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Direct restorative technique in posterior teeth to treat erosion-induced tooth wear

Introduction: The restorative reconstruction of lost tooth structure and the restoration of the original vertical bite position in a dentition that has been severely affected by tooth erosion or abrasion always presents the dentist with problems in implementing the therapy. Traditionally, this therapy is carried out with laboratory-produced restaurations, which usually require preparation of the remaining tooth substance and result in high costs for the patient, so that alternative procedures should be considered. It should be emphasized that any restorative work, even minimally invasive, is only indicated in these patients if the preventive approach of inhibiting further loss of tooth structure is successful at the same time.

Treatment method: The following article presents a case study on the use of direct adhesive composite restorations as a possibility for reconstructing an erosively severely altered dentition. Transfer splints, which are fabricated on the basis of individual wax-up models, are used to reconstruct the occlusal surfaces.

Conclusion: The procedure described is a well-studied and proven method for restoring teeth with erosion-induced tooth wear. As with all new procedures, there will be a certain learning curve for the practicing dentist, after which high-quality restorations can be implemented using this technique.

Keywords: adhesive technique; composite; erosion; occlusal vertical dimension; tooth wear

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Figure 1 Dental situation of a 33-year-old patient with trough-shaped erosions at the cusp tips of the premolars and at the canine. Simultaneously, an abrasion facet is present at the cusp tip of the canine tooth.

Figure 2 Situation after filling the trough-shaped defects with flowable composite. The cusp tip of the canine was supplemented with a highly viscous composite.

1. Introduction

Increasingly, scientific studies as well as observations from daily practice are found to address the occurrence of non-caries-related tooth wear. New prevalence data also indicate that this type of tooth wear and the associated therapies are becoming increasingly important in dentistry [10]. In addition to mechanical wear of teeth by foreign bodies (abrasion) or direct tooth-to-tooth contact (attrition), chemical attacks (erosions) are mainly responsible for the observed tooth wear. The differentiated view of erosions has led to the term "erosive tooth wear" being used in recent scientific literature. This is understood to be the sum of irreversible (macroscopic) loss of tooth structure and (microscopic) softening or demineralization present at the tooth surface, triggered by mostly acidic agents without the involvement of microorganisms [22]. In the following article, the more commonly known term erosion is used partly synonymously.

The surfaces of enamel or dentin that have been demineralized by acid attack are particularly susceptible to mechanical stress, which leads to an acceleration of tooth structure loss. Furthermore, continuous attack on the dentin often leads to painful tooth hypersensitivity. However, other problems, such as difficulties with food grinding and speech, as well as headaches and jaw pain, can also severely affect the quality of life, especially the oral-health-related quality of life (OHRQoL) of those affected. In addition, poor aesthetic appearance of the anterior teeth associated with tooth wear can significantly increase the individual suffering of affected patients [1, 17].

1.1 Restorative therapy considerations

Restorative treatment of erosive tooth wear should always be accompanied by preventive measures to avoid further tooth structure loss. In principle, it should first be noted that physiological loss of tooth structure occurs in the course of life in all individuals and does not necessarily require restorative therapy. However, restorative therapy of such affected dentitions may become necessary for various reasons and to varying degrees. Reasons for restorative therapy may be: a loss of hard substance that is not commensurate with age or progressive loss of hard substance with extensively exposed dentin areas, the presence of pain, limited masticatory function, a threat to the integrity of the tooth or pulp, or compromised esthetics [13].

In the case of smaller, often trough-shaped dentin defects, it is usually sufficient to selectively fill and seal these surfaces with flowable composite materials to prevent further progression of the defect (Figs. 1 and 2).

For more extensive defects, often involving the entire dentition, restorative therapy ranges from direct adhesive composite restorations to indirect restorations using composite or ceramic workpieces [2, 4, 7, 12, 15, 21, 23, 24, 33]. The larger the defects, the more dentists tend to use indirect restorative methods [11]. The longest follow-ups for total restoration of dentitions with pronounced tooth structure loss are based on studies of up to eleven years each [8] for ceramic restorations and for direct composite restorations [30]. Both the long-term results obtained in these very long follow-up studies and the overall long-term results available are promising in the majority of the studies, despite the challenging nature of the problem. A conclusive assessment of which restorative material is most suitable under these multiple influences is currently not available [18]. A direct comparative study including different material types is not available.

1.2 Direct restorations

The advanced loss of tooth structure, which is often associated with the loss of vertical occlusal height, presents the practitioner with a particularly difficult task. It is also important to bear in mind that, in addition to the chemical-erosive component of tooth wear, mechanical influences and parafunctions such as existing bruxism can also have a major impact on tooth wear and the future stress on restorations. Therefore, it is predominantly recommended to protect

Figure 3 Occlusal view of the initial situation of the patient described in the case report.

Figure 4 Anterior situation of the patient.

Figure 5 Wax-up of the posterior teeth with omission of the last molar, which was later built up freehand. The "drainage grooves" modeled buccally and lingually with wax at the time are no longer provided by the authors today.

the often extensive restorations during the night by occlusal protective splints against the effects of nighttime, uncontrolled teeth grinding.

Continuous improvements in the material science of dental composite materials and the desire of patients for forms of therapy that are gentle on the tooth substance and financially affordable have led to a steady expansion of the range of indications for direct composite restorations. One advantage of direct restorations with composites is that composites allow a purely defect-oriented approach without having to sacrifice healthy tooth structure by additional preparation measures. In principle, this procedure is also possible with indirect approaches using ceramics or laboratory-processed composites in so-called "non-prep restorations", but it requires extraordinary skill on the part of the practitioner and dental technician and has therefore not been able to gain widespread acceptance to date.

The authors of this article have extensive experience with the direct restoration technique using composites to treat non-caries related tooth structure loss. Therefore, the following article will also deal with this approach and in particular with restorations in the posterior region. However, it should be emphasized that, as mentioned above, other techniques or materials can also be used to address these complex situations.

Preferably, nanohybrid composites or pure nanofiller composites are used. Relatively low occlusal wear and good physicomechanical properties have been demonstrated for this class of materials [9, 19].

The use of direct composite restorations for bite elevation has not been widespread to date, which can be explained, among other things, by the considerable time required and the difficulty of designing an accurate occlusal morphology when teeth are built up freehand. In order to circumvent the problems of the freehand technique and to simplify the readjustment of the vertical dimension, various methods have been presented and further developed with which an ideal occlusion, initially individually waxed up in the dental laboratory, can be transferred to the patient's mouth with the aid of transfer splints [3, 25, 32] or silicone stamps (stamp technique) [20]. This can also be used to fabricate provisional occlusal abutments in order to test a new occlusal position planned at a later date with ceramic workpieces in advance over a desired observation period [16]. A survey of dentists in private practice who have already carried out direct bite height reconstructions with composite in their practices with the aid of transfer splints showed that the technical implementation also works well and efficiently under practice conditions [28].

2. Case presentation

In the following, the technique of direct bite height reconstruction with composite using transfer splints is explained on the basis of a patient case with erosion-related tooth damage.

2.1 Initial situation

The patient, who was 31 years old at the time of the initial examination, stated that she had suffered from bulimia in adolescence. At the time of the initial examination, the disease had been successfully treated for several years without any relapses into the old behavioral pattern of the eating disorder. The patient's medical history was inconspicuous. Clinical

examination revealed no evidence of myofunctional complaints, and periodontal conditions were stable on all teeth without the presence of relevant probing depths or bleeding. Oral hygiene was excellent.

As shown in Figure 3, the patient had advanced erosive defects on all teeth, mostly with dentin involvement. In the posterior region, mainly the occlusal surfaces were affected. The maxillary anterior teeth showed shortened dental crowns as well as palatal and labial significant loss of tooth structure (Fig. 4). The patient was particularly disturbed by the appearance of her maxillary anterior teeth. In addition, the posterior teeth showed disturbing hypersensitivity. The patient was informed in detail about various treatment options and opted for a restoration with direct adhesive composite restorations, as she wanted the procedure to be as gentle on the teeth as possible.

For all restorations, including the subsequently fabricated anterior restorations, the nano-filler composite Filtek Supreme XTE (3M, Neuss, Germany) was used in combination with the three-step etch-and-rinse adhesive Optibond FL (Kerr, Bioggio, Switzerland).

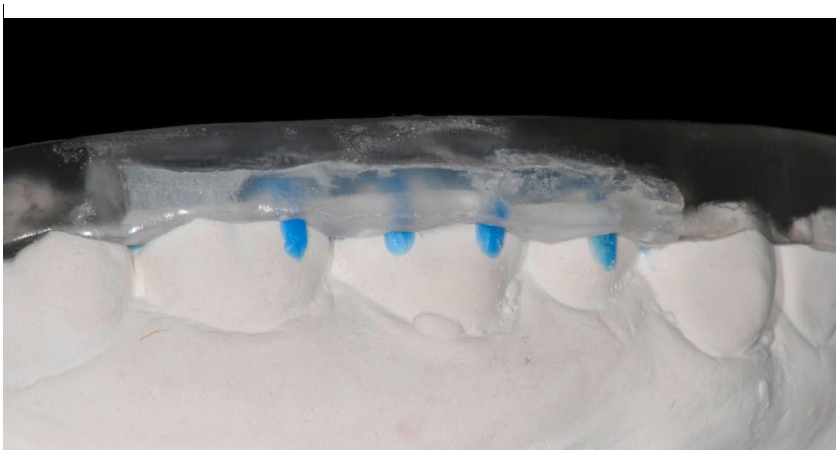

Figure 6 Wax-up model with transfer splint. In the vertical direction, the splint is extended as short as possible. This allows the composite filled in the splint to flow out after the splint has been pressed onto the tooth row.

Figure 7 Isolation of the adjacent teeth with Teflon tape.

2.2 Preparations

In the approach described below, caries lesions or buccal or palatal/lingual tooth structure defects are usually treated in a first step using conventional techniques. This is usually followed by the fabrication of the auxiliary splints mentioned below and the restoration of the occlusal surfaces or incisal edges. These first steps in the simplification of the form considerably facilitate later, sometimes demanding work steps, e.g. the application of the rubber dam and the concentrated execution of the restorations, which are then exclusively occlusal and incisal. In the case described, with the exception of the defects on the palatal surfaces of the maxillary anterior teeth, no such defects were present that would have necessitated such a two-stage procedure for the posterior region.

From the initial situation, alginate impressions of the maxilla and mandible were taken and a bite registration in habitual intercuspidation was performed. In the dental laboratory, the ideal occlusion was waxed up by approximately 2 mm with the anterior teeth blocked. During the fabrication of the wax-up models, the anterior teeth and the posterior portions of the terminal molars were not built up (Fig. 5). On these models, two translucent transfer splints each were fabricated from transparent acrylic for the maxilla and the mandible, which were relined with a transparent silicone-based bite registration material (Fig. 6). The non-waxed areas later allow stable support of the splints in the patient's mouth.

2.3 Isolation of the adjacent teeth and adhesive pretreatment

After placing rubber dams, the adjacent teeth of the teeth to be initially restored were isolated with Teflon tape to prevent interdental entanglement (Fig. 7). Existing composite surfaces of the teeth were roughened with an intraoral sandblaster with 50 µm aluminum oxide powder (Hager & Werken, Duisburg, Germany) in accordance with the procedure for corrective fillings. The eroded or sclerosed dentin surfaces were refreshed with a fine-grain diamond before application of the etch-and-rinse adhesive system. Studies have shown that such pretreatment significantly improves the bond strength to erosively or sclerotically altered dentin [5, 6]. Similarly, sandblasting the dentin at a pressure >5 bar with aluminum particles >30 µm can have a positive effect on the bond strength of adhesives [14].

2.4 Build-up of the occlusal surfaces

With the aid of the transfer splints, bite elevation was performed in the

Figure 8 Situation after completion of the occlusal composite restorations.

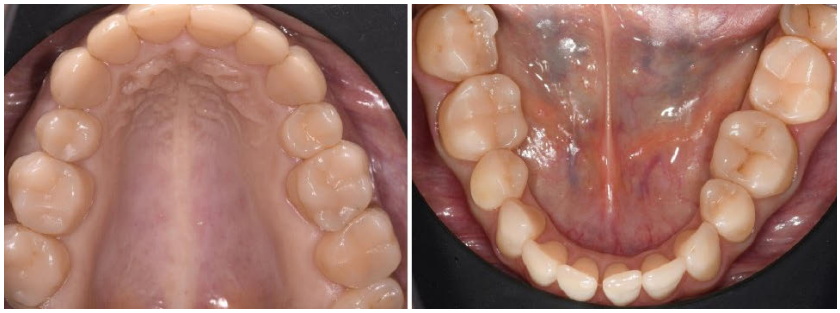

Figure 9 Situation eight years after insertion of the composite abutments with continued satisfactory results.

Fig. 1–10: T. Attin

Figure 10 Labial view of the anterior teeth restored with direct composite.

posterior region with direct occlusal composite build-ups. The highly viscous composite material used for the restoration was filled into the splint in a quantity corresponding to the missing tooth structure and heated to 68 °C for 5 min under light protection on a heating plate (Calset, AdDent, Danbury, USA). Heating reduces the viscosity of the composite material, thus facilitating the placement of the splint on the dentition. Laboratory tests have shown that heating the composite does not affect the material properties [31]. The short vertical design of the splints allows excess material to flow off well when the splint is placed and most of it can already be removed before polymerization. Before applying the filled splint, a thin layer of flowable composite (Filtek Flow, 3M) was applied to the tooth surfaces without curing it.

The splint was placed on the dentition with pressure. After removing the accessible excess, the composite material was light-polymerized through the transparent splint. The light polymerization was initially performed only briefly for approx. 3–5 s, so that after removal of the splint any remaining excess of the not yet fully cured composite could be easily removed with a scalpel. Subsequently, a second (long) light polymerization was performed with simultaneous cooling of the teeth for 60 s per tooth. It has been proven that such a two-phase polymerization does not negatively influence the curing of the materials [29].

The difficult-to-access proximal surfaces of the composite abutments were finished and smoothed with single-sided diamond files in a reciprocating angle piece (Swingle, Intensiv, Grancia, Switzerland). Subsequently, the now already restored teeth were isolated with Teflon tape and the remaining posterior teeth were built up as described above and finally polished. The areas not included in the wax-up and the splint were finally reconstructed freehand with composite (Fig. 8). The bite elevation in the posterior region created sufficient space for a subsequent reconstruction of the anterior teeth, which was then fabricated. To protect the restorations from nighttime grinding, the patient was given a grinding splint made of soft acrylic after completion of all restorations. The patient has regular recall appointments. Apart from minor maintenance work, e.g. occasional polishing of the margins of the restorations, no further reworking of the restorations was required during the follow-up visits, which have now lasted eight years. Moreover, the images taken after eight years of wear show only minor signs of wear on the restorations (Figs. 9 and 10).

3. Discussion and concluding remarks

The procedure described is now a well-studied and proven method for restoring teeth with erosion-induced loss of tooth structure. Points to be discussed about the procedure are included in the above text at the appropriate points and should not be repeated here.

In conclusion, however, it is important to point out that preventive measures and checks must be carried out to stop further acid-induced damage, not only because clinical observations have shown that the adhesive bond of restorations is subjected to a great deal of additional stress if strong acid attacks continue,

which often seems to contribute to the failure (loss) of the complete restoration. A conclusive explanation for this phenomenon is currently not available. However, it is conceivable that the repeated acid attacks degrade the hybrid layer of the adhesive bond of the restoration, first at the restoration margins and then gradually undermining it.

With regard to the frequent discussion about the most suitable restorative material for the cases described above, it should be noted that a randomised clinical trial with a split-mouth design is currently being completed with the cooperation of the authors. The long-term follow-up studies will provide further information on how the procedure presented here compares to the use of indirectly fabricated ceramic restorations.

Note

This original paper contains some modified minor text passages from previous publications of the authors [3, 26, 27, 34].

Conflict of interest

Prof. Attin is a consultant to the company Hager & Werken mentioned in the text. In addition, the authors declare that there are no conflicts of interest as defined by the guidelines of the International Committee of Medical Journal Editors.

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