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CORONAL MICROLEAKAGE OF THREE RESTORATIVE MATERIALS AFTER PULPOTOMY WITH MTA - AN IN VITRO STUDY

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Abstract

Pulpotomy is one of the most common procedure, which is applied to children, especially in immature permanent teeth.

Purpose: The aim of this study was to asses the coronal microleakage of three restorative materials after pulptomy with MTA (mineral trioxide aggregate): IRM (intermediate restorative material) - group A; glassionomer aqua-ionobond - group B and composite resin- group C.

Methods: Fifteen extracted teeth for periodontal reasons that had been stored in formalin 10% are divided randomly in three groups and after pulpotomy with MTA are filled with above materials according respective groups. The specimens were placed in normal saline and stored in an incubator at 37°C for 24 hours to ensure setting of the materials. The teeth were then thermocycled for 150 cycles, dried and sealed with nail varnish, leaving 1 mm around the restorations and immersed in 0.5% methylene blue dye for one week. They were then rinsed, dried and sectioned longitudinal, and microleakage was evaluated using a stereomicroscope (10×).

Results: According to results, the microleakage was 79,9% for group A, 29,3% group B and 11,2% group C. The microleakage was present in every group, (more frequent in group A) with a statistical difference between groups (p=0.001).

Conclusions: The temporary material was the most compromising, leading to failure of treatment. For this reason, the permanent restoration may apply immediately since MTA does not necessarily require a moist cotton pellet for setting.

Key words: Coronal microleakage, glassionomer cement, MTA, pulpotomy, thermocycle.

Introduction

Finn (1995) defined pulpotomy as the complete removal of the coronal portion of the dental pulp, followed by placement of a suitable dressing or medicament that will promote healing and preserve vitality of the tooth. One of the most important and difficult aspect in this therapy is definition of pulp status or phase of its inflammation (1). After definition of the diagnosis and the amount of pulp to be removed, than the results are related with quality of the restoration.

Recently are some materials that's find use in pulpotomy for permanent teeth. One of them is MTA (mineral trioxide aggregate), who is using rarely in our clinics in Albania because of its cost.

When the material is hydrated it becomes a colloidal gel that solidifies in approximately 3 hours (2) and recommended for use in vital pulp therapy (3, 4, 5, 6, 7). Arens and Torabinejad (8) have recommended covering MTA with a wet cotton pellet and a layer of IRM (intermediate restorative material) to get a better setting of the material. So, the permanent restoration delayed in the next visit.

Recontamination of the tooth can occur between appointments in some clinical circumstances such as leakage, loss of the temporary filling or fracture and massive restoration. In these situations, the pulp is exposed to the oral cavity, which allows its recontamination by fluids, organic material or microorganisms.

A review of the endodontic literature has indicated there is no general consensus if the application of a moist

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cotton pellet should be used to enhance the setting ability of MTA in various endodontic procedures. Because of its hydrophilic characteristic, moisture in the surrounding tissue acts as an activator of the chemical reaction in this material (9).

Since MTA may be setting without moist cotton pellet and recontamination of the tooth is continuous risk when the permanent restoration is delayed, than we undertook this study through which we have compare three most common materials for restoration in our clinics after pulpotomy with MTA.

Methods and materials

Fifteen extracted human intact permanent molars and premolars had been stored in 10% formaline solution for 10 days. The access cavity was made using a high speed air turbine under water coolant with a round bur. All teeth were irrigated using 2.5% sodium hypochlorite (OGNA, Laboratori Farmaceutici, Italy) for one minute. The teeth were divided randomly into three groups of five teeth each. All materials were mixed and handled according to the manufactures instructions. Specimens were filled as follows:

Group A: Pulpotomy with MTA, moist cotton pellet and IRM.

Group B: Pulpotomy with MTA, glass ionomer cement (aqua ionobond).

Group C: Pulpotomy with MTA, glassionomer cement liner (aqua ionobond) and resin composite.

We have done pulpotomy with MTA to evaluate if blue dye solution penetrates the layer of MTA, since the MTA considered as one of the best materials selected for vital pulp treatment in immature permanent teeth.

The teeth were placed in normal saline and stored in an incubator (GallenKamp, London, UK) at a temperature of 37°C for 24 hours to ensure setting of the materials.

The restorations were thermally stressed for 150 cycles of 1 minute each by placing them alternately in water baths at 5°C ± 3°C and 55°C ± 2°C.

Than the specimens were dried and painted with three layers of nail varnish except 1mm around the restoration margin to prepare them for leakage assessment. All specimens were placed in 0.5% methylene blue dye solutions (pH=7.0) for 7 days (this is the usual period of subsequent dental visit, by reason of great number of patients in Clinic of Albanian University) at 37°C in the incubator.

The above procedure was done in Morphopathological diagnostic laboratory, Halili Complex.

They were than washed under running water, dried and longitudinally sectioned in a bucolingual direction using a high speed diamond fissure bur under water coolant (Clinic of Albanian University).

Dye penetration were measured in millimeters, using calibrated stereomicroscope (XTL6445) at x10 magnification (Faculty of Natyral Sciences, Tirana University). The photos were done with soft ware TS View Version 1.0.0.1. (Figure nr.1). Data was analyzed using chi-square test ($p \leq 5\%$) to determine if a statistically significant difference existed between the groups.

Results

All samples were screened under the stereomicroscope. Amongst three tested material, Tetric (bonded composite) showed the last microleakage, followed by glass ionomer and IRM.

The maximum linear dye penetration was measured for each specimen, from the cavosurface angle, on the temporary restorative material - dental enamel joint; the cavity axial wall length corresponding to the maximum linear dye penetration was also measured for each specimen, from the cavosurface angle, on the temporary restorative material - dental enamel joint to the pulp chamber floor, by using calibrated stereomicroscope (XTL6445) at x10 magnification. Finally, the proportion, in percentage, between the dye penetration measure and the correspondent cavity axial wall length was calculated, establishing the infiltration wall percentage in each specimen. The mean percentage of each group was calculated (see Table nr.1).

The results showed there were statistically significant

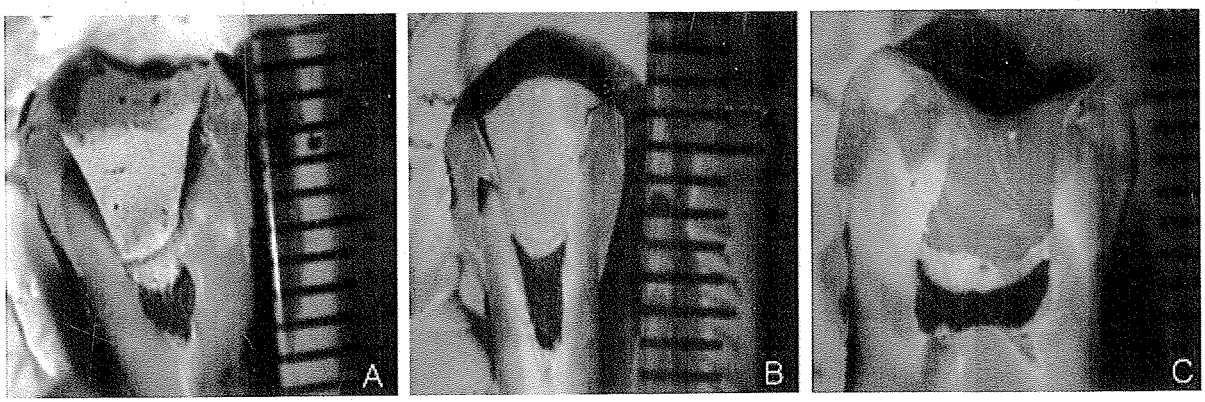

Figure nr.1. Images in stereoscope of one sample from each group

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differences between tested materials (p=0.001).
Microleakage was present in each group (more in the first group) with statistically differences between groups. So, the microleakage was 79.9% for IRM, 29.3% for glass ionomer cement and 11.2% for composite resine.

Table nr.1 The mean microleakage values, in percentage for each group

Group A		
Teeth	**Depth of cavity (mm)**	**Microleakage (mm)**
a,1	7,89	5,53
a,2	7,39	6,25
a,3	5,96	4,88
a,4	8,42	6,85
a,5	9	7,39
Average	7,732	6,18
Percentage	6,18/7,732 x 100 = 79,9%	
Group B		
b,1	6,67	2,14
b,2	9,21	1,67
b,3	8,07	3,84
b,4	6,96	1,28
b,5	5,82	1,85
Average	7,346	2,156
Percentage	2,156/7,346 x 100 = **29,3%**	
Group C		
c,1	8,53	1,71
c,2	9,82	0,32
c,3	8,84	1,11
c,4	7,21	1,21
c,5	7,85	0,42
Average	8,45	0,954
Percentage	0,954/8,45 x 100 = **11,2%**	

Discussion

Usually prognosis after any type of pulp therapy improves in the absence of contamination by pathogenic microorganisms. Thus biocompatible neutralization of any existing pulpal contamination and prevention of future contamination (e.g., microleakage) are worthy goals in vital pulp therapy (10).
In this study we have used sodium hypochlorite 2.5% for irrigation and pulpotomy was done with MTA. According to manufactures instruction, MTA needs a moist cotton pellet for initial setting, so, permanent restoration delayed in next visit. But when the teeth presented with a destroyed crown, one of the determining factors of success during pulpotomy in immature permanent teeth, is correct and immediate restoration of the tooth.
Microbial microleakage may occur after loss of restoration or dental fracture (11,12,13). IRM is very susceptible to infiltration during thermal stress. In this study, the effect of thermal stress on groups A and C was found to be statistically significant.
In this study IRM did not keep teeth from leakage for a week, so postponement of permanent restoration could compromise the results of pulp treatment. Cotton pellets decrease the space available for temporization and therefore may play a role in promoting microleakage (14). MTA without a moist cotton pellet placed over the material set faster but application of a moist cotton pellet on MTA affects setting time and the hardness of the cement (15).
Usually permanent restoration after pulpotomy with MTA recommended after 3-4 hours or within 2-3 days, whereas in our study the teeth remained in the methylene blue dye for seven days because of great number of patient in Albanian University Clinic. According to this study the teeth filled with resin composite and glass ionomer cement have less microleakage than the first group. Although some study (16,17,18,19) indicate that cavities filled with resin modified glass ionomer had significantly less leakage than similar cavities filled with conventional glass ionomer cements, our study showed that filling with this cement and postponement of final visit doesn't compromise the result of treatment.
In vital pulp therapy an ideal material must resist bacterial microleakage and must stimulate remaining pulp tissue return to healthy condition by promoting the formation of dentin. In such a circumstance, the temporary restorative material provides no protection against bacterial infection (20). Methylene blue dye had reached cotton pellet in the first group, but had not penetrated the layer of MTA. This is due to the material of MTA, which after first setting does not allow penetration of dye. The latter must be tested.
This study highlights the clinical facts, which provide an ideal restoration and the success of pulp therapy. The results of this study suggest that a permanent restoration should be done as soon as possible after pulpotomy with MTA, especially when the tooth presented with destruction of the crown.

Conclusion

TThe temporary material was the most compromising, leading to failure of treatment. For this reason, the permanent restoration should be applied immediately since MTA does not nesessarely require a moist cotton

pellet for setting. If we have to left the next dental visit for a week, than it is better to use glass ionomer cement or to increase the thickness of the MTA liner, but if the patient presented with destruction of the tooth crown, we have to store the result of treatment, by permanent restoration at one appointment.

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