

# CLINICAL-STATISTICAL STUDY ON THE LONG-TIME BEHAVIOUR OF CERVICAL RESTORATIONS

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**Keywords:** carious cervical lesions, composite or amalgam restorations, defects over time

**Abstract:** In odontology, cervical carious lesions represent a distinct entity because of the morphological and physiological particularities of the area; their therapy poses problems related to the viability and duration of restorations. The aim of the present paper is to highlight the deficiencies that may occur over time in cervical composite or amalgam restorations. The material is represented by 105 three-year-old cervical restorations, more exactly 59 composite and 46 silver-amalgam restorations. The method is represented by a clinical-statistical analysis of the restorations, considering the patients' gender and age (patients in the 20-60+ age bracket). The clinical status of restorations is assessed comparatively for the 2 restorative materials to meet 8 criteria, 6 common to the 2 types of restorations and 2 specific to each type of restoration. The results of the study show that, in the case of 3-year-old restorations, there are more or less important deficiencies, both common and specific to the restorative materials used, which is also mentioned in the literature. The conclusion of the study is that, over time, there are deficiencies not only in the preparations but also in the restorative material, their probable causes being synthesised in a table. It is clear that the imperfections in the restorative material as well as the defective technique employed during the stages that necessarily precede the use of restorative material, amalgam or composite can contribute to the occurrence of defects in cervical restorations over time.

**Cuvinte cheie:** leziuni carioase cervicale, restaurări cu material compozit sau amalgam, defecte apărute în timp

**Rezumat:** În odontologie, leziunile carioase cu localizare la nivelul coletului dentar reprezintă o entitate distinctă, datorită particularităților morfo-funcționale ale zonei; terapia acestora pune probleme legate de viabilitatea și durata restaurărilor. Scopul lucrării de față este acela de a pune în evidență deficiențele, ce pot să apară în timp la nivelul restaurărilor cu materiale compozite sau amalgam, efectuate la nivelul coletului dentar. Materialul de lucru a constat într-un număr de 105 restaurări cervicale, vechi de trei ani, dintre care 59 erau realizate cu material compozit și 46 erau confecționate din amalgam de argint. Tehnica de lucru a constat într-o analiză clinico-statistică a acestora după sex și grupa de vârstă (între 30 și peste 60 de ani). Aprecierea statusului clinic al restaurărilor a fost făcută comparativ pentru cele 2 materiale de restaurare după 8 criterii, din care 6 comune celor 2 tipuri de restaurări și 2 specifice, fiecareia dintre acestea. În discutarea rezultatelor studiului și în conformitate cu literatura de specialitate studiată apare foarte evident faptul că, după 3 ani de la efectuarea restaurărilor, acestea prezintă deficiențe mai mult sau mai puțin importante, comune ambelor materiale restauratoare, dar și specifice fiecareia. Concluziile rezultate, ca urmare a studiului nostru au fost că, în timp, apar deficiențe atât la nivelul preparațiilor, cât și la cel al materialului restaurator, cauzele lor probabile sintetizându-le într-un tabel. Este cert că, în apariția defectelor în timp a restaurărilor cervicale contribuie atât imperfecțiunile materialului restaurator ca și, în egală măsură, tehnica defectuoasă în pașii ce preced în mod necesar aplicarea materialului restaurator, indiferent dacă este vorba de amalgam de argint sau de material compozit.

## INTRODUCTION

Tooth gingival-cervical pathology causes difficulties for dental practitioners, being an area that is less agreeable to them and a source of dissatisfaction for the patient in terms of aesthetics, pain and fear. It is also an area affected by carious lesions. When restorative treatment is necessary, minimally invasive treatment is preferred to maximally preserve healthy dental hard tissues. The approach to carious lesions does not pose serious problems as the treatment and restorative materials used for it are well known.

In order to last long, the cervical preparation restoration should exactly follow the instructions, the steps indicated as far as such restorations are concerned, in connection with the type of material used, occlusal relations (if necessary), oral hygiene and other aspects.

The restorative material should be chosen depending on the case particularities, after the assessment of the benefits of physiognomic and non-physiognomic materials to the cervical restorations in the frontal and lateral areas of dental arches.

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### **Anatomical-topographical data regarding cervical area**

Anatomically, the tooth cervix is the junction line between the dental crown covered by enamel and the dental root covered by cementum, known as cemento-enamel junction. It varies with the age of the patient and the periodontal health. Age can cause gingival retraction, the clinical crown of the tooth changing its appearance and the cervix of the tooth becoming visible and vulnerable to dental caries.(1,2)

The cervical region of the tooth crown is a circumferential few-millimetre high area, situated between the maximum bulge of the vestibular surface and its projection on the lingual surface and the tooth cervix, representing about 1/3 of the tooth crown height. It is a sensitive area, often the source of pain and the place of unaesthetic exposure of the tooth cervix, especially in anterior teeth. Its location between the marginal gingival prominence and the dental maximum vestibular or oral bulge creates an optimal retentive area, which makes it vulnerable especially when oral care is poor.(1)

The specificity of the cervical area of the tooth is given by a number of anatomical and morphological features as follows:

a) the anatomical cervix corresponds to the cemento-enamel junction. In this area, the dental hard tissues have some specific morphological characteristics:(2,3)

- the enamel layer becomes thinner as it gets closer to the tooth cervix, and its structure is increasingly irregular, rich in organic matter, generating limited areas of hypomineralised enamel, known in the literature as specific enamel defects.(3,4) Cervical enamel sometimes appears in the form of bevel-edged islands having few and fragile atypical enamel prisms, oriented almost perpendicular to the long axis of the tooth. In the cervix of lower lateral incisors the thickness of enamel prisms is 0.2 mm.(2,5) In the cervical area, perikymata, the anatomical site where the striae of Retzius meet the enamel surface forming distinct, circumferential grooves, create a rough surface. Their number decreases with age, missing totally after the age of 70-75;(2,4,5)
- the enamel prisms in the tooth cervix are fragile, being subject to permanent deformation (flexion), which attenuates masticatory pressures. That is why they can undergo a process of detachment or fracture, associated with dentin exposure to oral environment;(6,7)
- the root cementum is less mineralised than enamel or dentin, having a structure rich in organic matter, higher permeability and lower resistance. It sometimes covers a small area of the tooth enamel with thin acellular and fibrillar cementum. Towards the dental crown the cementum thickness decreases to 20-60  $\mu$  and here, on a specific rough surface, in the presence of dentinal tubules, an ideal area for plaque accumulation is created, which is a favourable environment for cavities and gum inflammation;(5)
- in the cervical area, dentin is less hard and more soluble. Moreover, there are fewer dentinal tubules that have a smaller diameter compared to those in coronal dentin;(2)
- the enamel in the tooth cervix gets thinner, being in a topographical relation with the root cementum and forming the cemento-enamel junction, which is different from one tooth to another. At the level of the cemento-enamel junction, there may be situations in which the enamel is covered by cementum, is tangential to it, or there is no contact between the 2 structures;(1,2,5,7,8,9)

b) the enamel bulge in the cervical area helps to protect the free gingival margin and to deflect food. Its

alteration, by losing dental hard tissue because of carious lesion or defective restoration, results in periodontal pathology;(9)

c) the enamel natural curvatures allow not only the functional stimulation of the gingival tissues by massage but also the plaque accumulation.(9)

In order not to become a source of irritation for the periodontium, it is necessary that the restoration of the cervical third should anatomically reproduce the tooth and especially the vestibular bulge as precisely as possible. The restoration form, the material used and its biomechanical qualities are some of the factors that influence the success of this area restoration.(9)

For a long lasting restoration of cervical carious lesions, the instructions for the use of aesthetic and unaesthetic restorative materials should be followed and a series of important factors should be considered such as the carious lesion aetiology, oral hygiene, the position of the affected tooth in the dental arches, the correction of occlusal relations (when necessary), the presence of hypermineralised tissues that are less apt for adhesion, the morphological modifications that are less propitious for the restoration longevity.

Theoretical knowledge and clinical practice have evolved a lot in recent years and with them the hope for high-performance treatment, able to meet the patient aesthetic and functional requirements as well as his/her material resources.

### **Material selection to restore cervical lesions**

A great variety of restorative materials are currently available, able to meet the aesthetic needs of patients while observing the principle of preserving dental hard tissues. The question that arises is how the restorative material is selected so that:(10,11)

- it can allow for the maximum longevity of the restoration;
- the degradation of the restoration colour can be avoided;
- it can allow for an optimal marginal adaptation and the avoidance of secondary caries.

As far as cervical lesions are concerned, the options are related to 2 categories of adhesive materials: composite materials and glass ionomer cements. However, for the dental arch lateral area the option of a silver amalgam restoration is still valid.(11,12)

The restorative material is chosen according to the following criteria:(1,2,13,14,15)

- lesion topography;
- lesion extension;
- difficulties in having access to the lesion;
- oral environment;
- patient's needs and resources.

### *Dental amalgam*

For the tooth cervix, and especially for the dental arches lateral areas, there are well known advantages of using silver amalgams, especially in cases of serious caries risk. The disadvantage is that a retentive cavity is necessary, which entails a great loss of dental hard tissue. Moreover, the retentive cavity is sometimes difficult to achieve because of the location of carious lesions in areas with difficult access and reduced visibility. The achievement of a dry operating field is also difficult. In addition, because of its unaesthetic aspect, it is less and less accepted by patients. However, its longevity compared to composite materials is generally accepted.(1,11,16)

### *Composite materials*

The use of composite resins in anterior teeth restoration represents the most aesthetic therapeutic solution. They can be inserted into the smallest preparations. However, even the most recent adhesive techniques cannot provide them with perfect marginal seal.

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Composite materials seem to be easy to use, but the adhesive technique is very sensitive and requires particular attention to details. Even if the restorative material application technique is correct, in less than a year there are signs of the adhesive bond degradation.(16,17)

The fact that free unpolymerised monomers remain in the restoration following the composite resin polymerisation stimulates the development of cariogenic bacteria resulting in the occurrence of secondary caries and/or the degradation of polymers.(1,13,17)

The process of the composite material adhesion to enamel is relatively simple but strong adhesion requires a sufficient clean and dry enamel surface.(1,2,14)

Adhesion to dentin is more difficult, because dentin has, by nature, no affinity for the composite resin.

To achieve effective adhesive bonding to dentin its mineral structure should be removed, leaving a soft and delicate collagen lattice that will be infiltrated by the adhesive resin. Following polymerisation it is locked in and around the exposed collagen fibres. When there are open dentinal tubules, they increase the infiltration surface forming the hybrid layer.(13,14,17)

Excessive dentin demineralisation can result in collagen degradation, distortion, and finally in the formation of a collagen fibre lattice that is too thick to allow adequate penetration of the primer and the adhesive resin. The hybrid layer thus obtained is porous, allowing collagenases to enter the collagen lattice, resulting in breaking the hydrolytic bonds at the interface.

It is clear that any error made by the practitioner in meeting the dentin bonding protocol may result, over time, in the loss of adhesive bond, which can cause marginal micro-and/or macro-infiltrations thus increasing the probability of the restoration failure.(1,11,13,14,17) It is important to note that the dentin acid conditioning required for stable adhesive bonding may be the cause of the restoration failure.

There are many advantages of using composite materials as follows: excellent aesthetic aspect, conservative (minimally invasive) approach, good adhesion to dental hard tissues – enamel and dentin, and low thermal conductivity. There are also disadvantages such as: polymerisation contraction (0.6-6% of the volume) and different polymerisation quality depending on depth, degradation of the quality of the adhesion to dentin over time with the occurrence of marginal micro-infiltration at the level of adhesive interface, change in the colour/marginal inadequacy, stability degradation and high risk of secondary caries occurrence compared to amalgam, longevity limited to 5-8 years.

For the proper insertion and adaptation of the restorative material in the preparation a system of cervical matrices is required. After the restorative material is applied, it is necessary to obtain a smooth surface that does not retain plaque. To that end the material should be finished.

### Clinical-statistical study on the behaviour of cervical restorations using composite material or silver amalgam

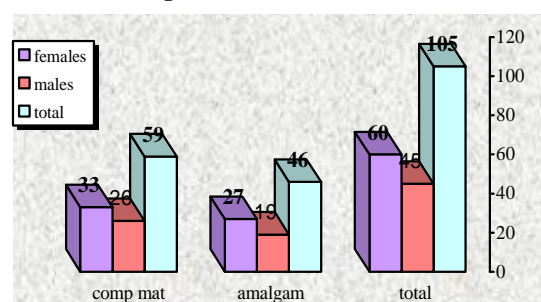
#### PURPOSE

The aim of the study was to draw a parallel between the behaviour of the two restorative materials over time, composite and silver amalgam respectively, used in the restoration of cervical preparations.

#### METHODS

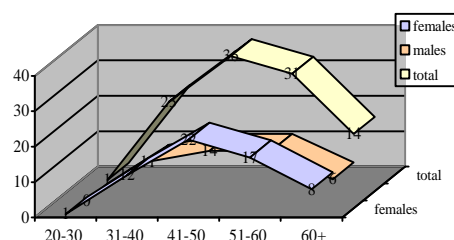
We studied the clinical appearance of some restorations performed using the two types of materials 3 years after their application. We selected a number of 105 patients of both sexes and of different ages, in the 20-60+ age bracket, from the patients who saw 7 dental practitioners working for “Carol Davila” University of Medicine and Pharmacy in Bucharest between 2011 and 2013. 105 crown restorations were examined. 59 of them, mainly located in the front and premolar teeth cervix in both arches, were made using a composite material, and 46 were silver amalgam restorations, located on the lateral sides of both arches, all of them being at least 3 years old (figure no. 1).

**Figure no. 1. The number of cases studied by the restorative material used and gender**



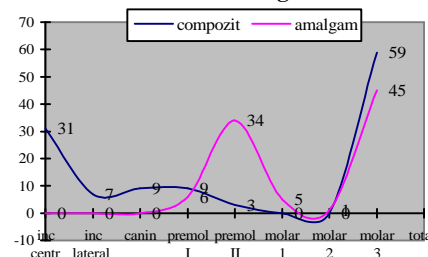
The patients of both sexes were in the 20-60+ age bracket. Females and the 41-60 age bracket were predominant for both types of restorations (figure no. 2).

**Figure no. 2. Distribution of cases by age bracket and gender**



As for the groups of teeth that were clinically examined, composite materials were especially used for front teeth (47), premolars (9) and upper first molars (3). Silver amalgam was used for the restoration of the teeth in the lateral areas of the arches: 6 second premolars, 34 first molars, 5 12-year molars and 1 wisdom molar (figure no. 3).

**Figure no. 3. Distribution of cases by the teeth restored using composite material and silver amalgam**

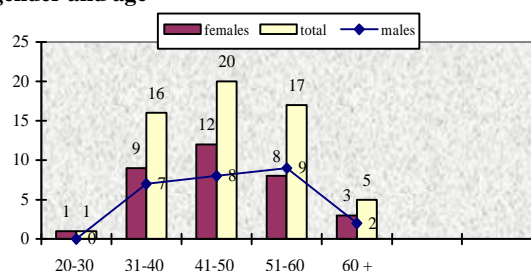


With respect to the patients' age and gender, composite restorations were more common in women aged between 41 and 50, as it can be seen in figure no. 4.

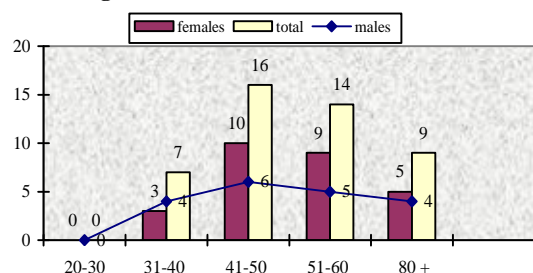
Silver amalgam restorations were more common for the women in the 41-50 age bracket (figure no. 5).

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**Figure no. 4. The number of cervical composite restorations by gender and age**



**Figure no. 5. Number of cervical amalgam restorations by gender and age**



The clinical examination of these restorations focused on several elements that were common to both types of restorations such as:

- correct restoration;
- restoration loss;
- occurrence of marginal staining in preparation/restoration;
- cavity wall marginal fractures;
- restorative material marginal fractures;
- marginal secondary caries.

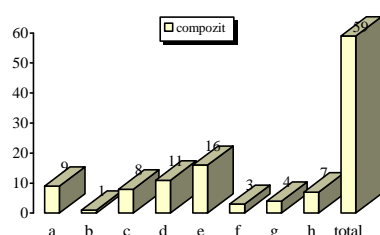
With respect to the restorative materials that were used, the following aspects were monitored:

- change in the restoration exterior line in relation to the region anatomy or the silver amalgam rough surface;
- changes in the colour of the composite material or adjacent enamel.

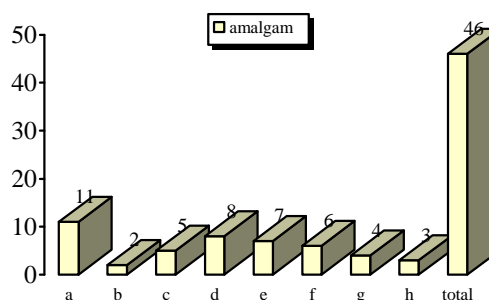
### RESULTS

The results of the study regarding the defects occurred in composite restorations in a 3-year period, considering the criteria mentioned above are presented in figure no. 6A. We noticed that the changes in the composite colour occurred in 11 cases, the changes in the anatomical convex aspect of the restoration in relation to the cervical area anatomy occurred in 8 cases, and the changes in the colour of the marginal area in the preparation/restoration, which was considered the consequence of marginal infiltrations, occurred in 16 cases.

**Figure no. 6A. Clinical aspect of composite restorations**



**Figure no. 6B. Appearance of amalgam restorations**



Legend:

- a. correct restorations
- b. no restoration
- c. change in the filling exterior appearance (contour, rough appearance)
- d. changes in the enamel or filling material colour
- e. marginal staining in preparation/restoration
- f. cavity wall fractures

In figure no. 6B, we noticed changes in the colour of the enamel adjacent to the filling material by silver impregnation in 8 cases, the rough appearance of the amalgam surface in 5 cases, and marginal infiltration in 7 cases. There were clinically detectable defects in 9 composite restorations and 11 silver amalgam restorations.

### DISCUSSIONS

The causes that could have led to the changes in both types of restorations over time, with direct reference to the qualities and defects of the materials used, are summarised in table no. 1. These possible causes are considered in the light of the data known from the literature in the country and abroad as well as by appealing to own experience in order to document and argue the data of our study.

**Table no. 1. Presentation of the defects found in composite or amalgam restorations and of their possible causes**

Presented defect	Possible causes of defects by the restorative material	
	Composite materials restorations	Amalgam restorations
1. Loss of restoration	Incorrect adhesion Insufficient enamel for adhesion Imperfect isolation of the operating field while applying the restorative material	Cavity with precarious retentivity Imperfect isolation of the operating field
2. Change in the surface appearance	Tempestuous horizontal brushing	No amalgam finishing after its application into the cavity
3. Change in the restoration or dental enamel colour	Impregnation with food colours (cocoa, coffee, coke etc.) Composite material aging	Enamel silver impregnation
4. Marginal coloration in preparation/restoration	Filling marginal inadequacy following the polymerisation contraction, degradation of the adhesion quality allowing marginal infiltration in the interface	Incorrect marginal condensation of the material with gaps between cavity and restoration
5. Marginal wall fractures	Very thin enamel, unsupported by dentin, fractured following manual scaling or hard	Failure to remove all demineralised enamel areas Very thin marginal

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	brushing	amalgam layer
6. Marginal restorative material fractures	Manual scaling Composite application on a cementum layer without adhesion Insufficient enamel for adhesion	Amalgam imperfect condensation Thin amalgam fractured following manual scaling
7. Secondary caries	Failure in completely removing demineralised enamel Failure in completely removing altered dentin	Failure in completely removing demineralised enamel Failure in completely removing altered dentin

As it is observed in the study conducted by us and it can be seen in the presented figures and tables, 3 years after the restorations were performed, the following defects occurred:

- defects in restorative material such as loss of restoration, changes in the surface appearance, which in the case of composite refers to the convex anatomical form of the cervix, and in the case of amalgam to the rough, retentive appearance of the filling surface, changes in the colour of composite materials, as well as possible fractures of both types of restorations;
- defects in the preparations made for restorations, regardless of the material used, such as cavity marginal wall fractures, the occurrence of gaps between the cavity wall and restoration, with subsequent marginal infiltration and marginal cavities occurrence. Moreover, in the case of silver amalgam, changes in the enamel colour may occur, by silver impregnation because of the amalgam composition.

The most important causes of the defects that occur over time are related to the defective preparation or the incorrect techniques employed while applying the restorative material. There may be also other causes that are related to defective brushing techniques, brutal manual scaling, poor oral hygiene, diet rich in pigments etc.

### CONCLUSIONS

The carious lesion located in the tooth cervix represents a touchstone for the dental practitioner, being an area that is difficult to access, and a source of dissatisfaction for the patient, in terms of aesthetics, pain and fear.

The treatment of cervical caries requires the dental practitioner full attention in all its phases from the diagnosis to the selection of the restorative material in relation to the location of the lesion and in compliance with the instructions and techniques for preparing cavities and inserting the restorative material.

Considering all the above-mentioned elements carefully, the occurrence of immediate defects can be avoided, and most of the inherent problems that occur over time can be minimised. Among them, we can mention the change in the appearance of the restoration surface, the occurrence of marginal infiltrations, the change in the colour of the composite material or the enamel, the marginal fracture of the cavity wall or the restorative material, as they are made evident by our study.

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