The reproduction of natural dentition

All-ceramic crowns in a complex anterior restoration

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The wide variety of materials and manufacturing techniques available provide the ideal fabrication method for every indication. In combination with dental technical skills and a good understanding of shades and colours, this leads to outstanding restorations.

Imitating natural dentition is the greatest challenge in the fabrication of prosthetic restorations. A natural appearance is always determined by a number of various characteristic features, so the technique applied for the reproduction of the teeth cannot always be the same. This is the reason that it is essential for us to observe, learn and recognize fine details and continue to develop, step by step, every day. The basis for imitating nature is an understanding of the characteristics of healthy teeth and of ceramic materials. The reproduction of light optical properties in particular is a challenge that requires an in-depth perception of colours. Properties such as light reflection, transmission and fluorescence contribute significantly to a successful result.

When imitating the light optical properties, the basic structure consists of three different layers: translucent, semi-translucent and opaque. The surface colour is then applied based on a 3-D colour concept. Even though state-of-the-art materials (e.g., polychromatic zirconium dioxide) have become very popular owing to advances in materials science, layering ceramic, built up by hand, is still indispensable for aesthetic restorations. In this article, well-proven techniques will be presented based on two case reports. The IPS e.max Ceram Selection Enamel and Effect materials were used together with the IPS Ivocolor stains and glazes (both Ivoclar Vivadent). Both situations proved to be a challenge in terms of the reproduction of light optical properties. However, imitating nature is possible!

Case 1
Initial situation and treatment plan
The approximately 50-year-old patient had suffered a fracture of the roots of teeth #11 and 21 as a result of an accident. The teeth could not be saved. After careful extraction, considerable resorption of the soft tissue at the labial aspect was observed. After consultation, the patient opted for implant treatment. Prior to this, however, an intervention had to be carried out in the area of the labial soft tissue. The aim was to adjust the gingival contours so that a perfect result could be achieved despite the high smile line. Owing to the advanced soft-tissue resorption, a removable implant superstructure made from gingiva-coloured ceramic was produced, taking aesthetic and hygienic aspects into account.

The two maxillary central incisors occupy an important position from an aesthetic perspective, since the prominence of these teeth expresses the patient’s individuality. Furthermore, the central incisors are the starting point for the continuity and symmetry with the other teeth. Therefore, restoration specifically requires these teeth to be unique and crafted carefully. In this case, from a prosthodontic perspective, it was important to integrate the asymmetrical anterior teeth. The mandibular anterior teeth were crowded and there was no contact with the antagonists.

For functional integration, the maxillary anterior crowns had to be placed in a narrow mesiodistal area. The implants were inserted in regions #11 and 21, taking surgical and prosthetic requirements into consideration (Fig. 1). After osseointegration, the implants would be restored with a splinted, screw-retained all-ceramic restoration (Fig. 2).

Inspiration during the build-up
When building up all-ceramic crowns, the following steps must be carried out with great care: (i) control of the opacity, which influences the brightness, and (ii) characterization of the incisal edge with translucent or opaque materials. Concerning the first point,
depending on the opacity of the framework material, the appropriate brightness can be achieved by means of Deep Dentin or Power Dentin (IPS e.max Ceram), even in materials with a high translucency. In order to reproduce the natural tooth shade, it is important to understand light transmission and reflection. Likewise, the skilled application of light optical effects (e.g., fluorescence and opalescence) is of significance. This is where the new IPS e.max Ceram Selection Enamel and Effect materials are of use. With this outstanding set of materials, lifelike tooth characteristics can be reproduced even more accurately. Figures 3–5 illustrate the layered build-up.

In order to achieve full aesthetic integration of the implants, in addition to the shade and shape of the teeth, it is important to ensure that the surface texture is adjusted to suit the oral environment. To allow the surface texture to appear as natural as possible, fine characteristics (e.g., surface gloss) must be imparted. The surface gloss changes the light reflection, it therefore affects the shade. For this reason, it is imperative to adjust the surface texture carefully. In this case, the IPS Ivoclar staining and glazing system was used for surface finishing.

Results
The finished crowns were screw-fixed to the implants and the result was assessed. The natural appearance was enhanced by a conscious asymmetry of the teeth, among other factors. The gingival contours were ideally adjusted. The teeth (crowns) and soft tissue complemented each other beautifully. The individuality was shown here perfectly. Although this was a challenging and complex case, the results were pleasing for all involved.

Case 2
Initial situation and treatment plan
This patient was also around 50 years old at the time of treatment and came to the practice with an aesthetic problem in the anterior region. The existing restorations on teeth #21–12 were defective and strongly discoloured and no longer suited the patient’s requirements. A slight overbite was noted. Tooth #23 had inadequate contact with the antagonist. In addition, vertical and horizontal restoration of the alveolar ridge in region #12 was observed. Resorption of the soft tissue owing to tooth loss also affected the situation (Fig. 4).

This patient needed extensive treatment in order to achieve an aesthetically pleasing result. An alveolar ridge augmentation procedure was thus first performed. On the basis of the pre-operative examination, a soft-tissue reconstruction was then carried out. The aim was to create a harmonious gingival area (Figs. 9a & b). In this case, sufficient tissue was important, since the horizontal resorption of the alveolar ridge adversely affected the vestibular extent of the crowns. By the time the temporary restoration had been made, the final result had already been defined and the framework for the final restoration planned. It should be pointed out that, in the case of aesthetic restorations, close cooperation between dentist and dental technician is essential. Of course, the patient too must be involved in planning and treatment. The treatment goals are determined together in order to achieve outstanding and satisfactory results for all involved.

Fabrication of the restoration
The frameworks (crowns and bridge) were produced from the lithium disilicate glass-ceramic IPS e.max Press (Ivoclar Vivadent). Since the reproduction of translucency is a challenge in a layered ceramic restoration, contrast effects were applied within the crown during a previous staining process (Fig. 11). In addition, an appearance that underlines the material advantages can be achieved by means of a partial cut-back. IPS e.max Press offers countless possibilities for the production of aesthetic restorations. In this case, the framework was specifically reduced and therefore a perfect basis was created. The vestibular regions were then built up with ceramic layers. After the internal shade composition and adjustment of the tooth morphology were complete, IPS Ivoclar was used to replicate the surface characteristics. In contrast to conventional stains, these stains can be fired at a lower sintering temperature of 750°C. The reasons for staining are adjustment of the degree of saturation, characterisation and correction of the internal structure.

**Fig. 3:** IPS e.max ZirPress G4 was used for imitation of the gingiva. The basic opacity of the crowns was defined with IPS e.max Ceram Deep Dentin A3.5. Then, (2) IPS e.max Ceram Power Dentin A5 and (3) IPS e.max Ceram Selection Light Absorber fog and Light Absorber taupe were applied in a layered build-up. We were able to create a wonderful contrast in the ivory-coloured layer. — **Fig. 4:** Next, (4) IPS e.max Ceram Special Incisal grey and Cervical Transpa orange, (5) IPS e.max Ceram Selection Special Enamel quartz and IPS e.max Ceram Opal Effect 2 (OE 2) were applied to imitate depth within the neck of the tooth. For the characterisation of the incisal edge, we used (6) IPS e.max Ceram Mamelon light, (7) IPS e.max Ceram Selection Light Reflector salmon, (8) IPS e.max Ceram OE 1, (9) IPS e.max Ceram Selection Light Absorber taupe, (10) IPS e.max Ceram Power Incisal and (11) IPS e.max Ceram Deep Dentin A3 and OE 2. — **Fig. 5:** In addition, the mamelons were applied directly at the labial and lingual aspects. For this, we used (12) IPS e.max Ceram Deep Dentin A3 and Occlusal Dentin orange in order to achieve an illusion of depth to the incisal edge. The translucency of an incisal edge is determined by the proportion of layered ceramic on the labial aspect and by a cut-back on the incisal aspect. — **Figs. 6 & 7:** It was possible to restore the teeth and soft tissue aesthetically and functionally. The ceramic enabled excellent shade reproduction with many individual characteristics. — **Fig. 8:** Initial situation: in addition to the mismatch of shade and morphology, functional problems were identified. — **Figs. 9a & b:** Before and after the intervention in region #22. The soft-tissue situation was managed by surgical treatment and temporary restorations. — **Figs. 10 & 11:** Framework made from an IPS e.max Press LT A1 ingot. The contrast within the crown was enhanced by applying the stains inside the crown.
IPS e.max Ceram is a low-fusing ceramic. In order to adjust the surface texture during the glaze firing, it is necessary to handle it carefully and manage the firing programs. In cases such as this, in which a distinctive characterisation is required, the stain-firing sequence must be lengthened. Texture control then becomes more difficult. In view of this, IPS Ivocolor is a good product that allows characterisation at a low temperature. It can therefore be applied without losing the surface texture. During the final glaze adjustment, the delicate surface characterisations and the stained areas were retained. By applying the individual characteristics of natural teeth, we aimed to create a natural appearance. IPS e.max Ceram Selection was also used here. A successful combination of light transmission and reflection was achieved: a perfect reproduction of natural shade with the effect of depth (Figs. 12–14).

Conclusion

The most important advantage of IPS e.max Press is the combination of a high level of aesthetics and exceptional strength. Incident light on IPS e.max lithium disilicate behaves in a similar way to that on natural teeth. This ensures maximum aesthetics. In addition, the material provides ideas and inspiration. The integration of IPS e.max Ceram Selection and IPS Ivocolor, as well as IPS e.max Ceram Power Dentin and Power Incisal ceramic, greatly expands the range of aesthetic possibilities. In the future, the clinical indications for the IPS e.max system will be increased even further.

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