

## THE IATROGENIC ASPECT OF AMALGAM UNDER COMPOSITE RESTORATIONS

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**Abstract:** The amalgam restorations were widely used due to their undisputed qualities, but over the years, the aesthetic concept in dentistry introduced composite restorations as base level even for the posterior treatments. Sometimes, the amalgam is not fully removed and the result is a rather unusual combination of these two restorative materials. The remaining amalgam is accidentally detected during composite restorations retreatment. The aim of the present paper is to evaluate the statistic distribution of this type of clinical situations detected on 258 patients from both genders that had restorative treatment during a period of 10 years. A clinical examination was first accomplished for each patient. A radiographic investigation was performed for every amalgam-composite restoration detected. Each patient was also asked to answer to a questionnaire regarding his dental history. The radiographic results and the anamnesis data were noted in a treatment sheet specially designed for this study. The results of the study were finally gathered and they represented the basis of the discussions upon the causes that led to these incorrect restorations. The conclusions indicated that the deficiencies in the initial partial removal of the amalgam, as well as the improper subsequent restoration techniques are only operator related.

### INTRODUCTION

Since the introduction of the amalgam in dentistry more than 150 years ago, the dentists have used it extensively as a filling material of the cavities, with efficient prevention of secondary caries.

Amalgam was well known as the first choice for the restoration of the posterior teeth for a long period of time. This was due to its well-known longevity and strength necessarily required in this highly intense occlusal stress area.

Amalgam restorations are nowadays considered to be the most common dental restorations. Their popularity might be attributed to amalgam good mechanical properties, ease of application and the one-appointment treatment.

There is still a large demand for such restorations even if they are unaesthetic.

The cavity preparation for amalgam is also not quite a biological one and a proper moisture control is always necessary during the restorative process.

In the last three decades, the controversies regarding the possible adverse effects of mercury on health and the lack of aesthetics of amalgam (as a filling material), generated a trend in replacing this type of restorations with adherent ones.

The technological progress in the field of adherent restorative materials made them over the years to gain some properties similar to amalgam in terms of increased resistance to pressure and wear.<sup>(1,2)</sup>

Nowadays, dentists and patients frequently prefer the aesthetics provided by the adherent restorative materials not only for the treatment of the primary caries but also for the replacing of defective amalgam restorations.

Limited clinical experience in the delicate process of removing posterior large restorations may affect the outcome.

The most frequent complications that are associated

with amalgam removal are related to the structural integrity-teeth fracture or the necessity of an endodontic treatment due to an accidental opening of the pulpal chamber.

Both pathological situations may occur during the retreatment of large restorations in deep posterior cavities with limited access or visibility.

These local factors determine the dentists to compromise in amalgam removal by leaving fragments of the old restorations in the walls close to the pulpal chamber, where the risks are higher.

Placing a new adherent restoration over the partially removed amalgam generates a type of a mixed restoration that is just covering the unfinished treatment beneath.

The simple patch accomplished with the new restoration does not solve the primary issue - a recurrent decay that evolves and affects (in an unspecified period of time) the second restoration that needs a retreatment, too.

During the retreatment of the adherent restoration, the underneath amalgam fragments are revealed and the combined amalgam-composite restoration can now be fully investigated and treated as necessary.

### PURPOSE

The most delicate issue in managing the combined amalgam-composite restorations is to determine the real degree of dental destruction.

In order to apply the appropriate treatment, the amalgam fragments must be totally removed and the secondary caries have to be properly excavated, according to the clinical characteristics.

The aim of this study was to evaluate the statistic distribution of this type of clinical situation detected in a group of patients, in a certain period of time.

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### MATERIALS AND METHODS

258 patients from both genders who had restorative treatment during a period of 10 years presented 260 amalgam-composite restorations detected during the retreatment of incorrect adherent restorations.

For each patient, the initial status was registered with a digital image of the clinical case of the incorrect adherent restoration(s) on the posterior teeth.

The first image was attached to patients' treatment sheet, the data regarding the initial reasons for dental treatment requests being also recorded. A similar examination protocol was used in all the clinical cases, in order to obtain all the necessary information for a correct diagnosis.(3)

Once the removable appliances cleared, the teeth were cleaned using a toothbrush and a dental floss and a moisture control method was used.

Clinical examinations were made with a good illumination, using a dental mirror and an explorer and each surface of interest was dried for 5 seconds before the visual inspection.(3)

The need for retreatment, in each clinical case, was evaluated using the following criteria (individual clinical characteristics were also considered):

- Configuration / discoloration of the marginal adaptation;
- Retained /partially retained / missing restorative material;
- Proximal configuration (where it is necessary);(4)
- Aesthetic aspect.

The restorations were visually and tactilely evaluated by moving a sharp probe over the surfaces and margins.

A visual method and a tactile method were used for detecting the presence of the marginal secondary caries. A sharp probe was used by moving along the interface between the cavity margins and the restorations. A visual method and bitewing radiographs were used for identifying the recurrent caries.(3,5)

The protocol of retreatment followed several steps. First, the adherent material was removed using a round carbide bur at conventional speed with a centripetal technique till the complete exposure of the inner cavity and of the remaining fragments of the amalgam. The remaining mercury amalgam from the juxta-pulpal walls was removed according to SMART technique recommended by IAOMT.(6)

SMART technique improves traditional safe amalgam removal techniques based on the use of masks, water irrigation, and high volume suction.(6,7)

Additional protective measures were added to the conventional protective measures during this study.

The windows in the dental office were opened prior, during and after the procedure in order to reduce the mercury concentration in the air.

All the dental personnel used protective gowns and covers to reduce the contact with the material particles generated during the mechanical removal of the amalgam.(8)

The dentist and all personnel present in the room used surgical masks, face shields, hair or head coverings and non-latex nitrile gloves which are more resistant to mercury and mercury compounds than regular latex gloves.(9,10)

A face and head barrier and a full body impermeable plastic barrier were used for the patient's skin and clothing protection.

For each patient, the moisture control method used a dental dam made from non-latex nitrile material and a saliva ejector placed under the dental dam in the opposite part of the mouth to reduce mercury exposure.

The amalgam was sectioned in large parts with a small

round carbide bur at conventional speed. It was removed by the dislocation of the pieces with a hand instrument and they were discharged one at a time using a small dental forceps.(8)

During the amalgam removal, a good irrigation was used to reduce heat and a conventional high speed evacuation device was placed near the tooth of interest to eliminate the water and to capture amalgam particles.

After the complete amalgam removal, the dam isolation was removed and the patients were asked to rinse the mouth with water and then with an adsorbent suspension of charcoal or chlorella.(11-17)

The restorative protocol for all treated teeth had the following basic steps:

- Necrotic dentin removal;
- Cavity cleansing;
- Color selection;
- Tooth isolation;
- Proximal conformation (when necessary);(4)
- Dentinal protection;
- Composite resine application;
- Morfologic and functional adaptation;
- Finishing and polishing.

The necrotic tissues removal was performed with a round carbide bur at conventional speed, after the isolation with dental dam and a saliva ejector (placed under the dental dam in the opposite part of the mouth) was reapplied.

The dentin removal was made step by step with a tactile control using a standard probe to assess the hardness of the remaining layer.

This excavation stopped when no necrotic dentin could be removed with the probe even if juxta-pulpal dentin had a modified colour.

Colour selection was made in standardized conditions for all cases, using a universal colour key on wet teeth.

Pre restorative conformation of the cavities with proximal components was obtained with partial or circular matrix according to the features of the clinical case.(4)

Dentinal protection was obtained with indirect pulp capping using calcium hydroxide as first stimulative layer for the pulp and resin modified glass ionomer cements (RMGIC) as the base protective layer.

The long term indirect pulp capping was used after the incomplete removal of necrotic dentin from the juxtapulpal region because of the high risk of opening of the pulpal chamber during the process.

At first, in this two stage technique, a calcium hydroxide liner was placed on the wall of interest and a resin modified glass ionomer cement was used as a temporary filling material for several months.

The good sealing properties provided by the RMGIC isolated the residual bacteria and arrested the caries' progression.

After a period of at least 60 days, without pain or symptoms of pulpal inflammation detected, the second step was accomplished.(3) This step consisted in the removal of the temporary restorative material and of the residual caries located on the juxta-pulpal wall.

In between the initial and the final step, the remineralization of the dentin and the formation of the reparative dentin strengthen the wall of interest, allowing the excavation of the residual caries without exposing the pulp.

The adherent filling material was placed after the final dentinal protection with a liner of calcium hydroxide and the RMGIC as base.(11,18-24)

The application of the composite followed the regular

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steps: total etch (for enamel and dentin) with phosphoric acid, bonding (as specified by the producer) and resin layering placement for vertical cavities and cusp buildup restorative technique for occlusal components.

The light curing of the composite was accomplished using a LED device with time and power settings adjusted to the type of material and shade selected for each clinical case.

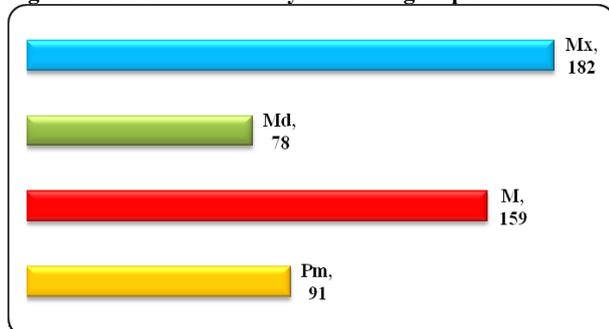
The functional adjustment removed the excess of composite and obtained the correct morphology for each surface with proper marginal adaptation. The finishing stages eliminated the surface scratches and the polishing steps created a high luster using various abrasive systems. The final status for each patient was documented with a digital image of the clinical case with the correct adherent restoration(s).

### RESULTS

The distribution by gender indicated that 113 females and 145 males, with ages from 45 to 69 years presented 260 incorrect combined restorations which were treated in a private practice dental office in Bucharest by two experienced dentists during 10 years.

The distribution of amalgam-composite restorations that needed retreatment by arch and group of teeth is presented in figure no. 1.

**Figure no. 1. Distribution by arch and group of teeth**

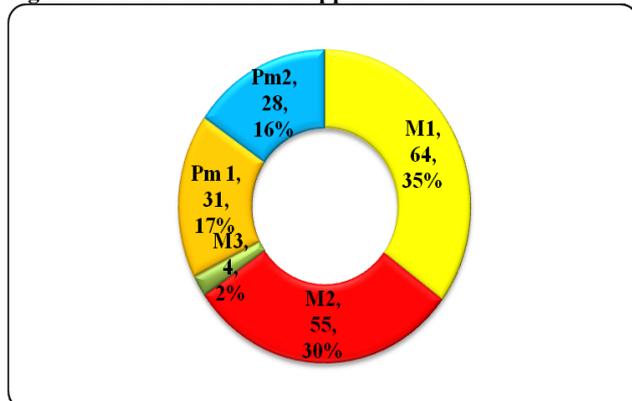


Regarding the type of class of combined restorations, the cavities with proximal component (modified class II Black) were identified on 195 teeth (75%), while modified class I (with occlusal and/or vestibular and oral surfaces affected) were detected on 65 teeth (25%).

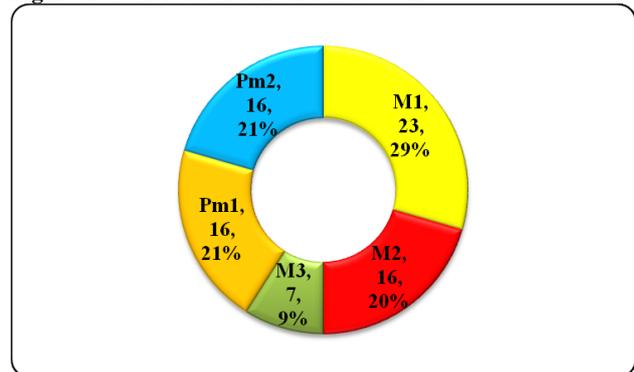
There were 125 (64,1%) class II restorations with one proximal component (mesial or distal) and 70 class II restorations with both proximal surfaces included (35,9%).

45 clinical situations (36%) involved the mesial surfaces and 80 cases had the distal surfaces that needed direct adherent treatment (64%).

**Figure no. 2. Distribution on upper teeth**



**Figure no. 3. Distribution on lower teeth**



The distribution of combined restorations that needed retreatment on the upper teeth is presented in figure no. 2 and the distribution of combined restorations that needed retreatment on the lower teeth is presented in figure no. 3. The distribution by the depth of the cavities after the removal of the combined restorations and of the necrotic tissues indicated that 210 (80,77%) of them were deep and only 50 had a medium depth.

The medium depth cavities were distributed as follows:

- 45 in female patients and only 5 in male patients;
- 32 class I with 22 molars and 10 premolars and 18 class II on molars with one vertical component on the mesial surface.
- The deep cavities were distributed as follows:
- 70 in female patients and 140 in male patients;
- 33 class I on 20 molars and 13 premolars and 177 class II on molars and premolars, with one or both proximal surfaces affected.

115 (54,76%) (from the 210 deep retreated cavities) needed long term indirect pulp capping (at least 60 days) and the rest of them (95 deep cavities) (45,24%) had the indirect pulp capping followed by the final restoration in the same treatment session.

The deep retreated cavities that needed long term indirect pulp capping for at least 60 days were 16(14%) of class I (10 molars and 6 premolars) and 99(86%) class II (molars and premolars) with one or both proximal surfaces affected.

### DISCUSSIONS

The results of this study indicated that the most frequently affected group of teeth are the molars in comparison with the premolars group (ratio of 1.75:1). Their posterior position limited the access and the visibility for the operator at the time of the first corrective intervention when the amalgam filling was replaced with an adherent one.

The difference in size also generated a greater degree of incidence for molars because of their particular occlusal pattern with pits and grooves that can easily host undetected caries until advanced stages.

The greater incidence of combined amalgam-composite fillings at the upper arch with a ratio of 2,33:1, in comparison with the lower arch, is a direct consequence of the limited visual field available for direct inspection.

This hypothesis sustains that, in most cases, secondary caries (88,84% as stated by the patients and detected after the filling removal) associated to the amalgam restorations were the main reason for the replacement with composite restorations.

The secondary deficiency in the treatment is the one that generated the studied pathology, the incomplete removal of the amalgam with the incorrect treatment of the secondary caries leading to combined restorations which also presented recurrent caries (93,07% as determined during the treatment).

During the retreatment, the male patients had more deep cavities than the females (a 2:1 ratio) and the females had more medium cavities than the male patients.

These results support the female patients' compliance to dental treatment, the small number of advanced caries indicating their greater commitment to regular early checks and treatment if needed.

The large number of deep caries that were treated using a long term indirect pulp capping (54% from deep caries and 44% from the total) indicated great deficiencies in the initial treatment that generated massive secondary caries with a rapid evolution towards the pulpal chamber.

Based on the characteristics of the location of the necrotic tissues (juxtapulpal wall aspect) under and around the fragments of amalgam, it can be easily understood why the initial dentin removal was not properly done.

The location of the remaining amalgam on the internal walls was, in most of the cases, in the distal region on the occlusal surface or in the distal vertical cavity on parapulpal or gingival wall.

The access limitations in the posterior region, especially to the distal vertical cavities developed a pattern of failure for both upper and lower teeth.

These iatrogenic restorations were the result of improper treatments even with local anesthesia in most of the cases (220 of 260, 85%) (as stated by the patients). Therefore, the partial removal of the amalgam filling was a direct consequence of the dentist's decision due to the high risk of pulpal injuries.

### CONCLUSIONS

Combined amalgam-composite restorations are the result of several factors that act simultaneously, leading to an incorrect treatment that, in time, may affect the dental vitality.

The main negative factor incriminated is the limited dentist's experience in managing deep recurrent decays on posterior teeth.

The absence of any dentinal protection under the amalgam that was incorporated in the subsequent adherent filling (especially in the distal parts of the cavities) underlined the limited skills of the dentist in placing bases.

The incidence of the studied pathology presented values that increased as the number of surfaces in the restoration increased. The lowest number of combined restorations was associated to class I cavities.

The large number of maxillary teeth that needed retreatment with a greater numbers of treatment sessions and increased costs can be explained by the dentists' inability to perform all the steps of the working protocol using the dental mirror.

The fragments of amalgam covered by the composite restorations are, in fact, the direct result of the dentist's limited clinical experience in treating recurrent caries on posterior teeth.

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