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Introduction of a new technique for adhesive restorations of cervical lesions

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Abstract

Class V-restorations represent a challenge in treatment that is often underestimated due to their usually close proximity to the gingiva at the cervical margin and other specific features. Accordingly, in the literature, the long-term survival rates of these restorations fall short of those of other direct adhesive restorations.

The following article presents a new technique that can help to avoid problems during the filling process of these cavities. In a first step, this so-called BERK-technique aims at a sealing of the critical gingival margin by a targeted stepwise application of flowable resin-based composite in order to facilitate subsequent filling steps.

Introduction and problem description

Class V-restorations of carious and non-carious cervical cavities with resin-based composite exhibit a limited survival rate compared to other resin-based composite restorations (1, 2). This is the case even though it often involves the restoration of easily accessible, single-surface cavities in the anterior or premolar region.

The reasons given for the limited survival rate are problems regarding proper isolation of the cavity or the occurrence of gingival bleeding during the filling procedure. Furthermore, there are dentin structures in the cervical region that are not optimally suited for an adhesive bond. For example, the surface of non-carious cervical lesions has a sclerotic, often hypermineralized surface that can only be infiltrated to a limited extent by adhesive systems (3). Furthermore, the cervical dentin is not well suited for an adhesive bond due a low density of dentin tubules and unfavourable alignment of tubules parallel to the surface (4).

It is also being discussed that bending forces applied to teeth, which can occur in the case of parafunctional malocclusions, may trigger a stress moment in the cervical region (5). It is conceivable that this can impair the long-term bonding of restorative materials in this area. However, the view that parafunctional may lead to a locus minoris resistentiae in the cervical region, is not undisputed in the literature (6, 7).

The cervical area is very delicate regarding proper isolation of the cavity and contamination control during the filling procedure. The use of a rubber dam has been shown in controlled studies to have a positive influence on the clinical outcome (8). However, the application of rubber dam in direct restorative therapies still does not appear to be very widespread and is especially considered to be very demanding in the context of Class V-restorations (2).

The preparation of a cervical cavity frequently results in minor injuries and thus bleeding of the adjacent, often inflamed gingiva. This bleeding can be stopped with suitable hemostatic agents. If contamination of the dentin substrate with the hemostatic agent occurs, this can be handled with suitable measures without impairing the bond of the adhesive system to the dentin (9).
Retraction cords are often inserted into the sulcus to control contamination of a cervical cavity and to displace the adjacent gingiva. On the one hand, this ensures that the outward flow of sulcus fluid is blocked as far as possible, and the cavity is not contaminated with sulcus fluid. Secondly, the gingiva is displaced by the inserted cord to such an extent that there is no longer any contact between the gingiva and the cervical margin of the cavity and a controlled application of adhesive and filling material in this area is possible. However, many users (including the author of this article) will probably touch the gingiva with the modelling spatula when applying high-viscosity resin-based composite to a prepared cervical cavity and trigger bleeding again. Another problem that may arise, when restoring lesions in the cervical region, is that the practice routine does assumably often not allow sufficient time for the filling procedure in these cavities, which at first glance appear to be easily accessible and simple.

To avoid problems in the design of resin-based composite restorations, the author developed a special technique called BERK. The acronym BERK stands for Basic Evolutionary Restorative Key and includes, among other things, the strategically targeted application of filling material to gradually restore the original tooth morphology.

This technique can be used for all cavity classes and is described in detail here in the context of a Class V-resin-based composite restoration.

Patient case

The 75-year-old patient, who had been undergoing treatment for many years, increasingly complained of hypersensitivity in the lower anterior teeth, which had pronounced dental hard tissue defects in the cervical region (Fig. 1a). The patient's oral hygiene was rated as good. The present cervical defects could possibly be classified as so-called cleaning defects, which are frequently observed with intensive oral hygiene efforts. With increasing age, however, the patient had difficulty cleaning the hard-to-reach defects adequately. In addition, it was feared that further degradation of the dental hard tissue in these areas could lead to a loss of tooth integrity or pulp exposure. It was, therefore, decided to restore the particularly severely affected teeth 31, 32, 41 and 42 with resin-based composite restorations in the cervical area.

The teeth responded positively to a sensibility test with cold spray and showed periodontal probing depths of 2-3 mm. The mobility was graded as 1.

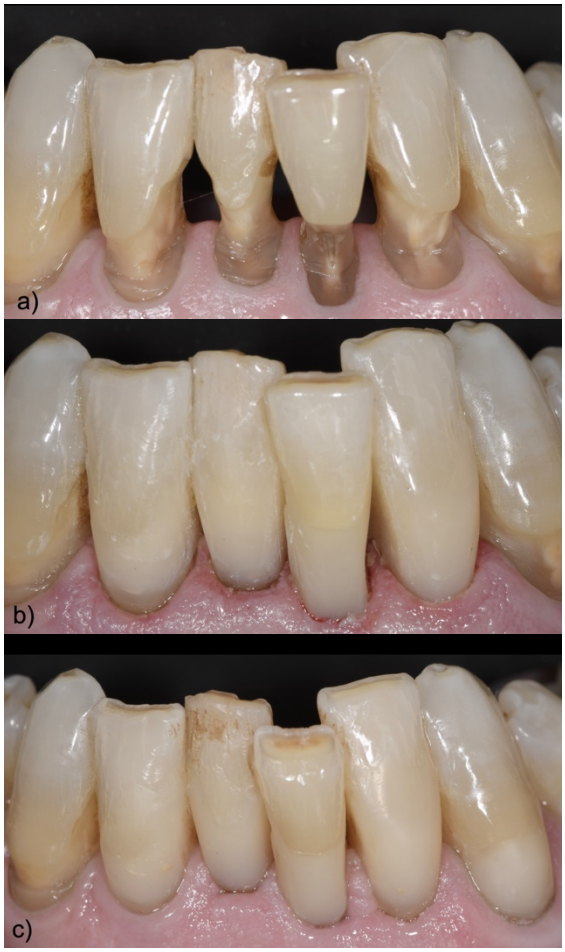

Figure 1. Mandibular anterior situation of the patient at different treatment times. **a)** Initial situation with multiple cervical lesions of the mandibular anterior teeth. **b)** Situation after completion of the restorations of teeth 31, 32, 41 and 42. **c)** Situation after 2 years and d) after 5 years of service.

The teeth were restored as described below. After five years of observation (Fig. 1b-c), the restorations of the now 80-year-old patient can be classified as acceptable except for few small defects in the very cervical aspects. The gingiva shows a slightly progressive recession over the observation period.

Two years after restoration of the lower incisors, it became clear that the patient was no longer able to adequately clean the cervical defect on tooth 33. It was, therefore, decided to restore this tooth with a resin-based composite restoration as well (Fig. 2).

Procedure

The procedure of the BERK-technique is illustrated in more detail in the case of the canine 33. The initial situation shows a deep Class V-defect with a cervical epigingival margin (Fig. 2a). After placement of a retraction cord, the entire margin of the cavity was supragingival located and more or less easily accessible (Fig. 2b).

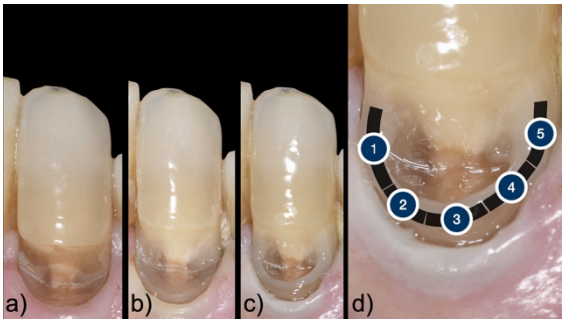

Figure 2 (a, b, c, d). Illustration of the step-by-step procedure for the restoration of tooth 33. **a)** Tooth 33 at the beginning of the treatment. **b)** Situation after placement of the retraction cord and preparation of the cavity. **c)** Situation after completion of the cervical "trough" made of flowable resin-based composite. **d)** Schematic drawing of the applied resin-based composite portions, each of which was briefly cured separately.

The sclerotic dentin surface of the cavity was freshened with rotating diamond burs. A ball-shaped diamond bur was used to finely accentuate the margin. The cervically exposed portion of the root surface was cleaned and conditioned with oscillating, diamond-coated files. The use of files in the epigingival area allows a careful and gentle procedure without damaging the gingiva. The enamel margin area was bevelled with a flame-shaped diamond bur. Subsequently, the cavity and the marginal areas were additionally cleaned by sandblasting using 50 µm aluminum oxide powder. After application of 37.5% phosphoric acid for at least 10-15 s on enamel and at most 10-15 s on dentin, a two-bottle adhesive system was applied using the etch&rinse-technique according to the manufacturer's instructions and light-cured. In order to secure adequate cervical adhesion and to avoid later discoloration, the complete adhesion procedure should also include the adjacent exposed and cleaned root surface.

In the next step (Fig. 2c and d), a flowable resin-based composite was applied in subsequent portions to the cervical cavity margin using a thin Luer-Lock application cannula type 45 (inner diameter approximally 0.25 mm).

The flowable resin-based composite was applied in approxmally five small portions. After application of the first portion, a short light-curing period of approximally 2-3 s was carried out. The second portion was then applied in a targeted manner, again

followed by a short light-curing impulse. Further portions of the flowable material were applied according to this pattern, until a kind of "trough" was formed in the cervical area. After applying the final portion of the flowable resin-based composite, light polymerization was carried out for 20 s.

Subsequently, high-viscosity resin-based composite material was applied into the cavity with a small spatula and finally light-cured for 40 s (Fig. 2e). The restoration was finished and polished with oscillating, diamond-coated files, abrasive stones and silicone polishers (Fig. 2f). One and three years after application, the restoration was still functional, showing no distinct signs of degradation (Fig. 2g and h). Figure 3 shows another case after seven years of service, in which the described technique was used to restore a non-caries cervical lesion.

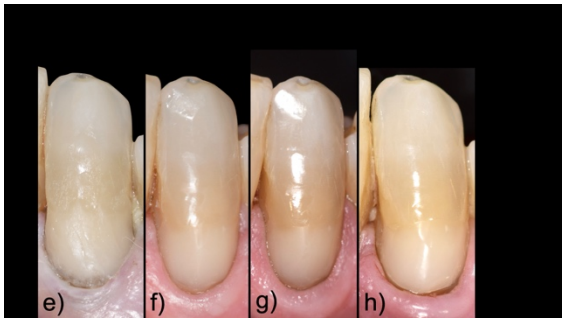

Figure 2 (e, f, g, h). Illustration of the step-by-step procedure for the restoration of tooth 33. **e)** Situation after application of high-viscous resin-based composite, before polishing. **f)** Condition after polishing and **g)** after one year and **h)** after three years of service.

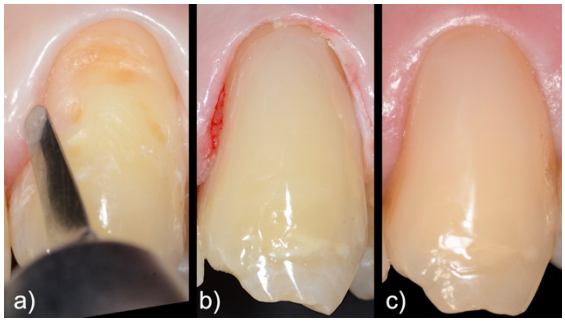

Figure 3. Class V-canine restoration from another case presentation. **a)** Preparation of the cavity with preparation of the coronal root portion for cleaning and root cement removal using an oscillating file. **b**) Situation immediately after completion and polishing and **c)** after the restoration has been in place for seven years.

Critical appraisal of the procedure

The technique described in this article is the first description of its kind for the restoration of Class V-lesions, as far as the author is aware after literature research.

The BERK technique, which initially focuses on secure sealing of the critical cervical margin close to the gingiva, makes it easier for the practitioner to apply the rest of the filling material properly in the subsequent steps. The fabricated "trough", primarily created for marginal sealing, also leads to a displacement of a new cavity margin away from the gingiva. It ensures that there is no conflict with the adjacent gingiva, when further filling material is placed in the cavity, and the practitioner can concentrate fully on the remaining parts of the cavity. The technique is therefore not only suitable for Class V-cavities, but for all direct restorations in which critical areas (e.g. close to the gingiva) are firstly built up and sealed before further filling steps are carried out.

In the present case description, placement of a retraction cord was preferred to the application of a rubber dam for contamination control. This was done in accordance with descriptions in the literature, which show that the two methods are similar with regard to the longevity of Class V-restorations, if the procedure is carried out carefully (10). However, when contamination a cavity is difficult to control and to ensure over the whole working process, it is always advisable to use rubber dam application. The dentin surfaces were pretreated and cleaned by grinding with a bur and sandblasting, which is essential for an optimal bond of an adhesive to eroded or sclerotic dentin, as often being the case in exposed cervical dentin areas (3, 11, 12).

Quite often, bleeding of the adjacent gingiva after cavity preparation of Class V-lesions interferes with the bonding steps and the application of the resin-based composite. In these cases, it is important that a complete hemostasis is achieved before application of the retraction cord. Hemostasis could be achieved with for example aluminum chloride or ferric sulfate hemostatic agents. It should be noted that all hemostatic agents will induce formation of a precipitate on cavity surfaces. With respect to contamination with either of the two agents mentioned above, a study revealed that a following etch-and-rinse adhesive approach resulted in better marginal performance of resin-based composite restorations than a self-etch approach (9). To get rid of any kind of precipitates, the author recommends cleaning of the surface by sandblasting with aluminum oxide before applying the adhesives steps. Of

course, this must be done carefully so as not to provoke renewed bleeding of the gingiva. However, the experience shows that a well-applied retraction cord usually protects the gingiva adequately.

If contamination with saliva or blood occurs and it is not possible to sandblast the surfaces again, the following recommendations are given in the literature (13-17), depending on the time of contamination, after firstly rinsing with water and subsequent drying: contamination occurs 1) after etching with phosphoric acid -> repeat etching, if necessary for a shorter time, 2) after primer application -> repeat primer application, 3) after bonding application -> repeat application of primer and bonding. The application time of the primer should always be increased.

The root surface at the cervical margin was also slightly prepared to remove adhering staining or calculus and root cement residues (18), which would prevent optimum adhesion in this area. This prevents any adhesive or resin-based composite material, which may have inadvertently by applied in this area, from showing marginal discoloration later.

If an aesthetically unpleasant discoloration of the margins occurs later, it can often be corrected by polishing again, with or without prior sandblasting, or by a narrow resin-based composite repair filling in the margin area, after sandblasting and complete adhesion procedure (19). In the technique described for stepwise simplification of morphology, a flowable and a high-viscosity resin-based composite filling material were used. A critical question, which is often raised, is if flowable resin-based composites are less stable in colour as high-viscous materials. The question comes up, as flowable resin-based composites have a lower filler and a higher resin matrix content than their high-viscous counterparts, allowing more uptake of water and discolouring agents over time. Unfortunately, the literature gives not a simple answer to this question as colour stability depends on various factors, such as type of resin, type of polishing procedures, type of staining (coffee, tea, nicotine or mouthrinses), type of fillers and so on (20-24). A systematic review on clinical studies, with 3-years follow-ups as longest observation period, showed that resin-based composites of both viscosities are equally suitable for restoring Class V-cavities, also in terms of colour stability (25). As it might not surely be the case for longer periods, the author prefers to fill the main part of the cavity with highly-filled resin-based composite.

Nevertheless, a possible difference for these two material viscosities may be due to the individual handling and preference of the respective practitioner.

The use of the extra-thin cannula to apply the flowable composite offers various advantages that are not only beneficial in the Class V-situation described. The material can be applied in a very targeted, controlled and bubble-free manner. For this purpose, it is advisable to carry out the working steps under adequate magnifying aids using loupes or a microscope. The thin cannula can be bent very easily so that the resin-based composite can be optimally placed directly in every difficult-to-reach and angle of a cavity. The insertion of small portions, which are virtually “frozen” by a short tack-curing process, prevents the formation of excess material, which can otherwise easily occur when larger portions are inserted.

The procedure of tack-curing with a final long polymerization has shown in various studies that it does not lead to a deterioration of the material properties of dual-curing and light-curing resin-based composites (26-29).

In conclusion, the procedure presented in this article has the potential to improve the quality of adhesive restorations and to make the treatment of Class V-cavities (and other cavity designs) more reliable and predictable.

Conflict of interest

In recent years, the author has received material donations and/or fees for lectures and consultations from the following companies mentioned in the article (DentsplySirona, Voco, Hager & Werken, and Intensiv). He is also a partner in the company IFG-Fortbildung (Timmendorfer Strand, Germany), which distributes products of the company Intensiv in Germany.

Acknowledgements

The treatment cases shown were treated with the attentive assistance of the dental assistants Ms. Lirie Bllaca and Ms. Elsa Islami, whom I would like to take this opportunity to thank for their always perfect support.

Table 1. Materials used in the present case descriptions.

Material		Brand name (manufacturer)
Flowable resin-based composite	-	Filtek supreme flow (3M ESPE (now: Solventum), St. Paul, USA)
	-	GrandioSO Flow (Voco, Cuxhaven, Germany)
Cannula	-	Type 45 (Voco)
High-viscous resin-based composite	-	Ceram.x Mono / Ceram.x Spectra ST (DentsplySirona, Konstanz, Germany)
Adhesive system	-	Optibond FL (Kerr, Kloten, Switzerland)
Oscillating file system	-	Proxoshape red/yellow with Swingle Contra-angle (Intensiv, Lugano, Switzerland)
Diamond burs	-	Various types (Intensiv)
Retraction cord	-	Ultrapak (Ultradent, Cologne, Germany)
Sandblasting device	-	Microetcher (Danville Materials, Carlsbad, USA)
Sandblasting powder	-	Airsonic Alu-Oxyd, 50 µm (Hager&Werken, Duisburg, Germany)
Silicone polishers	-	Greenie/Brownie (Shofu, Ratingen,Germany)
Silicone high-gloss polisher	-	Unigloss Polisher (Intensiv)
Abrasive stone	-	Ceramic polisher green, WS 94000C (Komet, Lemgo, Germany)

Zusammenfassung

Klasse V-Restaurationen stellen aufgrund ihrer meist engen Nähe zur Gingiva im zervikalen Randbereich sowie anderer Spezifika eine Herausforderung in der Behandlung dar, die oft unterschätzt wird. Dementsprechend stehen die in der Literatur verfügbaren Langzeitüberlebensraten dieser Restaurationen hinter denen anderer direkter Adhäsivversorgungen zurück.

Im folgenden Artikel wird eine neue Technik präsentiert, die helfen kann, Probleme beim Füllungsvorgang dieser Kavitäten zu umgehen. Diese sogenannte BERK-Technik zielt auf eine gezielte schrittweise Applikation von Kompositmaterialien ab, um nach einer Versiegelung der kritischen gingivalen Randbereiche eine Erleichterung darauffolgender Schritte in der Füllungstherapie herbeizuführen.

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