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The causes of adhesive direct dental restorations failures

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ABSTRACT

The modern dental caries adhesive direct restoration requires a working protocol that includes stages and techniques that must be strictly followed to ensure the correct morphological and functional reconstruction, as well as an increased longevity of the restoration and implicitly of the respective tooth in the oral cavity. Failures in achieving these goals are represented by the occurrence of recurrent caries, secondary or residual caries, coronary fractures, leading to pulpal and periodontal complications. They can be due to both incorrect therapeutic maneuvers and other causes, for which the dentist is not responsible, such as manufacturing defects of dental materials that are not visible during inspection or the patient's attitude towards oral hygiene.

Keywords: carious lesion, direct restoration, recurrent caries, adhesive dental materials

INTRODUCTION

Carious lesions represent one of the most widespread conditions of the human body, with a prevalence of over 90% in individuals, being encountered in both forms, as treated and untreated, with various complications. The direct restoration of carious lesions is the first step in changing the evolution of the respective tooth on the dental arch. A correctly performed dental restoration will lead to the morphological and functional reintegration of the teeth and prolong their presence on dental arcade. On the other hand, some mistakes made during the restorative therapeutic maneuvers can produce serious dental and periodontal damage on long term, which, if not treated in time, may require endodontic, prosthetic or surgical interventions.

Thus, although the treatment of carious lesions seems to be one of the tasks with a lower degree of difficulty for the physician, they actually represent a vital moment for the long-term health of the tooth and therefore must be treated in the most correct way possible, using the newest and advanced restorative techniques and materials that will ensure the success of the treatment.

DIRECT DENTAL RESTORATIONS

The modern adhesive direct restoration of teeth with carious lesions is a complex process divided into several stages with a specific order dictated by work protocols. Each stage, if not correctly executed, can represent a cause of failure of the restoration, being considered iatrogenic [1]. However, the blame for the direct dental restorations failures cannot always be attributed to the dentist. Sometimes we encounter situations that cannot be controlled, such as the manufacturing defects of dental materi-

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als that are not visible during inspection. Likewise, in the case of dental caries located on proximal surfaces, dental hygiene is extremely important even after the restoration of the affected tooth, and poor or even absent hygiene will inevitably lead to the recurrence of a new carious processes in the vicinity of the existing restoration [2].

The first step of any dental restoration is the excavation and remove of the altered hard dental tissues. Both altered enamel and carious dentin must be completely removed before any other therapeutic stages, but sometimes, due to difficult access and reduced visibility, incompletely cleaned areas remain, a frequent example being at the dentin-enamel junction. Other frequent error is when, out of fear of accidentally opening the pulp chamber during cavity preparation in the dental chair, the dentist decides not to completely remove the carious dentin located in the close proximity to the dental pulp [3]. These small areas of remaining altered dentin will represent the source of new carious processes that will develop under the restoration material, the "residual caries" or at the margins of existing restorations: the "secondary caries". The generic term for these kinds of carious processes is "recurrence dental caries". The term "secondary caries" is used more commonly than "recurrent caries" for caries that has developed adjacent to margins of restorations. The percentage of restorations in adults that were replaced because of the clinical diagnosis of recurrent caries was about 50 percent, with a range of 45 to 55 percent [4].

Residual carious lesions are generally difficult to be clinically detected due to their location, radiological examination being mandatory for an accurate diagnosis. These types of carious can produce various complications depending on the place of their occurrence, for example, a relapse at the level of the pulpal cavity wall, under the restoration itself, will progress towards the pulp chamber, frequently determining dental pulp implication that may require endodontic treatment [5,6]. Another possible location of the lesion is at the level of the side walls of the cavity which may have a direction of progression that does not interest the dental pulp, so painful specific symptomatology being absent. Conversely, the carious lesion can produce the undermining of tooth walls that will fracture during mastication as a result of occlusal forces, often leaving the dental restoration intact. Depending on the direction of the fracture lines and the amount of tooth tissue lost, the tooth may need to be covered with a dental crown or even extracted from the arcade.

FIGURE 1. Recurrent caries (residual caries) in tooth 47 under resin composite restoration

FIGURE 2. Recurrent caries in tooth 36 at distal and gingival level of resin composite restoration

Another error that can occur during cavity preparation is the non-removal of unsupported enamel prisms. After direct restoration maneuvers, there is the possibility that they will detach and fall, leaving behind small spaces gaps) that will retain the bacterial biofilm and lead to the appearance of secondary caries associated with this initial defective restoration.

Prior to the restorative treatment stage, it is necessary to apply an appropriate isolation system (rubber dam) because the penetration of salivary liquid inside the cavity will affect the qualities of the materials used and will create a microbial substrate on the basis of which new carious lesions can be grafted [7].

Once the cavity preparation is done, it must be prepared for the next step of direct restorative treatment. This stage is extremely important, especially in the case of adhesive materials, as it ensures the long-term retention of the restoration. Some frequent mistakes that can occur now are:

- lack of performing correct toilet of the cavity from small chips of removed altered dental structures, saliva or blood;
- insufficient demineralization of enamel and dentine in etching stage;

- wrong choice of the adhesive system: total-etch systems do not require demineralization, but self-etch systems require the use of acid;
- incorrect use of bonding: insufficient amount, application that did not lead to its penetration into the dentinal canals, insufficient light curing etc.;

For modern dental adhesive materials, this is the most important moment for obtaing a long-term dental restoration. In resin composite the hybridization quality is key to achieving reliable bond strength and hermetic seal of the dentin surface[8].

It is important to remind that, in order to achieve reliable results with modern adhesive systems and materials, the protocols must be carefully respected, so the restoration will benefit from a high bond strength obtained through the adhesive layer. Although high performance is already achieved with the high majority of adhesives currently available, we must keep in mind the importance of a rigorous and accurate adhesive technique. Insufficient bond strength of the restorative dental material can lead to partial or total loss of the restoration, sometimes even within days. This will represent the starting point of recurrent caries that will be diagnosed much later than the complete loss of the restoration. An improper marginal adhesive sealing is the starting point of nanoleakage and microleakage, clinically expressed as staining at restoration margins, dental sensitivity, and finally recurrent caries formation [9].

The restorative step of dental treatment can be also affected by other frequent mistakes. First of all, carious lesions on proximal surfaces (class II, III and IV cavities) always require the use of an appropriate conformation system. Its absence during restoration presents a number of disadvantages:

- Lack or incorrect restoration of the interdental contact point or contact area – in this situation, the most affected structure will be the superficial marginal periodontium, especially the interdental papilla which will be traumatized by contact with food during mastication, will become inflamed and lead to gingival retraction.
- Overcontouring of the contact point – unlike the previous situation, a too firm contact point will make it difficult to finish the dental restoration surfaces and there is the possibility that some restorative excess material will remain present and will act as a local irritating factor, will create tensions at the level of the periodontal ligaments of the teeth in that area and will prevent dental floss from entering that area for proper dental hygiene.

Inserting the material into the cavity requires care about the polymerization shrinkage when we are talking about the resin composites. Because of this, it is recommended to use resin composites layering technique, allowing a complete light curing and a lower shrinkage, therefore less stress induced on the cavity dental walls [10]. This kind of mechanical stress can lead to enamel crack propagation, cusp deflection, marginal and internal gaps, and decreased bond strength. The insertion of thick layers, as in the bulk fill technique, will lead to increased contraction that will no longer ensure a correct marginal adaptation of composites.

An incorrect technique of using restorative adhesive dental materials, both in adhesive stage or in placing them inside cavity can lead also to post-operative sensitivity, which unfortunately is present so frequently [11].

The last step of a direct restoration is the occlusal adaptation and finishing. Many times this stage is not given the necessary attention, which leads to compromising the entire treatment. Very often the adhesive material is inserted into the cavity in excess, which is not always visible, but is felt by the patient who reports a discomfort. Failure to remove this excess can lead to fracture of the restoration (partially or totally), sometimes even from the first tooth-to-tooth contact, therefore the patient must be asked to approach the arches gently to avoid this inconvenience from occurring.

In the case of proximal cavities, especially in the posterior region (class II cavities), the area most prone to immediate fracture is the marginal ridge. Also, the excess material on the occlusal surface will determine occlusal excessive forces applied on the respective restoration, so an occlusal trauma on the tooth, which will further transmit the forces to the periodontal ligaments. Left untreated, the situation leads to deep periodontal damage and loss of tooth support or fracture of the tooth walls and recurrent caries subsequently [12]. The finishing and polishing of the direct restoration is very important to achieve a smooth surface, comfortable for the patient, but more important non-adherent surface in order to avoid the accumulation of bacterial biofilm and the appearance of secondary caries [13]. This way the aesthetics and the longevity of the restoration are highly improved.

CONCLUSIONS

Recurrent caries are very often present in dental practice. Their etiology is complex, multi-factorial and they can be a result of the practitioner mistakes made during every step of a direct restoration protocol. At the same time, we must be aware of the other factors involved, like patient's condition (patient's caries susceptibility, patient's interest in oral care and hygiene) or location of initial restoration

(proximal cavities are highly exposed to recurrent caries at gingival level). Therefore any simple restoration must be treated with great attention and rigorous and correct treatment applied in order to avoid the complications produced by a secondary caries.

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