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Research Article

Assessment of Marginal Adaptation of Composite Resin Restoration - Microscopic Evaluation of Clinical Cases

Dana Bodnar[1], Ecaterina Ionescu[2], Anca Dumitriu[3], Mihai Ciocirdel[4], Dan Straja[5], Cristina Nistor[6]* and Bogdan Dimitriu[6]

[1]Department of Operative Dentistry, Faculty of Dentistry, University of Medicine and Pharmacy, "Carol Davila", Romania

[2]Department of Orthodontics and Dento-facial Orthopedics, Faculty of Dentistry, University of Medicine and Pharmacy, "Carol Davila", Romania

[3]Department of Periodontology, Faculty of Dentistry, University of Medicine and Pharmacy, "Carol Davila", Romania

[4]Department of Geology and Reservoir Engineering, Petroleum-Gas University of Ploieşti, Romania

[5]PhD Student at University of Medicine and Pharmacy, "Carol Davila", Romania

[6]Department of Endodontics, Faculty of Dentistry, University of Medicine and Pharmacy, "Carol Davila", Romania

***Corresponding Author:** Cristina Nistor, Department of Endodontics, Faculty of Dentistry, University of Medicine and Pharmacy, "Carol Davila", Romania.

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Abstract

The purpose of the study was to evaluate the quality of marginal adaptation class I restorations using the operative dental microscope. Material and methods – 30 posterior teeth with composite restorations were photographed by the digital camera of dental microscope and after that transferred on PC and measurements on the surfaces of the deficient or excess restorations were determined. Conclusions – Restorations with shortfall are more common than excess fillings errors.

Keywords: Composite Restorations; Marginal Adaptation; Operative Dental Microscope

Introduction

The marginal adaptation of restoration is mainly related to two objectives:

- The perfect seal of the interface between restorative material and the surface of the cavity's tooth to avoid coronary infiltration
- The placement of the restorative material should reach the limit between the prepared surface (cavity walls) and the external coronal area [1-3].

The limit between the prepared surface and the external coronal surface is coresponding to so called cavo surface angle point (Figure 1.a) regarding to that landmark of the restoration failures, which could be with excess or with deficit. When the restoration

is with deficit the restorative material is not applied in suficient quantity, to reach the level of the top of cavo-surface angle, so that a segment of the prepared surface (cavity wall) remains uncovered (Figure 1.b).

When the restorative excess is directed coronally, the top of the surface angle, covers a segment of the external unprepared surface of the tooth (Figure 1.b).

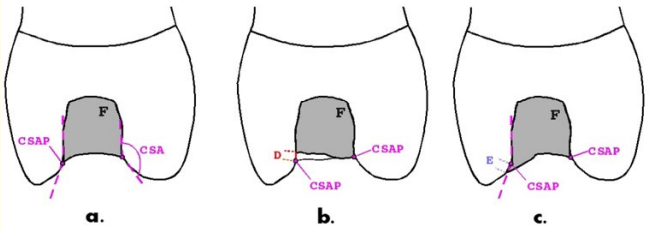

Figure 1: Diagram ilustrating the restoration of class I cavities on a lateral tooth (F - filling).

It is generally accepted that fillings are correct when their edges are placed on the border between the prepared internal surface of the cavity and the external enamel surface of the tooth [4-6]. The enamel edge may or may not be bevelled, if it is done the surface must be covered with resin composite.

It is obviously that in case of errors, the deficiencies are located on some segments of the edge, in this case by different reasons as: insufficient visibility, not using magnification or material placed in insufficient quantity or in excess [7,8].

In the same time marginal post-treatement fractures can interest both the hard tissue and the restorative material [9-12].

Material and Methods

We studied under the dental microscope Leica M320 a number of 30 composite restorations located at the level of maxillary and mandibular premolars and molars, targeting the quality of coronal restoration with composite resins.

Out of the 30 fillings studied, a number of 14 fillings showed marginal adaptation deficiencies, with excess 5 and with deficit 9.

The selection criteria of teeth was the presence of occlusal fillings of class I cavities and the type of tooth (premolar or molar).

In most cases, clinical records and details about the occlusal context were obtained (dental attrition, infraocclusion, occlusal trauma), including also the age of the filling.

For space reasons only some cases from this group of teeth are presented in this paper.

Figure 2 shows a failure with deficiency, in this case the uncovered part by the filling material of the wall of the prepared cavity was observed; the boundary between the external surface of the tooth and the prepared surface is visible.

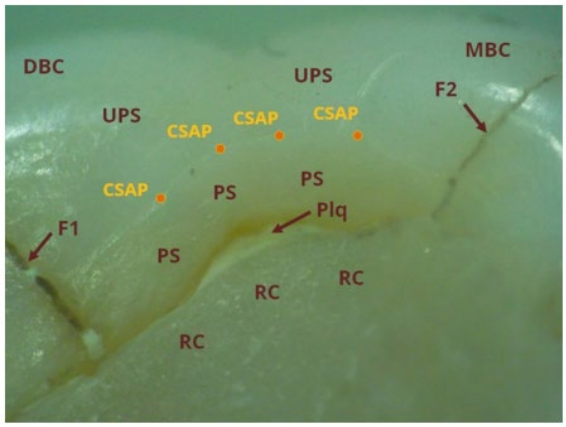

Figure 2: The edge of composite resin restoration, class I, situated on the second mandibular molar (37); a segment of the prepared surface of the cavity (PS) is not covered by restorative material, composite resin (RC). The image shows the disto-bucal cusp (DBC) and the mesio-bucal cusp (MBC); the occlusal surface is relative abraded and the cusp relief is not evident; the photo is made from lingual to bucal direction, at an angle of aproximatively 45^0 to the oclusal surface.

Figure 3 shows a case of composite restoration in excess, a segment of the filling material that covers the unprepared enamel surface of the tooth. The maximum peak of the excess is between mesio-buccal and mesio-lingual cusps, considerably exceeding the height that the occlusal surface should have had at this level (intercuspid sulcus area).

The points coresponding to cavo surface angles has been marked for more locations across the limit between the wall of the cavity and the external surface of the tooth (UPS).

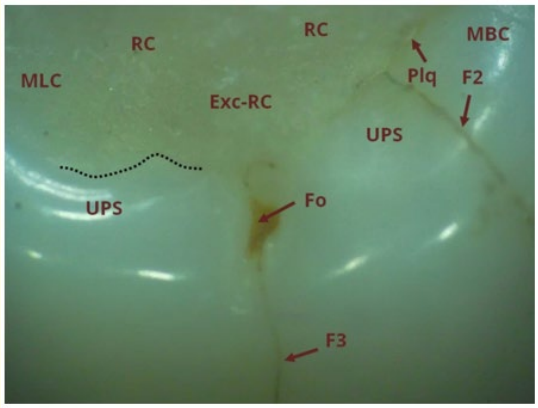

Figure 3: The edge of composite resin restoration, class I, situated on the same second mandibular molar (37), also showed in Figure 2. This photo is made from the mesial part of the tooth at an angle of 45^0 to the occlusal surface: MLC – mesio liangual cusp, MBC – mesio buccal cusp.

From the restoration towards the cusps expand two fractures that are slightly opened, as well as filled with secondary deposits of calculus : F1 and F2.

The rounded morpohology of the restoration in this marginal area demonstrates that the deficit is not caused by the therapeutic act, but rather that it emerged due to not having placed enough material from the beginning.

On the left side of the image, where the dotted line is placed, the composite resin climbs unreasonably high on the internal slope of the mesio-lingual cuspid; the punctured line indicates the level where the exceeded composite resin ends.

In thi image are caught two cracks with relatively vertical path, slightly opened:

- The fissure on the right - F2 - is the one already indicated in Figure 2, the one that crosses the mesio-buccal cuspid;
- The left fissure – F3 – runs through the mesial strip descending to the parcel from the fossa.

Both fissures stop towards the apical at the enamel-cement boundary.

These fissures are probably due by an occlusal trauma, being a consequence of not adapting the filling correctly.

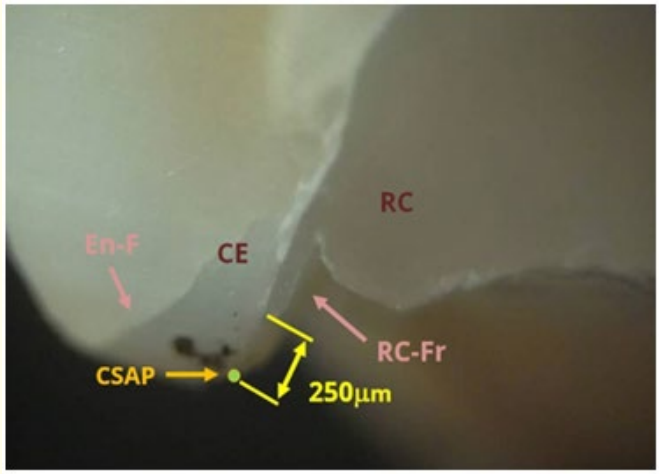

Figure 4: Second maxillary molar (27) having a fractured filling of composite resin; in the proximity area of fracture's filling is associated a cuspid fracture (cuspid fracture extends only into the enamel) (RLM, 40x).

Such fractures are typical for situations of mechanical overload of hard dental tissues remained in smaller volumes after severe carious destruction.

The filling deficiency was estimated at this site to be 250µm.

RC – resin composite

CE – cuspid enamel

En- F – fissure in enamel

RC – Fr – fracture in the composite filling

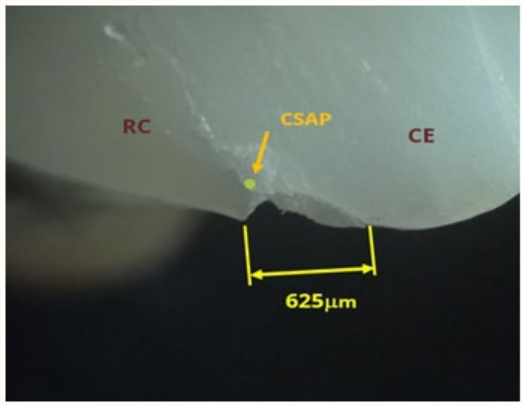

Figure 5: Filling of a class I cavity exceeding on a second maxillary molar (RLM, 40x). Due to the small thickness of the overtaking area, it fractured in the nearby of the internal cuspid slope.

We determined micrometrically a former extension of material of 625µm.

RC – resin composite

CE – cusp enamel

CSAP – cavo-surface angle point

Thus, in case of deficiencies, the length of the distance between the place where the coronal filling ends on the prepared surface and the place where the point corresponding to the peak of the cavo-surface angle is found (distance D in figure 1b). In case of fillings in excess, the length of the distance between the point is corresponding to the peak of the cavo-surface angle and the place where the filling material ends on the external coronal surface (distance E in Figure 1c). The readings were taken in microns (micrometers) as multiple values of 25µm at 40x magnification.

We selected some images to present in this article and we have marked with symbols chosen by us, composite resin areas, enamel areas, points corresponding to the peaks of cavo-surface angles, magnitude of defects, as well as other aspects such as cracks observed in hard dental tissues, where appropriate.

The present study could not assess small marginal adaptation defects (those below 200 µm), these are difficult to identify with the dental microscope.

Results

Out of 30 teeth with occlusal fillings of composite resin were analysed with the dental operating microscope, 16 posterior teeth showed no defects in the marginal adaptation of the fillings. This concludes that, 14 posterior teeth with occlusal composite-resin fillings presented marginal adaptation defects in excess or in deficit.

Micrometric data were grouped into two tables for marginal excess situations (Table 1) and marginal deficit cases (Table 2).

Tooth nr.	**1**	**2**	**3**	**4**	**5**
Tooth type	25	36	47	36	35
Error magnitude	+205 (min.)	+275	+350	+350	+375

Table 1: Data obtained by micrometry for situations of teeth in which we found marginal excess.

Tooth nr.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Tooth type	25	27(FA)	36(CBF)	36	47	15	24(FA)	38(CBF)	25
Error magnitude (µm)	-200 (max.)	-250	-375	-425	-475	-525	-600	-725	-850 (min.)

Table 2: Data obtained by micrometry for situations of teeth in which we found marginal deficiency.

In the table above, there are specified in parentheses next to the tooth code:

- CBS being the situations caused by the fracture of the filling material
- FA are situations in which a fracture of filling material was found without being the cause of the deficit.

Discussions

Microscopic studies carried out on extracted teeth allow a good evaluation of the quality of the fillings [18-23]. Although apparently these studies have only a scientific character. From the observed mistakes it can be determined:

- What are the most frequent errors committed;
- What are the causes that led to the failure of the fillings and possibly the fractures that occurred at the level of the remaining dental hard tissues;
- What could be done to avoid mistakes or inaccuracies that were encountered in the studied teeth.

The use of a layered restoration technique contributes to reducing the negative effects produced at the tooth-restoration interface by polymerization shrinkage of composite resins. This technique allows obtaining a homogeneous restoration and improves marginal adaptation reducing the risk of marginal infiltration [12,14,23].

After polymerization of the last layer of restorative resin material, it is not always ledge detectable, and the transition between the filling material and the unprepared surface can be smooth. On the other hand, using magnification and having a good view of the prepared cavity before placing layers of filling material, an excess of this size should not occur.

Due to the visibility that can be made almost exclusively indirectly in the posterior areas of the arches, it is difficult to place precisely the filling material [13-17].

Regarding deficiency filling situations, only two of the studied cases were due to marginal fracture of the composite material.

An essential requirement in case of correct restoration refers to the quality of marginal adaptation, which means that an optimal marginal adaptation in concordance, with other authors [10,11] refers to the lack of microleakage phenomena, like penetration of the bacteria from saliva and development of biofilms through cleavage space between the restorative material and restant dental hard tissue [12,13].

Marginal infiltration is influenced by the size and shape of the cavity, the technique of inserting the restorative material and even the way of performing the photopolymerization [14,15].

n this respect, in clinical practice and also in experimental studies, the problem arises between the excess of marginal restorations and restoration with marginal deficit. Usually, the restorations with marginal excess are considered primary, which relates to the way that the clinician inserted the restorative material in the prepared cavity; regarding restorations with deficit, those can be primary and also secondary, accidentally.

Conclusions

Restoration procedures in the distal areas are difficult to achieve. Clinical errors with excess have a lower frequency than restorations with deficit.

This micro images are important for the clinician to evaluate the quality of the restoration because same details can be unobserved during treatment or can be neglected.

Future clinical studies are needed to be developed, to confirm and validate these findings.

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