



STATISTICAL ANALYSIS OF THE DENTAL MATERIALS USED WITHIN THE DENTINAL SEALING AND PULPAL PROTECTION STAGES

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Abstract: Sealing the dentinal surfaces and the pulpal protection have always been controversial topics among specialists. The conventional methods imply the dentin replacement up to the dentin-enamel junction using liners or/and bases while the modern approaches suggest the use of liners when the thickness of the juxta-pulpal wall is thinner than 2 mm. The purpose of this study is to statistically analyse the most frequently used means for dentin sealing and pulpal protection by a group of sixty dentists. The results indicated that most of the doctors admitted to use the classic guidelines in deep cavities by using neo-dentinogenetic liners and bases up to the dentin-enamel junction. Flowable composites were the first choice when choosing high mechanical resistance liners and flowable composites (with base use-indication) and glass ionomer cements were the first choices when coming to bases.

INTRODUCTION

The dentinal sealing along with the pulpal protection can be made using different dental materials. These steps of restorative protocols can be accomplished using conventional and modern methods.(1,2)

Briefly, the conventional method implies the use of liners/bases up to the enamel-dentin junction whereas the modern one assumes the necessity of high viscosity liners as long as juxta-pulpal dentin is thinner than 2 mm.(3,4)

The idea of the conventional methods came, in the past, from the main need for thermal isolation along with chemical sealing and bio-mechanical replacement of dentin in case metallic based restorative materials were used. So, liners and bases or just liners or bases are used, in different depth cavities, in order to accomplish proper chemical, thermic or mechanical protection.(1,5,6,7)

Nowadays, adherent restorative materials do not share the same need. The thermal protection is provided through their in born properties while the chemical sealing is easily achieved through the use of the adhesive systems. Within this approach, active liners (calcium hydroxide-based products) are used for their neo-dentinogenetic effect and passive high viscosity liners (mostly resin modified glass ionomers, flowable resins) are used for a proper seal of the dentinal surfaces and for the compensation of the polymerization contraction of the overlying polymer-based restorative materials.(1,8,9,10)

Even if this new approach has been promoted for some time now, there is, still, a large number of practitioners who follow the conventional ideas or combined versions of the two methods while using adherent restorative materials.

No matter of the chosen method, a protective layer, liner or base, may be used. Liners and bases have various capacities for dentinal sealing, physical and biological properties which allow them to be selected, alone or together, according to

the features of the clinical case.(1,10)

The liners are dental materials, with different characteristics, indicated to be applied in very thin layers (up to 1 mm). The thickness of the layer, along with other properties, drives them to be varnishes, dentin desensitizers, adhesion systems, suspension liners, cements or polymer-based materials. Considering the mechanical properties, the two latter ones are divided into two main fields.(11,12)

The first one includes products with poor mechanical properties but noteworthy biological effects. They are represented by the self-setting calcium hydroxide-based products. These materials have a good, well-known, neo-dentinogenetic effect, a high solubility and a poor capacity for dentinal sealing.(7,10)

The second field is the land of the high mechanical properties, being home of glass ionomer cements (GIC), flowable composites, flowable ormocers, calcium hydroxide modified cements, calcium silicate modified cements, flowable hybrids: glass ionomer resin modified cements (RMGI), compomers, giomers.(1,6,10,11,12,13)

Unlike the self-setting products, calcium hydroxide modified cements are light-setting, with a poorer neo-dentinogenetic effect, low solubility and a high capacity for dentinal sealing.

The bases are dental materials, with different features, indicated to be applied in layers with thickness greater than 1 mm. This is mainly due to their good mechanical properties. In case of overlying polymer-based restorations, bases may be represented by GIC, zinc phosphate cement, polycarboxylate cement, flowable composites, flowable ormocers, self-setting calcium silicate cements, flowable hybrids: RMGI, compomers, giomers.(6,10,12)

The neo-dentinogenetic materials are mainly represented by calcium hydroxide and the calcium silicate-based

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products. They may be used as liners or bases in deep cavities. Each category has self-setting and light-setting versions. The self-setting products have more powerful biological effect than the light-setting ones. Basically, the self-setting calcium silicate products have better mechanical properties than the self-setting calcium hydroxide products and similar (or even better) neo-dentinogenetic effect. That is why they can be applied in thicker layers.(1,6,10,14,15)

In conclusion, sealing the dentin and protecting the pulp may be achieved using different methods, the dentist shouldn't be keen to applying one certain method or another but to choosing the right solution according to the features of the clinical case.

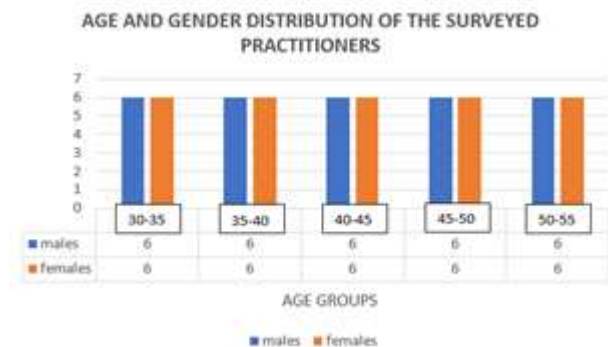
AIM

This study intends to statistically assess the materials and methods used within the dentinal sealing and pulpal protection stages by a group of dentists.

MATERIALS AND METHODS

60 dentists, with urban and rural practice, agreed to be involved in the study. The group, equally divided between females and males, had equal ratios among the age clusters. The distribution is indicated in the chart below.

Figure no. 1. Age and gender of the dentists in the study



The study was conducted over 6 months, each participant being asked to fill a multiple-choice questionnaire. The answers were gathered and statistical charts were made in order to discuss and draw conclusions.

The questionnaire included the following topics:

- Year of graduation ...
- Dentist ... / Specialist...
- Age ...
- Gender ...
- Business environment (urban / rural) ...

In case of applying polymer-based restorations, please choose one or more answers to the questions/statements below that fit(s) most of your practical habits:

1.The juxta-pulpal layer used in medium depth cavities is:

liner (adhesion system) high-viscosity liner base none depends on the features of the clinical situation

2. The juxtapulpal layer(s) used in deep cavities (dentin thickness < 2 mm) is/are:

high-viscosity liner liner (adhesion system) base depends on the features of the clinical situation

3.The juxtapulpal layer(s) used in deep cavities (dentin thickness > 2 mm) is/are:

high-viscosity liner liner (adhesion system) base depends on the features of the clinical situation

4.What dental materials do you use in a medium depth cavity for dentinal sealing/dentin replacement/compensation of

polymerization contraction of the overlaying polymer-based material?

RMGI GIC flowable composite flowable ormocer flowable giomer flowable compomer adhesion system others

5.What dental materials do you use in a deep cavity (dentin thickness>2mm) for dentinal sealing/dentin replacement/pulpal protection/compensation of polymerization contraction of the overlaying polymer-based material?

RMGI GIC flowable composite flowable ormocer flowable giomer flowable compomer adhesion system calcium hydroxide-based products calcium silicate-based products

6.What dental materials do you use in a deep cavity (dentin thickness<2mm) for dentinal sealing/dentin replacement/pulpal protection/compensation of polymerization contraction of the overlaying polymer-based material?

RMGI GIC flowable composite flowable ormocer flowable giomer flowable compomer adhesion system calcium hydroxide-based products calcium silicate-based products

7.What cavities do you usually use high-viscosity liners for?

medium depth cavities deep cavities

8.If using high-viscosity liners, what material are they usually made of?

RMGI GIC flowable composite flowable ormocer flowable giomer flowable compomer calcium hydroxide-based products

9. If using bases, what material are they usually made of ?

RMGI GIC flowable composite flowable ormocer flowable giomer flowable compomer calcium silicate-based products other cements

10. If using neodentinogenetic materials in deep cavities, the material(s) usually chosen is/are:

calcium hydroxide-based products calcium silicate-based products depends on the clinical case

11. If using calcium hydroxide-based materials as liners, the material(s) usually chosen is/are:

self-setting products light-setting products ?

12. If using calcium silicate-based materials, the material(s) usually chosen is/are:

self-setting products light-setting products ?

13. If using polymer-based liners, I apply them:

only on the proximity pulpal wall all the walls up/down to the DEJ

14. If using adhesion systems for bases or liners, the chosen generation is usually:

the 4th generation the 5th generation the 6th generation the 7th generation

15. If using adhesion systems for restorations, the chosen generation is usually: the 4th generation the 5th generation the 6th generation the 7th generation

16. If using GIC as liner/base, the commercial presentation is: powder/liquid capsules

17. If using RMGI as liner/base, the commercial presentation is: powder/liquid capsules monocomponent other

18. The most frequent indication(s) I use GIC for is/are: restorations liner/base luting preventive restorations none

19. The most frequent indication(s) I use RMGI for is/are: restorations liner/base luting preventive restorations

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none

20. In case of clinical situations which require long term indirect pulp capping, the method usually used is: step-wise selective removal it depends on the features of the clinical case I don't perform long term indirect capping I prefer endodontic therapy

21. In case of long-term indirect pulp capping, the temporary restorative material I usually use is:

GIC RMGI self-setting calcium silicate-based products others

22. What new dental materials developed for liner/base use have you bought in the last 2 years?

RMGI GIC flowable composite flowable ormocer flowable giomer flowable compomer adhesion system self-setting calcium hydroxide-based products light-setting calcium hydroxide-based products self-setting calcium silicate-based products light-setting calcium silicate-based products other cements others

23. Do you intend to buy a new product with liner/base use in the next period of time?

yes no

24. If you chose „yes” to the previous question, what category would that product belong to:

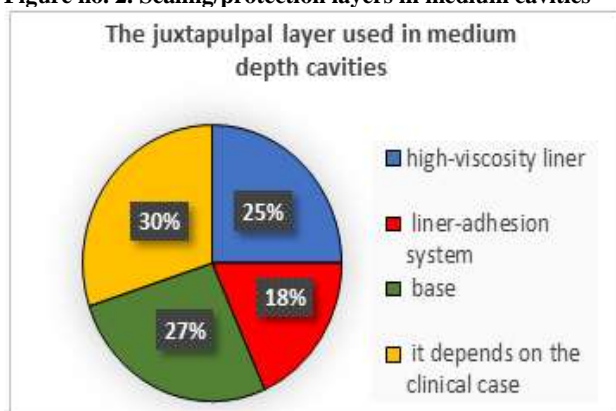
RMGI powder/liquid RMGI capsules RMGI other presentations GIC powder/liquid GIC capsules flowable composite flowable ormocer flowable giomer flowable compomer 6th/7th adhesion system 4th/5th adhesion system self-setting calcium hydroxide-based products self-setting calcium silicate-based products light-setting calcium hydroxide-based products light-setting calcium silicate-based products others

RESULTS

The answers to the multiple-choice questions were organized in several charts which were the starting line for further discussions and conclusions.

In medium depth cavities, the options included, mostly, liners with various viscosities (figure no. 2) while a high-viscosity liner and a base were the main choice for the juxta-pulpal layer in deep cavities with dentin thickness higher than 2 mm for three quarters of the surveyed persons. In this latter situation, 2 doctors chose adhesion systems as being the only sealing layer and 4 persons declared liners as the only means for dentinal sealing and pulp protection (figure no. 3).

Figure no. 2. Sealing/protection layers in medium cavities



The high viscosity liner/base duo was even more scored in the deep cavities with dentin thickness lower than 2 mm, only 6 practitioners admitting using only liners and 4 people considering the answer as depending on the features of the clinical case (figure no. 4).

Figure no. 3. Sealing/protection layers in deep cavities (I)

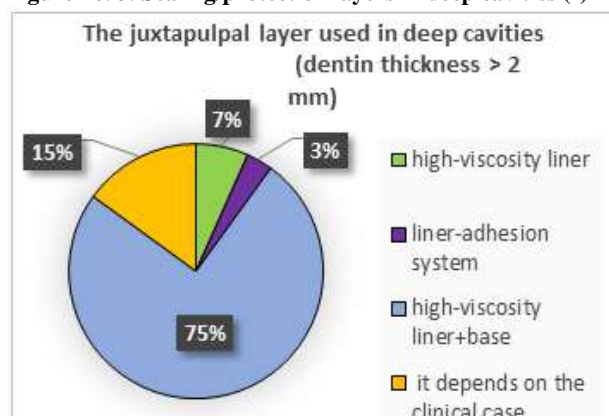
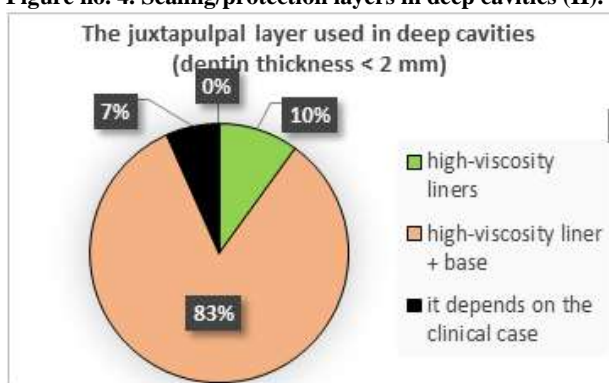
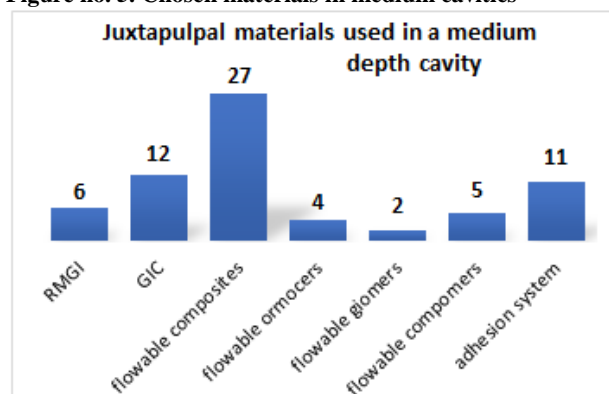


Figure no. 4. Sealing/protection layers in deep cavities (II).



40% from the questioned doctors indicated the flowable composites as being the first choice for sealing the dentin/replacing the dentin/compensating the contraction of polymerization in a medium depth cavity. They were followed, by far, by the glass ionomer cements and the adhesion systems. The RMGI, the flowable ormocers and the flowable compomers had similar and low scores, the last place being assumed by the flowable giomers.

Figure no. 5. Chosen materials in medium cavities



In deep cavities with dentin thickness higher than 2 mm, 97% of the dentists used calcium hydroxide products as neo-dentinogenetic materials along with flowable composite or GIC. Only two practitioners used adhesion systems as the only mean for dentinal sealing and pulp protection in these types of cavities (figure no. 6).

In case of juxta-pulpal layer thinner than 2 mm, all the participants declared the use of a neo-dentinogenetic layer accompanied by bases of mostly flowable composites and GIC (figure no. 7).

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Figure no. 6. Chosen materials in deep cavities (I)

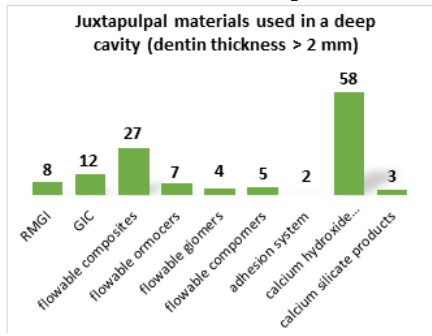
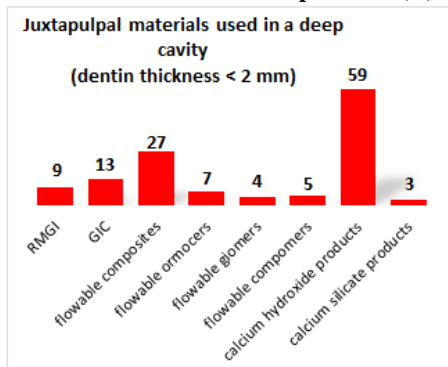
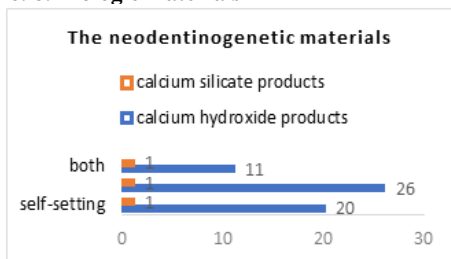


Figure no. 7. Chosen materials in deep cavities (II)



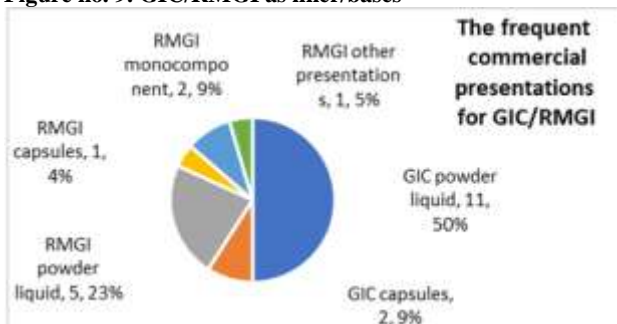
The most common choice was the light-setting versions of the calcium hydroxide products. 18% of the surveyed doctors, also, assumed the use of both, self-setting and light-setting, variants of calcium hydroxide-based products. Only 3 practitioners answered "yes" to using calcium silicate products (figure no. 8).

Figure no. 8. Biologic materials



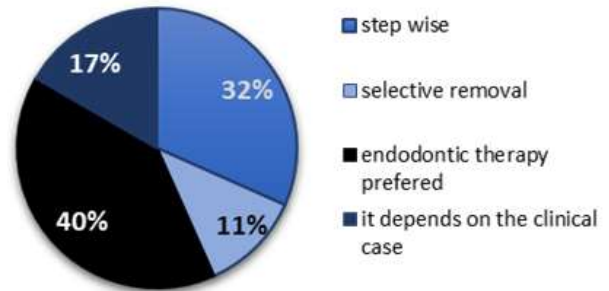
When it came to the most frequent use of GIC in their dental office, the doctors admitted that luting is the most common one followed by their use as a base. GIC were seldomly used as liners or even restorative materials. RMGI were also chosen by a limited number of practitioners. The most frequent commercial presentation of GIC and RMGI as liners/bases was the powder/liquid version (figure no. 9).

Figure no. 9. GIC/RMGI as liner/bases



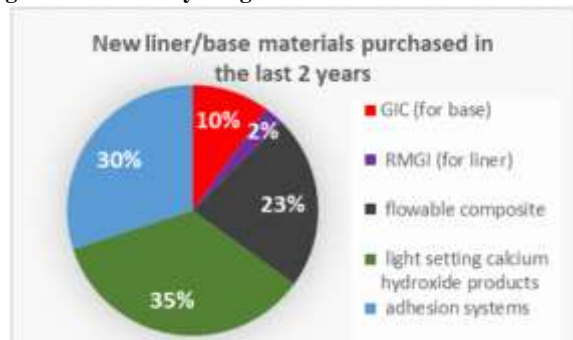
The questions about the long-term indirect capping attitude revealed 19 and 7 doctors who use step wise and selective removal technique, respectively, and a large number of practitioners who would rather make an endodontic treatment (figure no. 10).

Figure no. 10. Pulp-vitality preservation Long-term indirect capping attitude



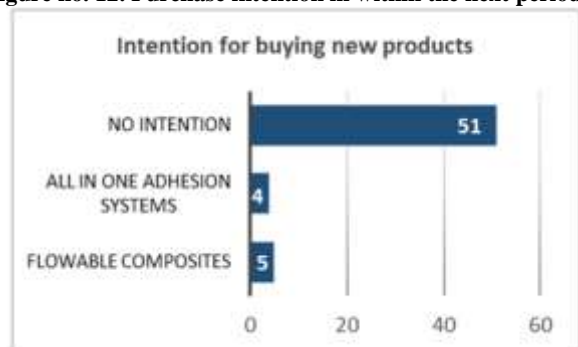
The quiz sheet also included questions about the newly purchased liner/base products. 14 doctors admitted to have bought calcium hydroxide-based products and 12 of them declared their interest for adhesion systems. A higher interest was also recorded for the flowable composites (figure no. 11).

Figure no. 11. Newly bought liners/bases



85% of the surveyed practitioners were not interested in buying new liner/base products in the next period of time, the intentions of the willing ones being split with close percentage between flowable composites and all-in-one adhesion systems (figure no. 12).

Figure no. 12. Purchase intention in within the next period



DISCUSSIONS

When questioned about the attitude towards the dentinal sealing and pulp protection in deep cavities with dentin thickness of the juxta-pulpal wall ≥ 2 mm, most of the doctors admitted to follow the guidelines of the classic protocols, by using liners and bases up to the DEJ. So, in this type of deep

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cavities, the general intention of the doctors is still the one of replacing the missing dentine with a material with close properties.(6,11)

A similar attitude was revealed when asked about the options for the dentinal sealing and pulp protection in deep cavities with dentin thickness of the juxta-pulpal wall < 2 mm. Only a few doctors said “yes” to the guidelines of the modern protocols, by using only high-viscosity liners (calcium hydroxide and RMGI products).(12)

No matter of the depth of the cavity, the flowable composites were among the first choices of many doctors, when concerning liners with high mechanical resistance or bases.

The most frequent neo-dentinogenetic materials were the calcium hydroxide products, while the calcium silicate products were used only by a very few specialists. Most of the doctors admitted to use the resin modified calcium hydroxide products despite their poorer neo-dentinogenetic effect when compared to the self-setting versions. This may be due to the facts that they are better sealers of the dentin surface and they have easier instructions for use.(14)

Even if all types of GIC have been on the market for so many years, the most common use in the dental offices involved in the study was luting the indirect restorations.

Unexpected results came also out from the attitude towards the long-term indirect capping methods, 24 dentists admitting to prefer endodontic rather than the preservation of the pulpal vitality.(15)

The newly purchased liner/base products included classic materials such as calcium hydroxide liners, a high interest being also recorded for the flowable composites and adhesion systems.

The interest in buying new products was at a very low level, only 15% of the doctors intending to buy new flowable composites and all-in-one adhesion systems in within the next period of time.(12)

CONCLUSIONS

The results show combined and controversial attitudes among the specialists.

Even if most of the doctors admitted to use the classic guidelines in deep cavities by using neo-dentinogenetic liners and bases up to the DEJ, the flowable composites indicated for bases were more frequently chosen than GIC. Flowable composites were also the first choice when choosing high mechanical resistance liners in all depth cavities.

The ormocers, giomers, even RMGI were used as liners/bases only by a few practitioners.

The resin modified calcium hydroxide-based materials were the most selected neo-dentinogenetic products in deep cavities.

The reasons why most of the doctors agree to the classic principles in deep cavities are maybe due to the doubts versus the existence of unwanted side-effects of the adhesion systems and the old belief presented in the introduction of the study of replacing dentin and enamel with specific dental materials whose properties are similar to those of the removed dental tissues.

On the other hand, the lack of interest for other materials than flowable composites and GIC, is possibly due to the absence of knowledge about these products, even if they have been developed for quite some time now.

The best attitude for dentinal sealing and pulpal protection remains the one adapted to the features of the clinical case. The combined options between old and new beliefs are not supposed to be in the way of the progress in any case but they represent a smart choice for the benefit of the clinical case.

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The authors 1, 4, 6 have equally contributed to the work.

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