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 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), the 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 ten 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 unfavorable 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.

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.

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

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

Treatment planning

Fillings were placed on the teeth, some of which were severely damaged, using an adhesive composite system (Syntac®; Kerr Ceram®) before planning 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:

1. Establish an anterior tooth-protected dynamic occlusion and rebuild the vertical dimension of occlusion (VDO).
2. The destructive processes to which the damaged teeth had been exposed should be halted and a lasting stable occlusion should be created.
3. 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 (Fig. 2c). In view of the extent of these restorations, and the fact that they would be expected to be in situ for more than ten years, it was necessary to develop new concepts for material use, adhesive systems and materials for cementation.

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.

Clinical implementation and long-term evaluation

Crown malformation 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 restoration present (large composite fillings, Fig. 3a). Onlays were placed on the anterior region and glass-ceramic veneers layered on refractory dies (IPS d. SIGN®) were inserted (Fig. 5b). Full-contour veneers present 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 light-curing 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 6b). 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 (Fig. 7a). 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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Conclusion

Given the enamel-like properties of the glass-ceramic material, the mini-

mally 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 8d). Beneficial clinical long-term results have been described and con-

firmed in several studies [4, 8]. Par-

afractures, endodontically treated teeth and an adequate amount of enamel have, among others, been

flagged as risk factors influencing the success of these restorations [3, 5]. Against such a background, the additive wax-up technique used here proved to be beneficial. Together with a diagnostic matrix, this technique enables a conserva-

tive approach to tooth preparation and helps preserve the remaining enamel during preparation. In ad-

dition, an in vitro investigation has shown encouraging data regarding the stress distribution in ceramic crowns [16]. It is important to note that preparations should have soft and rounded tran-

sitions to prevent stress peaks from occurring [3]. In recent years, the au-

thors 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.

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 ba-

sic 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 photo-

graphs will be presented which has been of great help to the author, spe-

cifically 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 stand-

ardized 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 indi-

vidual restorations. Standardized high

quality photographs are also an ad-

vantage 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 adjac-

tent tooth, before re-doing the resto-

ration (Figure 1).

Dental shade taking at the dental lab or in the dental practice can be frustrat-

ing as most dentists do not really know how to use the shade guide when they finish their undergradu-

ate studies. In particular, if work has to be redone, because the clinician does not know what was done incor-

rectly wrong or how to obtain the right shade.

Dental shade guides are used by den-

tists, dental assistants and dental lab-

oratory technicians to communicate proper tooth color, translucency and brightness.

However, many variables come into play no matter what system you de-

cide to use. Before even starting to think about shade taking, you need to answer an extremely simple and obvious question: are you using ex-

actly the same shade system with lab? There are many shade taking systems available, with variations in the shades between different manu-

facturers, 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 JD 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 rep-

resentation of what is actually seen but are close enough to identify a range of tooth colors. Eyesh are still 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 used in conjunction with digital photography if no direct light is pro-

jected to the mouth and the shade tabs, the main light source will be the flash of the camera, which has always the same temperature (be-

tween 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 be-

between the same shades can be con-

sidered. A good photo for both the dentist and the lab technician can be emailed so that they both look-

ing 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 teeth in the image sent by the cli-

nician (Figures 3-5)

Due to the flash of the camera, the technician can then compare, under the same light conditions as the cli-

nician, whether the restorations look similar to the original shade tab sent by the clinician (Figure 6). Veneers by CDT (Juergen Seger, Liechtenstein)

Tooth Color Basics

Color has two basic characteristics. Hue and Chroma. Natural tooth color also displays these same char-

acteristics. 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 rep-

resented 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 7).

Value is the brightness of a tooth. It is therefore given a separate classifica-

tion than color when communicat-

ing shade. Teeth also exhibit translu-

cency and can be measured by how much light can pass through differ-

ent 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 ad-

equately express tooth translucency.

Literature available from the editors on request.

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

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

Figure 3-4. Different appearance of the shade tabs under different light conditions.

Figure 5. 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 dye materials shade guide on order to come to the optimum result.

Figure 7 and 8. Major differences in the appearance of the same veneers teeth 11 and 21, due to the use or lack of lipstick. (Thanks for the pictures to CDT Juergen Seger, Liechtenstein)