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MDT Fabian Ebner *completed his professional training as a state-certified dental technician in 2013. After his qualifying examination, he began his training for Master Dental Technician at the Academy for Austrian Dental Technology in Baden near Vienna (Austria). He completed this in 2017 and subsequently founded the company "Fabian Ebner Dentaltechnik GmbH". At the beginning of 2019, he merged to "Dentaltechnik Humula Bizour Ebner GmbH". His focus is on digital dental technology.*

Dr. Leon Golestani *initially studied Aeronautical Engineering in Graz (Austria) from 2008-2013. From 2013, he studied Dentistry and Medical Journalism at the Private Danube University Krems (Austria) and in 2019, he obtained the academic degrees Dr. Med. Dent. and BA. From 2019 to 2021, he worked as an Assistant Dentist in the Wienerberg City Dental Clinic. In the summer of 2021, after successfully completing a two-year advanced training course, he received the certificate "Curriculum Implant Surgery" from the Graz University Clinic for Medicine in cooperation with the Austrian Society for Implantology. Since 2019, he has been working in Vienna as a Dentist in the Dental Clinic Josefstadt and Dental Aesthetics Clinic Kohlmarkt. At the same time, he is completing his Postgraduate MSc in Oral Surgery / Implantology and Master's degree in Medical Journalism. "*

Minimally invasive and biomimetic full-mouth rehabilitation

Dr. **Johannes Bantleon** and MDT **Fabian Ebner**; reported by Dr. Leon Golestani

As substance-friendly as possible and minimally invasive to (functional) highly aesthetic solutions: these are the factors that are equally important for dentists and patients. Additives and adhesive restorations using composite and ceramics not only represent "white" alternatives to amalgam or crowns (ceramic restorations), but also open up completely new treatment options for the patient and the user. The following case study by Dr. Johannes Bantleon (Vienna) and ZTM Fabian Ebner illustrates how with the help of adhesive, highly aesthetic composite structures in combination with occlusal onlays and veneers[1] made of hybrid ceramics, a dentition functionally damaged by erosion and consequent abrasion was restored by targeted additive biomimetic and evidence-based dentistry and the well-being of the patient was increased in the long term.

In our modern society, tooth erosion and abrasion have become part of the main causes of loss of mineralized tooth substance[1]. Surveys have pointed out that young people under the age of 20 in particular suffer from tooth enamel erosion and this can subsequently lead to tooth substance loss. These aesthetic and functional anomalies lead to embarrassment and high level of suffering. Early signs of erosion can include sensitivity, shiny and glassy enamel, yellowing from the underlying dentin, increased incisal translucency or shallow depressions in the occlusal surfaces. Conventional treatment for severely eroded cases usually involves a combination of endodontic therapy and the use of restorations (e.g. crowns) with significant invasive loss of tooth structure. Many colleagues wrongly consider direct composite restorations only as a cheap and not durable solution[2]. In the following case study, a minimally invasive, additive approach to restoring eroded and abraded teeth is presented. This approach has already been applied successfully on the basis of several clinical studies (Geneva erosion study, 3-step technique according to Vailati[2–4].

Fig. 1: Initial status, deep bite and loss of vertical dimension of occlusion (VDO).

Fig. 2: Upper jaw, initial situation.

Fig. 3: Lower jaw, initial situation.

Fig. 4: Lateral view from the right, showing the collapsed bite.

Fig. 5: Lateral view from the left, showing the collapsed bite.

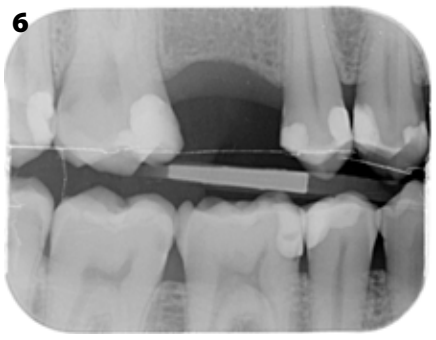

Fig. 6: Pre-operative bitewing, right side.

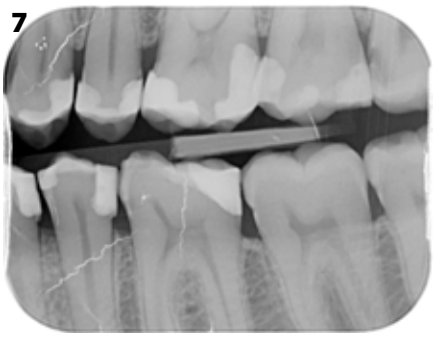

Fig. 7: Pre-operative bitewing, left side.

Initial history and onset

In the following, a case of a 36-year-old teacher is presented. Over the years, the patient beheld how the loss of hard tooth tissue increased despite countless new conservative treatments and frequently replaced restorations. Looking for a solution, he went to many dental practices. The common denominator in the treatment options that were offered to him comprised complex treatment concepts with crowns and bridges.

During the initial consultation, a strongly eroded and abraded dentition in the absence of conspicuous temporomandibular joint symptoms was observed (Figs. 1-7). During the anamnesis, the patient stated that he had suffered from bulimia when he was a teenager, which led to irreversible loss of tooth substance and vertical dimension and resulted in functional loss. At the initial consultation, the eating disorder was no longer present, which is a prerequisite for starting the minimally invasive treatment described

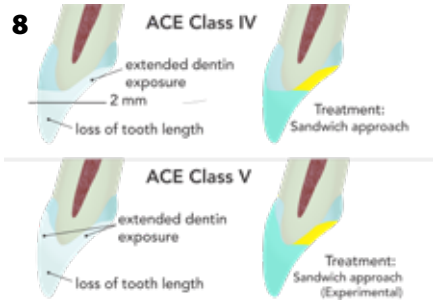

Fig. 8: ACE classification[5]

Fig. 9: Bite registration with jig in a neutral, reproducible and verticalized occlusion.

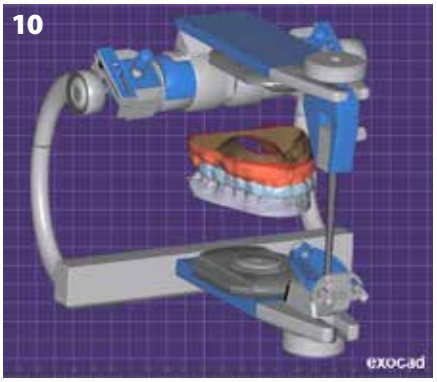

Fig. 10: Digitally created bite splint

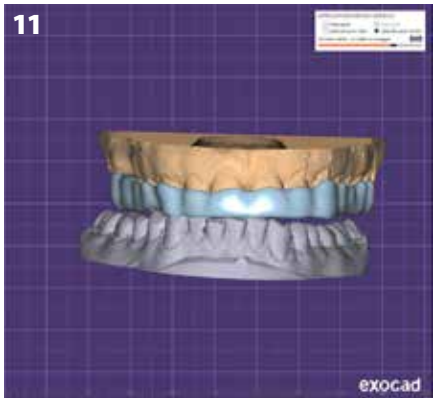

Fig. 11: Digitally created verticalization splint, laterotrusion to the right

Fig. 12: Verticalization splint

below. Since extensive palatal and also vestibular dentin exposure were combined with a consequential loss of tooth length comprising more than 2 mm, it was classified as ACE Class IV and V according to the ACE classification of Vailati[5] (Fig. 8).

After having the patient informed extensively about treatment options, he decided on an adhesive and additive treatment.

Back to origin

Due to the shortened tooth lengths of the heavily eroded and erased teeth and the resulting vertical loss, the patient had a traumatic deep bite (Angle Class I) at maximum intercuspidation, which led in particular to the loss of the palatal portion of the upper front teeth (13 to 23). Before the start of treatment, the complete bite was deprogrammed by means of the hydrostatic principle by an Aqualizer®, accompanied by physiotherapy. These hydrostatic bite cushions filled with water allow to determine a neuromuscularly controlled lower jaw position, excluding any occlusal interferences, such as direct restorations, crowns and bridges. As a result, the lower jaw is automatically guided into a reproducible, muscle-controlled position and the possibility for a later correct anterior canine guidance is created. This neutral and comfortable temporomandibular joint position for the patient was determined for the primary bite registration by means of Aqualizer and a frontjig (Fig. 9) and used to create a bite splint that was worn for 3 months (Figs. 10-12).

On the basis of the deprogrammed newly registered bite, occlusal onlays were then made of PMMA (polymethyl methacrylate) for the lateral teeth (#4 to #6) (Figs. 13-14). This lead to an open bite in the anterior zone, which was deliberately left open for 2 weeks

Fig. 13: Occlusal onlays from PMMA.

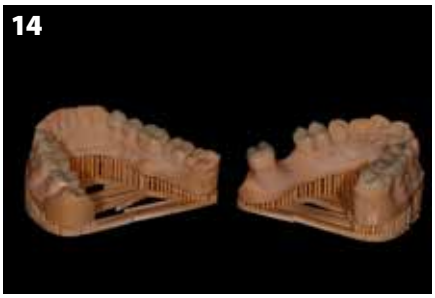

Fig. 14: Occlusal onlays on the master model.

Fig. 15: After bonding the occlusal onlays in the lateral tooth area.

Fig. 16: Increasing the vertical dimension over the lateral teeth in the final bite

(Figs. 15-16). In this case, the old restorations were not replaced for the time being. After isolation by means of a rubber dam, particle abrasion (AquaCare 29 µm Al_2O_3) and a total-etch procedure, the pieces were bonded at once with G-CEM LinkAce. Sterile Teflon can be used as a separation medium. Alternatively, instead of PMMA, directly or indirectly manufactured composites can be bonded to an a priori restored and sealed tooth structure. This composite build-up could also serve as dentin sealant from the author's point of view.

Preparation meets opportunity

After two weeks and having accustomed to the new bite position (detailed re-anamnesis and control of any symptoms; control of the temporomandibular joint and facial muscles; clarification with regard to the head, neck and sleep; checking the static and dynamic occlusion), the frontal open bite and the set occlusion were checked and a new, functional anatomy was determined for the palatal veneers that were planned for the anterior teeth. The patient felt unfamiliar with the new and open bite, but the muscular adaptation led to harmonious lateral tooth contacts with relief of the jaw joints: "I can bite really hard again and have a stable feeling when eating." In this treatment phase, any occlusion disorder can be eliminated before the anterior sextants are incorporated into the static/dynamic occlusion.

In preparation of the later treatment steps, the palatal exposed dentin in the upper anterior sextant was sealed by means of IDS (Immediate Dentin Sealing)[6] using a "golden standard adhesive" and any undercuts were blocked out with composite (Figs. 17-18). Due to this tissue-friendly way of working, no root canal treatment was necessary.

Immediate Dentin Sealing after tooth preparation for direct or indirect restorations (e.g. composite / ceramic inlays, onlays and veneers) - or generally exposed dentin to be restored, as in this case – comprises the sealing of the dentin surface with a dentin bonding agent before the impression is taken and before the temporary restoration is placed. The principles for dentin bonding are based on the work of Nakabayashi and colleagues[7] in the 1980s. The rationale is that the penetration of monomers into the hard tissue creates a diffusion layer or hybrid layer[8]. This approach was trend-setting because the infiltrating resin can create a "structural" bond that resembles the dentin-enamel junction as soon as it is polymerized. After this minimally invasive additive treatment, the wax-up was scanned for the manufacture of the veneers and an (analogue) impression was taken for the wax-up of the lower jaw.

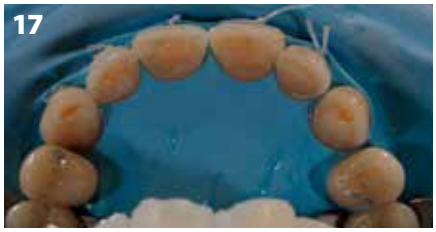

Fig. 17: After sandblasting

Fig. 18: After immediate dentin sealing of teeth #13 to #23 (in preparation of the later palatal veneers)

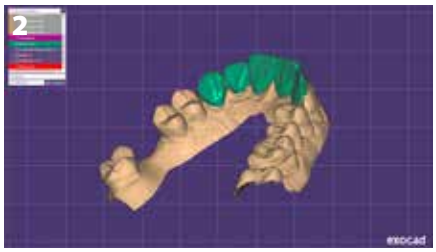

Fig. 19: Digital wax-up

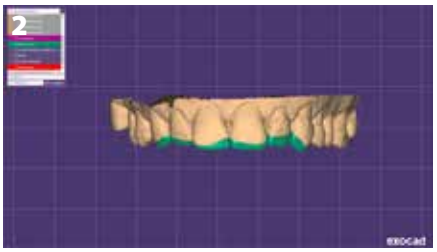

Fig. 20: Digital wax-up

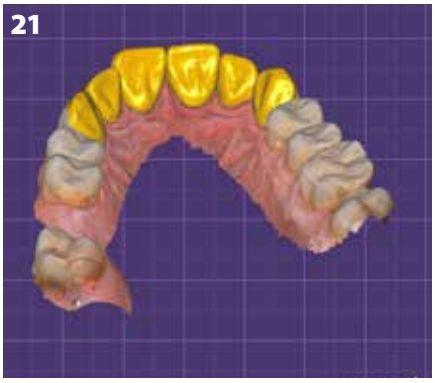

Fig. 21: Digital planning of the palatal veneers

Palatinal veneers and lower jaw build-up

The functional restoration of the palatal chewing surfaces was carried out using CAD/CAM produced palatal veneers made of hybrid ceramic (CERASMART270; Figs. 19-21). In order to avoid crown preparations and the associated hard tooth tissue removal, palatal veneers and additionally, direct vestibular veneers (Essentia, GC; Shade MD/U), were placed in the so-called "sandwich technique".

Before adhesive bonding of the veneers, the lingual surfaces were cleaned with a fluoride-free paste and then sandblasted (AquaCare, 29 µm Al_2O_3). The hybrid ceramic intaglios were also sandblasted, pretreated with a ceramic primer (CERAMIC PRIMER II, GC) and then adhesively bonded under absolute isolation (Figs. 22-23).

One week later, the vestibular surfaces from 13 to 23 were directly restored instead of making use of laboratory manufactured veneers (Fig. 24).

In the same session, the lower front teeth were additively restored. Together with a silicon key made from the wax-up (Fig. 25), a preheated composite (Essentia, Shade MD/U) was used. Static and dynamic occlusion were checked (Fig. 26).

Fig.22: After placement of CERASMART270 palatal veneers on teeth 13, 11 and 22 (palatal view).

Fig.23: After placement of CERASMART270 palatal veneers on teeth 13, 11 and 22 (front view).

Fig. 24: Build-up of teeth 11 and 21 with Essentia composite following the "Sandwich technique".

Fig. 25: Silicon key, made from the wax-up.

Fig. 26: After composite build-up of the lower jaw

Fig. 27: Depth markers in the 1st quadrant

Fig. 28: Depth markers in the 4th quadrant

Fig. 29: 1st quadrant before impression taking for the final onlays in hybrid ceramic (CERASMART270).

Definitive restorations in the lateral tooth area

After a waiting period of 5 months, the teeth were definitively treated per sextant. An implant had been placed on locus 16 in the provisional phase.

The preparations for the later definitive hybrid ceramic comprised a generally conservative treatment of the teeth, including caries restoration and IDS.

The temporary onlays were removed in one session. To help ensure the correct substance removal during preparation, exact depth markings between 1.5 and 2 mm were made through the PMMA temporaries (Figs. 27-28). This ensured a correct layer thickness for the later onlays. The temporary PMMA restorations were entirely removed as the adhesive bond with the hybrid ceramics would not be ideal (Fig. 29).

After one week, the teeth were isolated in preparation for the CERASMART270 occlusal onlays, stained with plaque indicator (Fig. 30) and sandblasted. This type of preconditioning of the tooth surfaces leads to an increase in the adhesive bond. The final hybrid ceramic was inserted using a dual-cure resin cement (G-CEM LinkForce, GC; Fig. 31) and the oxygen inhibition layer was prevented with by applying glycerine gel prior to curing (Fig. 32).

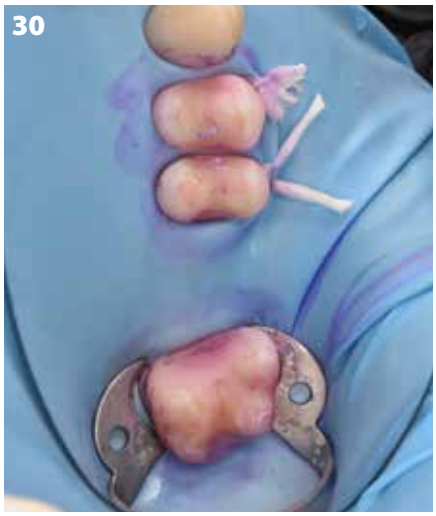

Fig. 30: Staining with plaque indicator

Fig. 31: Complete isolation with rubber dam, Teflon and a "block-out" resin

Fig. 32: Application of glycerine gel prior to curing

Fig. 33: Result, front view

Fig. 34: Result, lateral right view

Fig. 35: Result, lateral left view

Fig. 36: Result, occusal view on the maxilla

Fig. 37: Result, occlusal view on the mandible

Fig. 38: Post-operative bitewing, right

Fig. 39: Post-operative bitewing, left

Fig. 40: Two years after treatment, smile in front view

Fig. 41: Two years after treatment, smile in side view. Upper jaw, initial situation.

Fig. 42: Two years after treatment, intraoral front view, edge-to-edge

Conclusion

The patient was more than satisfied with the final result (Figs. 33-39). It was possible to maintain the eroded tooth substance for years in a minimally invasive and gentle manner and at the same time increase well-being aesthetically and functionally (Figs. 40-43).
The hybrid ceramic used (CERASMART270 from GC) has the same highly aesthetic properties as that of a conventional ceramic. Furthermore, it has a certain shock-absorbing function and if chipping would occur, the repair effort is low.

Another advantage compared to other materials is the clear superficial etching pattern (beneficial for bonding) and the strength, which is positively influenced by additional sintering. Hence, chipping of cusp tips is less likely during functional movements.

The step-by-step (three-step technique)[1] approximation of a biomimetic occlusion takes longer compared to other treatment alternatives, but the adaptation options with the laboratory, especially through the temporary PMMAs and the composites used, allow flexibility in terms of fine adjustments and corrections.

Fig. 43: Two years after treatment, isolated upper jaw

Parameters such as the smile line, incisal edges, the occlusion plane and the height of the bite can be continuously evaluated and changed until the desired treatment goal for the patient and practitioner is achieved.

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