Restoration of teeth using lithium disilicate glass-ceramics in a patient with Dentinogenesis Imperfecta

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Introduction

The availability of modern fabrication techniques and the introduction of cutting-edge restorative materials allow today's dental professionals to pursue treatment strategies that involve an ample temporary phase, during which functional and esthetic characteristics can be successfully re-created. The following case study describes the complex restoration of severely discoloured tooth structure with tooth-coloured materials in a young patient. Due to the use of long-term temporaries fabricated with CAD/CAM techniques in combination with high-performance polymers, the treatment team was able to study and adapt the restoration design during the growth phase of the patient. As a result, this approach ensured highly predictable results for the permanent restorations made of lithium disilicate glass-ceramic.

Preoperative situation

A 16-year-old patient presented to the practice in the company of his parents and expressed the wish to transform the appearance of his severely discoloured and deformed teeth. He reported no pain, but complained about the negative influence that the teeth had on his social life (Figs 1, 2a and 2b). On the basis of the examination and the patient history dentinogenesis imperfecta type II was diagnosed. In many cases, the teeth of patients with this disorder show enamel cracking, which causes accelerated wear of the teeth.

The present case involved the following special challenges: the young age of the patient (growth phase), his request for a prompt solution, the appropriate recreation of the tooth morphology and the complete adjustment of the vertical dimension of occlusion (VDO) as well as the permanent placement of the restorations on the damaged tooth structure.

Treatment plan

Before the teeth were permanently treated, fillings were placed in teeth 16, 26, 36 and 46 (Tetric EvoFlow / Ceram, Syntac) (Figs 3a and b). Due to the deformation of the dentin, the bond to dental enamel was considerably impaired in many areas. Against this background and because of the extreme discolouration of the dentin,

Fig. 1 Preoperative situation: Serious esthetic damage was caused by significant discoluration and unbalanced proportions of dental tissue as a result of the condition known as dentinogenesis imperfecta.

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Figs 2a and 2b Preoperative situation: The severe damage of the dentition also affected the function of the teeth.

Figs 3a and 3b Preoperative situation: View of the upper and lower jaw. The first molars of both jaws in particular show a high degree of destruction due to enamel cracking.

minimally invasive, purely adhesive cementation measures were completely eliminated as a restorative approach. In order to help recreate the functional and esthetic characteristics of the young patient's teeth, the following goals were defined: appropriate re-creation of the tooth morphology with anterior canine-protected dynamic occlusion and adjustment of the VDO. The aim of these procedures was to halt the destructive process to which the damaged teeth had been exposed and open up the possibility for the patient to have a normal social and professional life.

In order to provide the dental lab with a first impression of the preoperative situation, it was supplied with extraoral (portraits) and intraoral photographs. Furthermore, alginate impressions of both jaws were made, which would allow the fabrication of study models in the dental laboratory. In addition, the centric relation was established and an arbitrary facebow record was taken.

After the laboratory and clinical analysis as well as the assessment of the risks and benefits of alternative solutions, the patient and the clinical team decided on the following treatment plan:

Full crowns made of lithium disilicate glass-ceramics were used to restore the severely damaged teeth. The anterior restorations were fabricated with the layering technique (IPS e.max Press MO 0 / IPS e.max Ceram) and posterior restorations with the staining technique (IPS e.max Press LT A2). As considerable esthetic and functional changes were combined with the complete re-adjustment of the VDO, the clinical team decided on the following treatment procedure:

1. Fabrication of an analytical wax-up to assist in the creation of an esthetic and functional tooth morphology
2. Intraoral evaluation of the wax-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 modified Michigan splint for the functional evaluation of the new situation

Fig. 4 Long-term temporaries made of high-performance polymers. Long-term temporaries fabricated according to an analytical wax-up using CAD/CAM techniques were splinted in segments (3-4 units) and placed with glass ionomer cement. The long-term temporaries helped the patient quite considerably in evaluating the esthetics and function of the proposed restoration.

4. Tooth preparation guided by the diagnostic matrix and reciprocal determination of the maxillomandibular relationship with a split Michigan splint
5. Scanning of the wax-up and exact reproduction using CAD/CAM techniques to produce long-term temporaries made of high-performance polymers
6. Trial of long-term temporaries (min. 12 months) with the possibility of making modifications
7. After the successful termination of the provisional phase, impression-taking and prompt fabrication of the permanent glass-ceramic crowns in the dental laboratory
8. Try-in and permanent adhesive cementation of crowns made of lithium disilicate ceramic

Clinical procedure

Conditioning and preparation

The wax-up was evaluated by the patient in terms of its esthetics and function. Subsequently, eight-week splinting treatment was initiated to modify the VDO of the patient in accordance with the wax-up. All the preparations and the determination of the maxillomandibular relationship with a split splint were scheduled on one day. The diagnostic matrix served as the orientation aid for these preparations. As a result, minimal tooth structure was removed in accordance with the contours of the restoration as determined by the wax-up.

Temporary restoration

The first temporaries were fabricated chairside with the help of the multiple-use diagnostic matrix and a Bis-GMA-based temporary material (C&B Provilink). After the soft tissue had healed sufficiently, precision impressions were taken of both jaws. These impressions together with the facebow and the records of the maxillomandibular relationship were delivered to the dental laboratory. On the basis of the scans of analytical wax-ups, the long-term temporaries were milled from a high-performance polymer using CAD/CAM techniques. Due to the weak retention of the short abutment teeth, the long-term temporary crowns were splinted in segments of 3 to 4 units and cemented with glass ionomer cement (Fig. 4). This approach was taken in order to avoid premature loss of retention due to the short abutment teeth and to ensure adequate density of the long-term temporaries over a period of 12 months in situ. During this time, small tissue adjustments were made and crown 21 was lengthened with minimally invasive surgical methods.

After the smooth evaluation phase of the long-term temporaries, the permanent restorations were introduced. In a first step, the permanent maxillary restorations were fabricated. For this purpose, the temporaries in one half of the jaw were removed, the prepared teeth were finished and the maxillomandibular relationship was determined with a Bis-GMA-based provisional restorative (C&B Provilink) (Fig. 5a). This record subsequently served as the

Figs 5a and 5b Determination of the maxillomandibular relationship. The long-term temporaries of one quadrant were removed to fabricate the permanent crowns. The maxillomandibular relationship was determined with a Bis-GMA-based temporary restorative material. This record was subsequently used as a reference for establishing the maxillomandibular relationship in the second quadrant.

Figs 6a and 6b. Seating of the anterior teeth made of lithium disilicate ceramic.

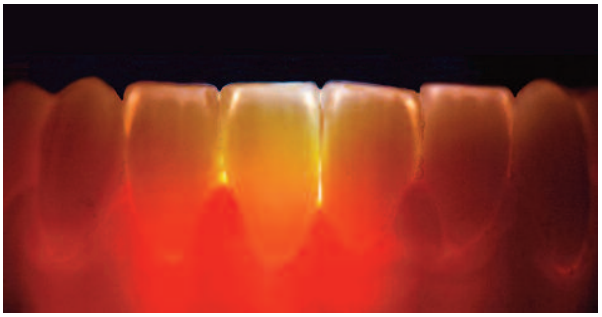

Fig. 6c. The specific level of opacity (MO) chosen for the framework ceramic allowed the severe discolouration of the tooth structure to be effectively masked, without significantly impairing the light transmission (Fig. 6c).

reference for the determination of the maxillomandibular relationship in the second quadrant (Fig. 5b). Next, precision impressions were taken for the fabrication of the permanent glass-ceramic crown units. During the period up to the incorporation of the permanent crowns, chairside-fabricated temporaries were used. After the placement of the glass-ceramic CAD/CAM restorations in the upper jaw, the single-tooth restorations were accordingly placed in the lower jaw (Figs 6a, 6b and 6c).

Try-in and seating of glass-ceramic crowns

After the removal of the temporary restorations, remains of the cementation material were removed from the preparation surfaces with the help of brushes and a fluoride-free cleaning paste. In order to check their shape and colour, the restorations were tried in with a pigmented glycerine gel (Try-in Paste, Variolink II).

In preparation for the permanent placement of the restorations, the inner surfaces of the glass-ceramic restorations were etched with hydrofluoric acid gel (< 5% IPS Ceramic Etching Gel) for 20 seconds and subsequently silanized (Monobond-S). Subsequently, the dentin adhesive system Syntac was applied to the prepared teeth. The restorations were cemented with the Variolink II system (dual-curing, low-viscosity, shade Base A1/110). The material was permanently cured with a high-performance polymerization light (bluephase G2 with > 1000 mW/cm^2) (Figs 7a and 7b, 8).

The extended provisional phase allowed the dental team to adequately test the adjusted VDO and therefore ensure a high level of predictability for the final restoration. The findings of this pre-treatment phase were successfully incorporated into the glass-ceramic restoration. The patient

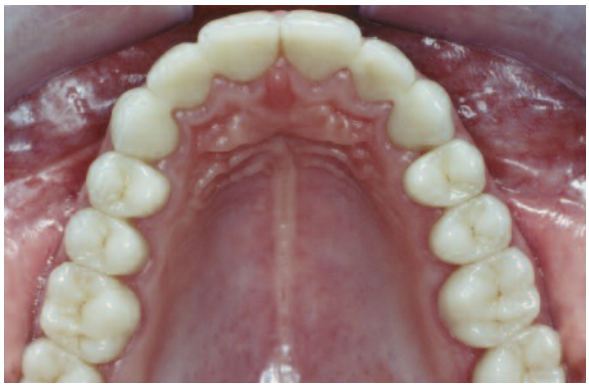

Fig. 7a View of the IPS e.max Press restorations in the upper jaw after adhesive cementation. Due to the very short abutment teeth, the anterior restorations were splinted in units of three. The posterior teeth were splinted in units of two.

Fig. 7b View of the IPS e.max Press restorations in the lower jaw after adhesive cementation. The crowns did not have to be splinted in the lower jaw. Single-tooth restorations were used exclusively.

was delighted with the result in terms of both esthetics and function (Figs 9a to 9c).

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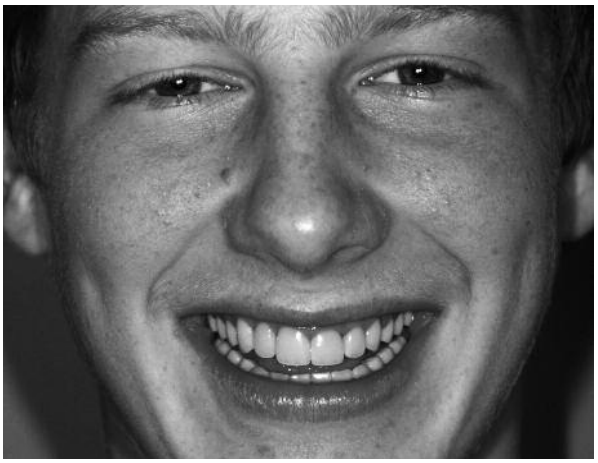
9a: At the beginning of the treatment, the 16-year-old patient hardly had a reason to smile due to his dental anomalies.



9b: A considerable improvement compared with the preoperative situation was achieved with the provisionals created with CAD/CAM techniques according to the analytical wax-up.

Fig. 8 Postoperative situation. Dynamic occlusion after the placement of the permanent restorations. The dimensions of the upper anterior teeth now correspond to the young age of the patient.

9c: Situation after the placement of the 28 crowns made of IPS e.max Press. The stained teeth have been successfully masked and an esthetic and functionally effective result has been achieved.