Complex esthetic and functional rehabilitation using glass-ceramic materials - long-term documentation of a restoration

Daniel Edelhoff[1] and Oliver Brix[2]

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.

[1] Prof. Dr Daniel Edelhoff, Munich

[2] Oliver Brix, Bad Homburg/Germany

Contact details:
Prof. Dr Daniel Edelhoff
Director Department of Prosthodontics
Ludwig-Maximilians-University
Goethestrasse 70, 80336
Munich, Germany
daniel.edelhoff@med.uni-muenchen.de

Oliver Brix
innovative dentaldesign Oliver Brix
Kisseleffstrasse 1a, 61348
Bad Homburg, Germany
Oliver-Brix@t-online.de

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.

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. 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.

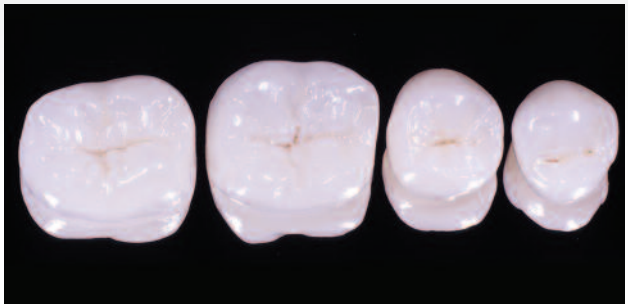


Fig. 4: Onlays made of leucite-reinforced glass-ceramic (IPS Empress Esthetic). The minimum layer thickness of the occlusal surface is 1.5 mm.

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)

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
- 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

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).

Clinical implementation and long-term evaluation

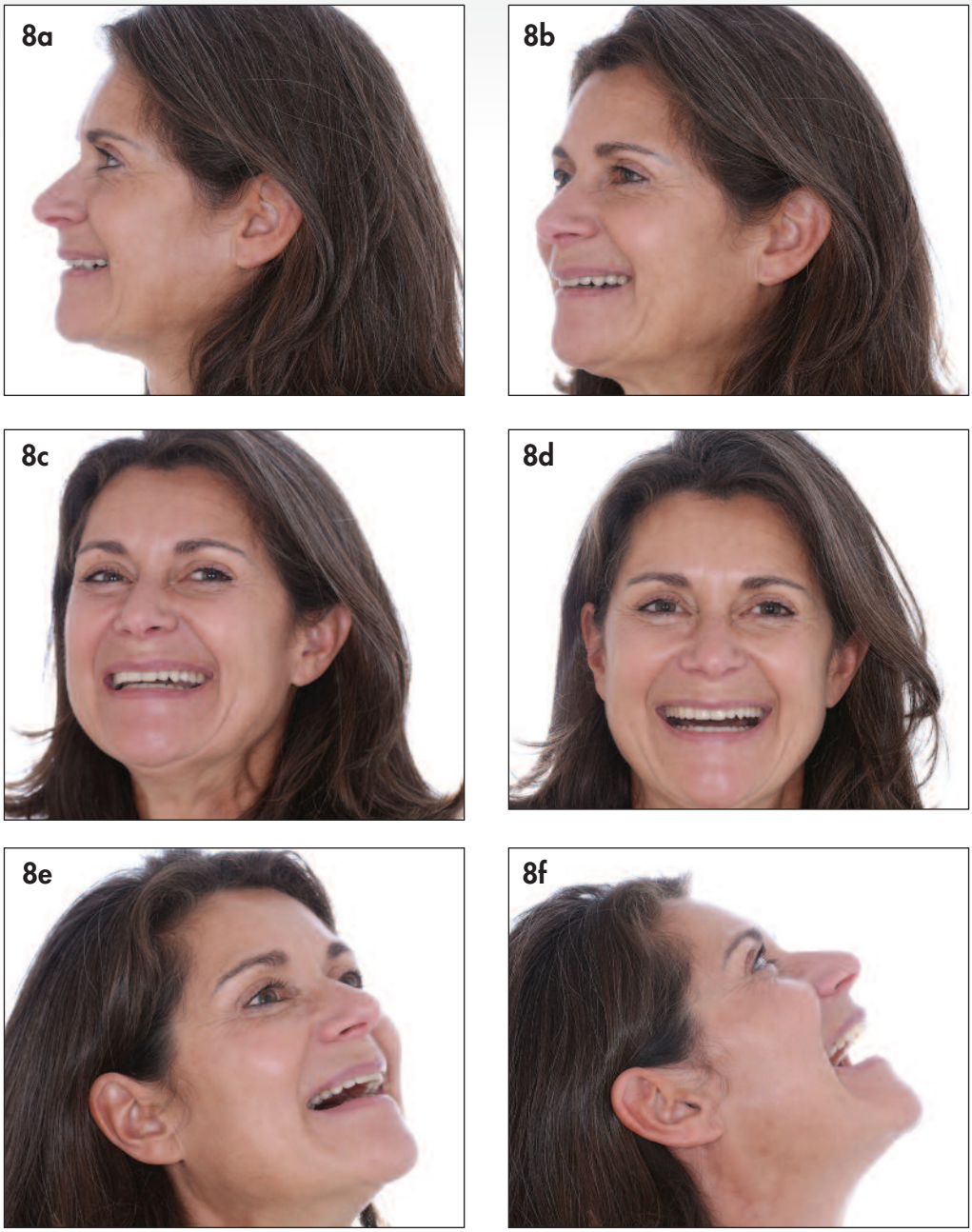
Crowns made of lithium disilicate ceramic in the layering technique (IPS e.max® Press/Ceram) were used for the upper anterior region because of the high degree of tooth destruction present (large composite fillings, Fig. 3a). In the lower anterior region, glass-ceramic veneers layered on refractory dies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



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.

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

Reprinted with permission by Reflect 2/2016