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REVIEWS

MICROLEAKAGE OF TEMPORARY FILLING MATERIALS USED IN ENDODONTICS

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ABSTRACT

INTRODUCTION: Pulpal and periodontal diseases often require multi-visit endodontic treatment, which necessitates the sealing of cavities with temporary filling materials. The main problem is the possible microleakage and further failure of the treatment.

AIM: The aim of this research is to provide an overview of the problem with microleakage of temporary filling materials.

MATERIALS AND METHODS: Studies and articles published by foreign and Bulgarian authors are reviewed in order to present the different types of temporary filling materials, the mechanism of microleakage, different methods of its detection, and the extent of microleakage by different types of temporary filling materials.

RESULTS: Different types of temporary filling materials show different levels of microleakage.

CONCLUSION: Microleakage can cause failure of the endodontic treatment. That is why, between the visits, an adequate temporary seal is needed.

Keywords: *microleakage, temporary filling materials*

INTRODUCTION

Coronal microleakage increases the risk of failure of the endodontic treatment. In case of multi-visit therapy an adequate temporary sealing is needed (1). It will avoid the infection and reinfection of the endodontic space and the leakage of intracanal dressing (2).

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AIM

The aim of this study is to investigate the effectiveness of temporary filling materials in avoiding microleakage between the visits.

MATERIALS AND METHODS

In order to evaluate the various temporary filling materials and look into the mechanism of microleakage, studies and articles published by foreign and Bulgarian authors are reviewed. This helps us to answer the question of how to prevent bacterial infection in the root canal system until the definitive obturation is placed.

RESULTS

Temporary Filling Materials

Temporary fillings are materials that are placed for a shorter time (up to a few days) (3). According

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to the time of stay, they can be divided into three groups:

- materials for temporary obturation with a short stay (placed for 1–2 weeks);
- materials for temporary obturation with an average stay (placed for several weeks);
- materials for temporary obturation with a long stay (placed for a stay of up to 6 months) (4).

According to composition:

- materials based on sulfate: conventional and enriched with plastic;
- materials based on eugenol: conventional and reinforced;
- zinc phosphate cement;
- zinc polycarboxylate cement;
- materials based on polyacrylic acid;
- materials based on gutta-percha;
- glass ionomer cements (GIC);
- materials based on resin (5).

Microleakage

The clinically undetectable transfer of bacteria, liquids, chemicals, or ions between the tooth and the filling or restorative material is defined as microleakage. According to the scientists there is no perfect material which can fully seal the cavity and prevent the penetration of the above-mentioned units. Therefore, even if clinically unrecognizable, microleakage is a major cause of infection persistence and endodontic treatment failure. There are different types of microleakage:

- Leakage at micron level (bacterial leakage): Gaps between the restoration and the tooth allow bacteria to enter the cavity and the endodontic space. This is defined as bacterial microleakage and can be observed at the micron level.
- Leakage at submicron level (nanoleakage): Leakage at the nano level is induced by the penetration of molecules or ions through the endodontic root canal filling materials or restorations with gaps (6).

Several methods can be used to identify microleakage:

- dye penetration;
- fluid filtration;
- dye extraction or dissolution method;
- bacteria and toxin infiltration method;
- air pressure method;
- electrochemical method;
- neuron activation method;
- radioisotope method;
- metal solution tracers;
- reverse diffusion method;
- artificial caries;
- three-dimensional method (7,8).

Deepak S et al. (2017) placed the experimental teeth in normal saline for 2 hours and then immersed them in methylene blue dye for 1 week. Then, they separated longitudinally the teeth with a diamond disc and measured dye penetration with a periodontal probe (9).

Peralta SL et al. (2017) investigated microleakage by subjecting teeth to thermal cycling that included 500 cycles for 30 s at temperatures between 5° and 55°C. The apical foramina were sealed using epoxy resin. The teeth were varnished with two layers of nail varnish, reaching within 2 mm of the temporary obturation. The teeth were immersed in a methylene blue solution for 10 minutes, after which they were cut longitudinally. Using a 40x magnification, the penetration depth of methylene blue was measured (10).

Jambagi SR and co-workers (2023) subjected the samples to a water bath for 500 cycles at temperatures between 5° and 55°C, and duration of 25 s. The second step was cyclic loading for 10,000 cycles for another 25 s. Then, they varnished the surfaces with three layers of nail varnish at 1 mm from the area of obturation, immersed the samples in a 2% rhodamine B dye solution for a period of 24 h, and rinsed them with saline (11).

Levels of microleakage, leading to endodontic treatment failure:

- Apical leakage—it can be influenced by a variety of factors, including filling techniques, root canal filling material qualities, and the presence or absence of a smear layer.
- Coronal leakage—it can cause recontamination of the root canal through poor crown sealing,

insufficient endodontic permanent restoration, or loss of the temporary filling (6).

Temporary Fillings and Microleakage

The materials for temporary fillings receive less attention than the permanent filling materials although they take a major part in disinfection and prevention of contamination and reinfection of the root canals (12).

A major factor in pulp and periodontal illnesses is the loss of integrity of the coronal tooth components and the entry of bacteria into the dentin and pulp region. Insufficient coronary sealing permits biological contamination and the infiltration of nutrients, pollutants, waste products from microbes, and saliva. Since apical microleakage might lead to recontamination, coronal microleakage also seems to play a significant role in endodontic failure (13–17).

The hermetically sealing of the access cavity between the visits is a major factor for the good outcome of the endodontic treatment. The important role of the bacteria-tight temporary filling has been shown in different studies (18).

In case of apical periodontitis with infected root canals, dressing with antiseptic medicaments between the appointments is required in order to decrease pain and a number of microorganisms, and to promote the healing process of the periapical tissues. This leads to the need of adequate temporalization for different periods of time (19,20).

Temporary filling materials are considered effective when they possess certain qualities, such as effective sealing of the cavity, thickness, resistance to temperature changes, abrasion and pressure, easy insertion and removal, compatibility with intracanal medications, and acceptable esthetic qualities (21,22,23).

Different studies on the microleakage of temporary filling materials, used in endodontics have been done. They use dye penetration, combined with thermocycling and load cycling (24). Swanson and Madison investigated the ability of saliva to penetrate coronally unobturated teeth undergoing endodontic treatment. The specimens were filled with gutta-percha and various sealers, then placed in artificial saliva for a week and then in dye to demonstrate the microleakage. Specimens were decalcified and cleaned. Linear measurements were done from the enamel-cementum interface to the point of maximum dye leaching. The positive control group was obturated only with gutta-percha, while the negative group had a temporary obturation. The results showed complete dye penetration in the positive control group. No penetration was observed in the negative control group. Specimens filled with gutta-percha and different sealers showed varying degrees of dye penetration .

Clinical cases such as that of Vail and Cuba demonstrate the role of temporary restorations in eliminating bacterial invasion, allowing a healing process even without complete endodontic treatment. These authors report a case of a patient who underwent emergency endodontic treatment but subsequently did not return for treatment completion over the next two and a half years. However, the temporary obturation was intact and radiographically healing processes were found in the periapex of the tooth (25).

Microleakage is observed around temporary obturations of various materials: calcium sulfate-based, eugenol-based and polyacrylic acid-based. The micropenetration depth is between 1.1 and 1.6 mm. Therefore, it is considered that the preparation will be protected from the harmful effects of microleakage if the temporary obturation is more than 4 mm thick. For some parts of the preparation, such as the proximal parts of second class cavities, this condition is more easily achieved. For other parts of the cavity, such as the occlusal, this condition is much more difficult to achieve. The problem can be solved as follows:

- The time until the next visit should be reduced as much as possible.
- When there is a need for a more permanent temporary obturation, materials for permanent obturation should be used—GIC or composite material.

DISCUSSION

After the analysis of the literature, we can acknowledge the need of adequate sealing of the endodontic cavity during root canal treatment. Temporary filling materials show different levels of microleakage and we cannot point out the best one on the market. That is why a choice should be made according to each specific case.

CONCLUSION

One major contributing element to the endodontic treatment's failure is microleakage. Therefore, it is extremely important to prevent this at every stage of root canal treatment by adequately sealing the tooth with temporary fillings.

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