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Resin-bonded single-tooth glass-ceramic restorations such as veneers and onlays have been used for many years in dentistry. Nonetheless, their use for complex restorations—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), appropriate 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.

Preoperative 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 unesthetic impact of her teeth (Fig. 1). When we recorded her dental history, she told us that she had become aware of an undiagnosed 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 an expedited minimally invasive procedure and tooth-coloured restorations.

Pre-operative situation: severely worn dentition. The patient wanted a long-lasting reconstruction of her teeth.

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

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 (Fig. 2a to b). 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: 1. Fabrication of a study wax-up to assist in the creation of an adequate esthetic and functional tooth morphology, 2. Intracoronal evaluation of the wax-up (mock-up) by the patient with the help of a diagnostic matrix, 3. Placement of the lithium disilicate crowns on the VDO as determined with the wax-up to a stabilization splint for functional evaluation, 4. Tooth preparations guided by the diagnostic matrices and reciprocal diagnostic matrices and reciprocal functional analysis of the dentition, 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, 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 layouting technique (IPS e.max Press/Ceram) were used for the upper anterior region because of the high degree of tooth contact present (Fig. 3a). In the lower anterior region, glass-ceramic veneers layered on refractory dies (IPS e.max®) were inserted (Fig. 3b). Full-contour crowns layered from leucite-reinforced glass-ceramic and customized using the staining technique were placed in the lingual 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 (Syntact) 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 restoration had been placed, 15 posterior onlays were retained in an undamaged state (Figs 6a and 8). 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 41 (Fig. 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.

Complex esthetic and functional rehabilitation using glass-ceramic materials

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.

Treatment planning

Fillings were placed on the teeth, some of which were severely damaged, using an adhesive composite system (Syntact®, CeramTek®) 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. 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 lasting, stable occlusion should be created. The patient wanted a long-lasting rehabilitation based on a minimally invasive procedure and tooth-coloured restorations.

Fig. 1: Preoperative situation: severely worn dentition.

Fig. 2a: Lateral view from the left of 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 of dynamic occlusion—loss of canine guidance and severe destruction of maxillary and mandibular anterior teeth.

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 restorations—function and esthetics of the dental morphology has been restored.

Fig. 3c: Mandibular veneer in the summer of 2015: a severe wear facet has formed on tooth 43 over the eleven years since the veneers were placed (Fig. 8b).

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).

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

Fig. 7b: Layered veneers (IPS E-LINE) 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 (Fig. 8b).
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Dental Photography. Part II
Protocol for shade taking and communication with the lab

By Dr. Eduardo Mahn, Chile

Abstract
Part I of this article discussed the basic equipment that is necessary for dental photography. In addition, a few examples of pictures taken that were better than others for the same situation were also shown. In part II, a protocol of taking digital photographs will be presented which has been of great help to the author, specifically in achieving the right shade and value.

It is based on standardized pictures that should be taken in order to show certain individual characteristics of the patient to be treated and standardized comparisons of the shade tabs and the natural tooth structures in order to give the technician more information than the usual A2 or A3 written on a piece of paper.

Shade taking
The evolution in digital photography and the possibility of taking pictures and evaluating them immediately as well as almost instantaneous access of the information by someone located off-site in the same city or even another country, we have a great resource available that can help us achieve the right shade of our indirect restorations. Standardized high quality photographs are also an advantage when the shade is taken for a direct restoration - for example a direct veneer or a class IV.

In this case a picture can really help the clinician identify the opalescent areas and the holo effect of the adjacent tooth, before re-doing the restoration (Figure 1).

Dental shade taking at the dental lab or in the dental practice can be frustrating as most dentists do not really know how to use the shade guide when they finish their undergraduate studies. In particular, if work has to be redone, because the clinician does not know what was done incorrectly or how to obtain the right shade.

Dental shade guides are used by dentists, dental assistants and dental laboratory technicians to communicate proper tooth color, translucency, and brightness.

However, many variables come into play no matter what system you decide to use. Before even starting to think about shade taking, you need to answer an extremely simple and obvious question: are you using exactly the same shade system at the lab? There are many shade taking systems available, with variations in the shades between different manufacturers, even though the concept may be the same.

They are also manufactured from different materials with different optical properties. For example, some labs are familiar with the Chromascope system, most of the dentists with the A-D shade guide, while the younger generation of dentists learned with the VID master shade guide. (Figure 2) The role of a shade guide is to help standardize the perception and so facilitate the communication in order to match the shade of the natural teeth with the required restoration.

Shade guides are not a perfect representation of what is actually seen but are close enough to identify a range of tooth colors. Eyesh are still much light can pass through different areas and the halo effect at the incisal third.

Figure 3. The picture will help the clinician to understand the challenge of reproducing the opalescent areas and the holo effect at the incisal third.

Figure 2. Example of different shade guides showing the same shade. The differences are obvious.

Figure 4. Different appearance of the shade tabs under different light conditions.

Figure 6. The technician should always check the final appearance of the restorations with the use of the natural die materials shade guide on order to come to the optimum result.

Figure 7 and 8. Major differences in the appearance of the same veneers between 11 and 2L, due to the use or lack of light. (Thanks to the pictures by CDT Juergen Jeger, Liechtenstein)

Tooth Color Basics
Color has two basic characteristics. Hue and Chroma. Natural tooth color also displays these same characteristics. Hue can be defined as the actual color such as, yellow or gray. Chroma is the intensity of that color and is sometimes called saturation. Hue and Chroma are typically represented by a shade guide in terms of which color comes closest to the actual tooth being measured. For example, shade guides will have a range of A1 to A4 or B1 to B4, plus C and D shades (Fig 1).

Value is the brightness of a tooth. It is therefore given a separate classification than color when communicating shade. Teeth also exhibit translucency and can be measured by how much light can pass through different sections of a tooth. Shade taking problems arise because most natural teeth are not an exact match to a shade guide, nor do shade guides accurately express tooth translucency.

Figure 5. Different appearance of the shade tabs under different light conditions.