Romanian dentists’ perception about direct restoration of dental caries on adjacent teeth: current techniques and materials, restorations longevity and failures. Part II

Irina-Maria Gheorghiu1, Sebastian Onu2, Alexandru Andrei Iliescu3, Paula Perlea4

1Department of Restorative Odontotherapy, Faculty of Stomatology, “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania
2Private dental practice, Bucharest, Romania
3Department of Oral Rehabilitation, Faculty of Dental Medicine, Craiova, Romania
4Department of Endodontics, Faculty of Stomatology, “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

ABSTRACT

Proximal surfaces of both anterior and posterior teeth frequently present dental caries, as a result of complex coronal morphology and other associated factors which favors bacterial microfilm retention. In this article we present the second part results of a cross-sectional study, using a questionnaire that was distributed to a number of 110 Romanian dentists. We investigated the most used dental materials and techniques and correlations with oral restorations longevity, and also the failures and patients’ complaints. The results indicate a modern, up to date approach of direct restoration in adjacent teeth from Romanian interviewed dentist.

Keywords: dental caries, adjacent teeth, restorative materials, current techniques, restoration longevity, restoration failure

INTRODUCTION

Dental caries are frequently situated on the proximal surfaces of both anterior and posterior teeth. The etiology is related to bacterial microfilm adhesion in these retentive areas, difficult hygienisation, with consecutive hard tissue demineralization and cavity appearance. Unfortunately, we are often confronted with dental caries in both adjacent teeth, in different evolution stages, requiring direct restoration. Dental caries on adjacent teeth treatment is based on modern adhesive conservative dentistry, but presents some special characteristics related to their localization and the importance of a correct restoration of interproximal contact point [1]. In this present study we investigated the importance of an appropriate matrix system for coronal conformation, different dental materials and techniques which can optimize and allow a successful result, as well as the failures and patients dissatisfaction with dental treatment, from interviewed dentists point of view.

METHODS

We carried out a cross-sectional study, using a questionnaire that was distributed to a number of 110 practicing Romanian dentists, regarding the prevalence, etiology, diagnosis and therapeutic approach of dental caries on adjacent teeth. The questionnaire contains a number of 30 questions, of which 18 are with the possibility of choosing only one answer and 12 are multiple-choice. The questionnaire’s questions were developed based on pre-
vious studies published. Participation in this study was voluntary, and written informed consent was obtained from all participating dentists. Of the 110 dentists invited to participate, 63 responded, giving an overall response rate of 57.27%.

In this article we present the answers and conclusions of the second part of the questionnaire, which is related to different restoration techniques, the most used materials and the life expectancy and failures of restorations of dental caries on adjacent teeth.

RESULTS AND DISCUSSION

1. The second part of the questionnaire started with a question (no 16) related to matrix systems used by dentists. We collected 108 responses divided as follows: 38 responses for celluloid band (35.1% of people ticked this answer), 42 responses for segmental metal matrix (38.9% of people ticked this answer) and 28 answers for the circular metal matrix (25.9% of people have chosen this answer) (Figure 1).

The use of a matrix system is mandatory in the case of dental caries carious on proximal surfaces and the choice of an appropriate system is made according to the type of affected tooth and personal preferences. In the case of teeth in the posterior area, the use of anatoform metal matrix is indicated, which is able to restore anatomic proximal contours and contact areas, while the rigidity prevents the matrix to deform when the restorative material is inserted into the cavity, whether it is segmental or circular [2,3]. For anterior teeth, celluloid band is the most common choice.

2. Question number 17 refers to the use of calcium hydroxide liner in deep cavities where pulp chamber opening has not occurred. The answers were divided into 76.2% (48) for yes and 23.8% (15) for no (Figure 2).

The use of a liner and base in the case of a deep cavity with intact pulp chamber is a technique called indirect pulp capping [4]. Calcium hydroxide liner is well known for its bioinductive (induce hard tissue formation) and antimicrobial activity, so it is used extensively.

3. The next question is related to the material used for the cavity base used for medium or deep cavities. The question had 3 predefined answer options, including the option not to use a base, as well as the possibility to add your own answer. Of the 63 responses received, 57.1% (36) were for glass ionomer cements, 23.8% (15) for flowable resin composites, 3.2% (2) for calcium hydroxide and 15.9% (10) stated that they do not use a base. The use of calcium hydroxide was added by the respondents, not being one of the answers included in the questionnaire (Figure 3). The use of a cavity base is no longer mandatory in the context of modern adhesive materials, but it presents a number of advantages that will improve the final result [5]. Glass ionomer cements have a cariostatic effect due to the continuous release of fluoride, good mechanical resistance as well as the ability to isolate the dental pulp from thermal and electrical stimuli, thus making it a suitable material.

Figure 1. The matrix system used

Figure 2. Use of calcium hydroxide as liner in deep cavities
for an insulating effect. Flowable composite resins are used as a base due to their viscosity that allows them to diffuse into all corners of the cavity, creating a uniform layer with very good marginal adaptation.

4. The 19th question of the questionnaire is related to the adhesive system used in direct composite resins restorations. There were 2 predefined answer choices and the possibility to add other answers depending on the adhesive system used. Thus, 61.9% (39) of the respondents chose the option of total-etch adhesive, with phosphoric acid and combined primer and bonding in a single bottle; 36.5% (23) the option of self-etch adhesive and only 1.6% (1) the option with separate acid, primer and bonding (Figure 4).

5. The 20th question of the questionnaire refers to the restorative materials used to restore dental caries on adjacent teeth in posterior area. The 63 respondents registered 107 answers divided as follows: 63 answers for composite materials (all respondents chose this answer), 30 answers for glass ionomer cements (47.6%), 12 answers for compomers (19%) and 2 responses for amalgam (3.2%) (Figure 5).

Despite the fact that the lateral area is not very visible, aesthetic materials are the basic choice for direct restorations, non-physiognomic materials such as amalgam being used only in isolated cases [7]. Thus, composite materials are the most common choice among dentists as they offer good mechanical and aesthetic properties, are easy to handle, and long-term success is ensured when the treatment protocol is followed. Regarding glass ionomer cements, they present the important advantage of dental adhesion in cavities with subgingival margins localization, with absent enamel, but the aesthetic qualities are weaker compared to composite materials. Compomers are a combination of composite resins and glass ionomer cements, combining the advantages of the two materials in terms of aesthetics, presentation and the ability to release fluoride, but the mechanical properties are weaker, especially abrasion resistance, therefore the low degree of use among dentists.

6. The next question is similar to the previous one, except that it refers to the restorative materials for the cavities prepared in the anterior teeth, hav-
ing the same answer options. This question collected 72 answers divided as follows: 61 answers for composite materials (96.8% of people chose this answer), 4 answers for glass ionomer cements (6.3%), 7 answers for compomers (11,1%) and no response for amalgam (Figure 6).

As it is about the front area, the aesthetic aspect takes precedence and less the mechanical characteristics, because these teeth are not subjected to as great forces as the posterior ones. Thus, composite resins represent the ideal material as they present the best aesthetic, biocompatibility, very varied color range, high translucency, special optic properties like light-scattering effect, all of them providing natural appearance [8].

7. Question number 22 of the questionnaire is about adapting the dental material used to the respective clinical situation. Of the 63 participating doctors, 79.4% (50) stated that they adapt the materials used depending on the clinical situation, while 20.6% (13) prefer to use the same materials regardless of the situation (Figure 7).

Currently, there is no ideal material for direct restorations that meets all requirements and can be used in every situation, therefore a material must be chosen according to the clinical case.

8. The 23th question of the questionnaire is about the direct restoration technique and had 4 answer choices and the possibility to choose more than one answer. It collected 96 responses divided as follows: 57 responses for the layering technique (90.5% of the surveyed dentists chose this response), 15 responses for the bulk-fill technique (23.8%), 21 answers for the sandwich technique (33.3%) and 3 answers for the centripetal technique (4.8%) (Figure 8).

9. Question number 24 refers to the influence of the restorative technique on the final clinical result. Thus, of the 63 respondents, 74.6% believe that the work technique influences the final result, 7.9% believe that it has no effect, and 17.5% cannot state with certainty a safe answer (Figure 9).

The layering technique is one of the most used restorative techniques as its first advantage is minimizing the polymerization shrinkage of composite resins. Its use is simple, it allows the use of different colors between the layers to obtain a natural result and the achieved success is lasting [9].

The bulk-fill technique addresses special light-cured resin composites designed for this technique that allow layers of up to 4 mm. Unfortunately, this technique has disadvantages, such as the difficulty in polymerization of deep cavities, the possibility of the incorporation of air bubbles, or marginal bond failures [10].

The sandwich technique represents a combination of the two previous techniques as it allows layering using two distinct dental materials. For example, in the case of medium/deep cavities, a base filling of 1-2 mm of glass ionomer cement can be added using the bulk-fill technique and the final filling of composite materials added in layers of 1-2 mm thickness.

The centripetal technique is a working technique that is highly recommended for restoration of dental caries on adjacent teeth. This allows a very good restoration of the interdental contact point through
the initial reconstruction of the proximal wall and the transformation of a Class II cavity into a Class I cavity that will later be restored using the layering technique [11]. The correct restoration of the area and contact point for proximal hard dental loss on adjacent teeth is extremely important because the success of the long-term restoration as well as the health of the periodontium of the two teeth depends on it.

Thus, analyzing all the aspects already discussed and taking into account the data obtained by the mean of our questionnaire, we can affirm with certainty that the working technique has an extremely important role in the success of the dental treatment both in short and long term.

10. Question number 25 refers to the finishing and polishing methods of the restored proximal tooth surfaces. This had 3 predefined answers and the possibility to add other answers and choose more options. The question obtained 96 answers distributed as follows: 45 answers for abrasive discs (71.4% of the respondents chose this answer), 32 answers for metal abrasive strips (50.8%), 46 answers celluloid abrasive strips (73%) and 3 answers for polishing rubber instruments (3.2% of the people surveyed chose this answer). The last answer was added by the respondents in various forms and united in one category (Figure 10).

The final step of finishing and polishing of the proximal surfaces of restorations on adjacent teeth is an important step of the treatment protocol, allowing the removal of excess restorative material so the periodontium health and integrity is preserved. Also, the unpolished dental material often presents a rough surface that will facilitate the bacterial microfilm adhesion and consecutively dental caries [12]. Both abrasive strips and discs have a major advantage in that they are flexible and easily conform...
to the shape of the tooth. The metal bands are thicker and more active, good for an initial finish, while the celluloid ones are thinner, so easier to insert interdentally, and with a finer grain adapted to the final polishing.

11. The next question is also related to the last step of finishing and polishing, but it refers to the occlusal surfaces of the posterior teeth and palatal surfaces of the anterior teeth. Like the previous question, this one too had 4 predefined answers and the possibility to add other answers and choose multiple options. The question gathered a total of 157 responses distributed as follows: 26 responses for Arkansas stone (41.3%), 62 responses for rubber instruments (98.4%), 36 responses for polishing brushes (57.1%) and 34 of answers for abrasive discs (54%) (Figure 11).

The occlusal surfaces of the posterior teeth and the palatal surfaces of the anterior teeth are easily accessible tooth surfaces, therefore the most effective finishing methods in this case are those using rotary handpieces [13]. Arkansas stone is primarily used for removal of excess material, occlusion adjustments and for a preliminary finish, and can be used on both surfaces. For the final polishing, rubber cups and brushes are used, preferably together with a special abrasive finishing paste.

12. Question number 27 refers to the longevity of this type of restorations observed by the participating doctors for their patients. The answers received to this question are as follows: 55.6% (35) of the respondents estimated that the restoration longevity on adjacent teeth is more than 5 years, 20.6% (13) chose the period of 4-5 years, 11.1% (7) voted for 3-4 years, also 11.1% (7) also chose the duration of 2-3 years and only 1.6% (1) considered that this direct restorative treatment will not survive more than a few months (Figure 12).

Estimating the life expectancy of direct restorations on adjacent teeth is a subjective assessment as the factors on which the success of this treatment depends are numerous and varied. The medical treatment carried out by the dentist is only the starting point, following that variable such as the oral hygiene, the carioactivity parameters, vicious habits or traumas will modify the restoration evolution. However, despite all the external factors that can shorten the life of restorations, approximately three-quarters of the responding dentists estimated the life expectancy to be at least 4 years. This success is mainly due to working techniques and modern adhesive materials that offer increased strength with a conservative approach and that represent a successful alternative to dental crowns even in cases with deep and extended dental caries.

13. Question number 28 tries to find out which materials suffer the most frequent failures. The question had 4 predefined answer options as well as the possibility to add other answer options. The responses received were distributed as follows: 36.5% (23) for resin composite materials, 42.8% (27) for glass ionomer cements, 11.2% (7) for compomers, and 9.5% for amalgam. Additional responses contained trade names or variations of already existing response materials were finally included in the general material categories (Figure 13).
Most failures were reported by respondents in restorations with glass ionomer cements. The main disadvantage of these materials is their lower mechanical properties compared to composite resin restorative materials: lack of strength and low resistance to abrasion and wear, low tensile and flexural strengths, lower discoloration resistance.

Light-cured resin composites also have a number of disadvantages that can cause restoration failure, the most important being polymerization shrinkage, which if not minimized by correct working techniques, will create a space between the tooth wall and the restoration material. This microscopic space allows the oral fluid containing pathogens to penetrate and form the basis of micro infiltration and recurrent caries. Also, in large cavities with thin walls, the polymerization shrinkage can produce their fracture. Another cause of failure is represented by pulp damage, produced by the residual monomer that can reach the pulp through the dentinal tubules. All these problems can be avoided by inserting the material in the cavity using special techniques (layering technique) and by adequate pulp protection [14].

As for amalgam, the failures caused by it are mainly due to the preparation of cavities with a lot of tooth tissue sacrifice which reduces the strength of the walls. They will not fracture immediately post-treatment, but over time by the addition of dental wear that reduces the coronary volume and as a result of continuous mechanical and thermal loads of restored teeth [15].

14. The 29th question of the questionnaire is about clinical and radiological investigation of failures of dental caries restoration on adjacent teeth. It had 5 predefined answers and the possibility to choose several answer variants or to add your own answer. The question received 137 responses divided as follows:

- 43 responses for secondary dental caries (recurrent caries) located at the gingival level (68.3%)
- 15 responses for secondary dental caries (recurrent caries) on the other walls, except the gingival one (23.8%);
- 21 responses for fracture of the restorative material (33.3%);
- 24 responses for coronary fractures (38.1%);
- 30 responses for pulpal pathologies related to restoration (47.6%);
- 3 responses for issues related to the contact point area (4.8%);
- 1 response for coronal discoloration (1.6%).

(Figure 14)

Analyzing the received answers, we can affirm that most frequent failures are related to the gingival wall, mainly due to the reduced access and visibility that can prevent the total removal of the necrotic tissues. Also, obtaining a perfect isolation is difficult in this area, which can allow the infiltration of oral fluid into the cavity, compromising the final result. In this case, the restoration itself is not affected, but the hard dental tissues around the gingival wall of restoration [16].

In the case of very deep lesions, preserving pulp vitality is not always guaranteed, even with pulp

- Secondary caries at gingival level
- Secondary caries on cavity walls
- Fracture of restoration
- Coronary fractures
- Pulpal pathologies
- Interproximal contact point issue
- Tooth discoloration

(Figure 14)
capping techniques. Another aspect encountered is that the preparation of extended dental caries often results in cavities with thin walls that will have to sustain large restorations and will predispose them to fracture during mastication. Conversely, fracture of the restorative material can occur both through the fault of the patient, for various reasons, or as a result of incorrect therapeutic maneuvers by the dentist. For example, a reduced thickness of resin composites under 1.5 mm cannot offer an acceptable fracture resistance value. Also, incorrect cavity design will induce tension in the restorative material and the microcrack appearance.

Other types of failures reported by the respondents are incorrect restoration of the contact point and coronal discoloration. Contact point problems are most often reported by patients as feeling pressure on both teeth caused by a too firm contact point or food getting in between the teeth and traumatizing the gingival papilla in the absence of contact point. As for the coronal discoloration, this is a problem encountered only in amalgam restorations.

15. The last question of the questionnaire, having the number 30, is related to the patients’ dissatisfaction regarding the direct restorations on adjacent teeth. The question had 4 predefined answers and the possibility to add your own answer and choose more options. The question got 85 answers, distributed as follows: 12 responses for unsatisfactory aesthetics (19%); 47 responses for issues related to the point of contact (71.4%); 13 responses for painful symptoms that persist after treatment (20.6%); 7 answers for large restorations that present a risk of coronal fracture (11.1%); 2 responses for increased treatment cost (3.2%); 4 responses stating that there are no complaints (6.4%) (Figure 15).

Of the complaints described by patients, interdental contact point issues are by far the most common. They present various accusations such as the impossibility of dental flossing when the contact points that are too firm or bleeding/sensitive dental papilla due to interdental penetration of food [17].

Two other types of complaints, namely the painful symptomatology that did not disappear after treatment and the increased risk of fracture of the remaining dental walls, are caused by very deep and extended dental caries that require large restorations. If the painful symptomatology persists, endodontic treatment will be necessary. Regarding cavity walls fracture, the only alternative method is dental crown.

Dissatisfaction related to aesthetics mainly applies to old restorations that have undergone color changes caused by various exogenous factors: smoking, coffee, tea, or in case of amalgam. Most of the time, the simple replacement of the old restoration resolves the patients’ aesthetic demands.

A special situation is represented by the treatment costs when the patient presents to dental office because he noticed only one dental caries and another one is diagnosed on the adjacent tooth during treatment. He is unhappy about having to pay extra for a problem he didn’t know about before, but fortunately, these situations are quite rare according to the responses received using the questionnaire.

CONCLUSIONS

The results of this cross-sectional study indicated that the Romanian dentists are using new conservative adhesive materials and working protocols for restoration of dental caries in adjacent teeth. They are aware of the importance and influence of a specific dental material, matrix system and inserting technique on the final result and the life expectancy of the restoration. When dealing with patients’ complaints, interrogated dentists accurately identified the causes of failures or dissatisfaction, which can help to future improvement of dental practice.

FIGURE 15. Patients dissatisfactions regarding the direct restorations on adjacent teeth

Conflict of interest: none declared
Financial support: none declared
Acknowledgments: for this article all the authors have equal contributions
REFERENCES


