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.

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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 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), anesthetic pre-treatment phase including a functional test drive (functional evaluation), selection of correct materials, combined with a preparation and placement procedure 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.

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 unfavorable esthetic impact of her teeth (Fig. 1). When we recorded her dental history, she told us that she had become aware of an unwelcome 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. 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 tooth-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-colored 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 tooth modifications had to be combined with a re-adjustment of the VDO, the clinical team decided on fabrication of a study wax-up to assist in the creation of an adequate esthetic and functional tooth morphology.

1. Fabrication of a study wax-up to assist in the creation of an adequate esthetic and functional tooth morphology
2. Introral evaluation of the wax-up (mock-up) by the patient with the help of a diagnostic matrix
3. Transference of 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 maxillary anterior and posterior 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 anterior crowns from leucite-reinforced glass-ceramic 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 restoration had been placed, all 16 anterior and posterior onlays were retained in an undamaged state (Figs 6a and b). However, cracking had been noted on the glass-ceramic onlays of teeth 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 and b). Similar to the other veneers, this area was in direct contact with the lithium disilicate crowns on the maxillary anterior antagonists during dynamic occlusion.

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Dental Photography Part II

Protocol for shade taking and communication with the lab

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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 wrong 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 with the lab? There are many shade taking systems available, with variations in the shades between different manufacturer, 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 3D 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. Eyes are still the best tool for identifying and communicating the correct dental shade. Tooth color can be referred to as being an A or B, or between a B2 and B4 shade. By describing the respective tooth closest to the one being restored. It is always best to get the patient to the dental lab and have a custom shade taken, if possible, particularly for the more difficult cases. However, in most of the cases this is not possible due to unwillingness of the patient to spend time going to the lab, or the location of the lab not being in close proximity.

The use of shade guides should be understood in conjunction with digital photography if no direct light is projected to the mouth and the shade tabs, the main light source will be the flash of the camera, which has always the same temperature (between 5500° and 6000°K) and can be used by the dentist in the clinic and the technician in the lab. When pictures are taken under different light conditions, the variations between the same shades can be considerable. A good photo for both the dentist and the lab technician can be emailed so that they are both looking at the tooth color under the same conditions. When the technician compares the color of the restoration with the shade guide, he can take a picture that will create an image to be used as a comparison under the same light conditions as the natural tooth in the image sent by the clinician. (Figures 3-5)

Due to the flash of the camera, the technician can then compare, under the same light conditions as the clinician, whether the restorations look similar to the original shade tab sent by the clinician (Figure 6). Veneers by CDT (Jürgen Sieger, 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 AQ or B1 to B4, plus C and D shades. (Fig 7)

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 adequately express tooth translucency.