finished and their shape and function was realized in fine detail. Complex manual layering techniques were not used.

Once the design of the posterior area was finished, we began to build-up the four anterior teeth. We used IPS e.max Dentin material in shade A2 as well as Mamelon, Opal and Incisal materials. Finally the large missing gingival areas were completed with SR Nexco Paste Basic Gingiva BG34. The individual characterization of the gingiva was carried out using SR Nexco Paste Dentin A2, SR Nexco Paste Gingiva G1 and G3, SR Nexco Paste Intensive Gingiva IG 2 and IG 4. We used brushes and pads to give a final polish to the composites (Figs 10 to 14).

The secondary structure was intraorally cemented to the multi-unit abutments and "no-Hex" abutments and the completed bridge was screwed in the mouth. This approach produced a tension-free fitting implant restoration. The inserted restoration blends harmoniously into the patient's mouth.

Fig. 9: ... and reproduced in ceramic using the press technique. Then the anterior teeth and the gingival areas were built-up individually.

Conclusion

Often, zirconium oxide frameworks are individually veneered with ceramic. This is how the required esthetics is achieved.

Fig. 10: After completion of the prosthetic gingiva and the final restoration

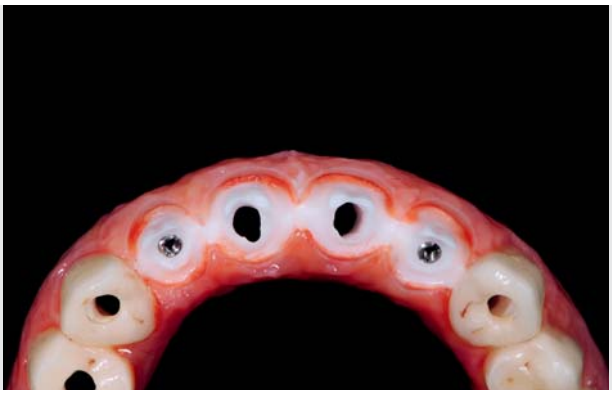

Fig. 11: The restoration before the anterior teeth were fixed

Fig. 12: The ceramic bridge from a lateral view. The pressed and layered crowns adapt well to one another.

Fig. 13: View from the front. The front teeth were built up individually and the posterior teeth were completed in ceramic using the press technique.

Fig. 14: View from basal. In order to produce a stress-free fit, the cementation of the posterior abutments was carried out in the patient's mouth.

The combination of veneered and pressed ceramics is an ideal method to achieve an esthetical appearance in an efficient way. The wax pattern can be exactly transferred into ceramic, which is a great advantage when dealing with large-spanned pieces of work. Zirconium oxide frameworks with ceramic pressed-over are a "state-of-the-art" solution in the field of metal-free prosthetics.

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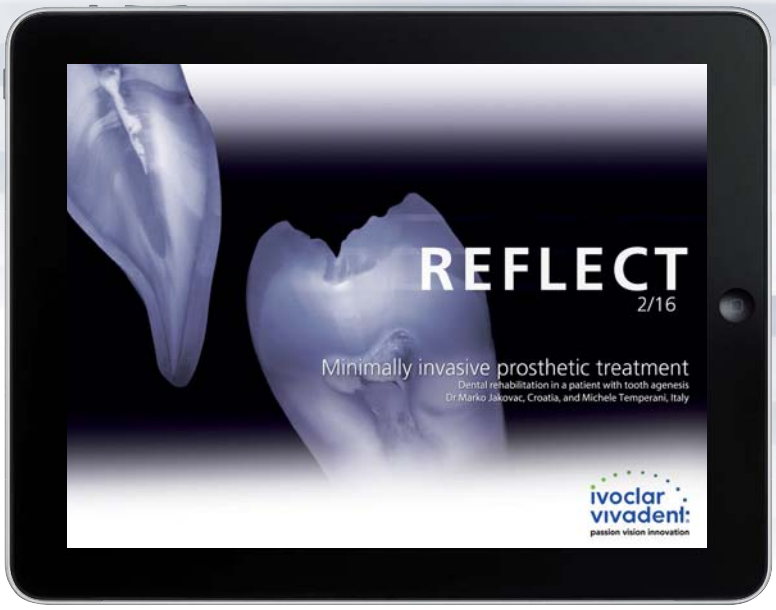

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