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IN-VITRO COMPARISON OF MICROLEAKAGE BETWEEN MTA AND BIODENTINE™ AS MATERIAL FOR OF ACCESS PERFORATION TREATMENT

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ABSTRACT

Aim: To analyze the differences between microleakage of MTA and Biodentine™ when used for treating access perforation. **Material and method**: The present study was done in the Department of Dentistry. A total of 30 freshly extracted mandibular premolars were collected and used in the study. The samples were randomly separated into two treatment groups of 15 teeth each. One group was treated with MTA while the other group was treated with Biodentine™. The materials for both the groups were manipulated according the manufacturer's instructions and inserted into the perforation from the pulp chamber direction until it was full and dense. Each sample was checked for closure density using a digital radiographic photograph. The leakage score was rated with a value of 0 for no penetration, a value of 1 for penetration less than 0.5 mm, a value of 2 for penetration from 0.5 mm to 1 mm, and a value of 3 for penetration of more than 1 mm. Data was analysed using SPSS version 22. **Results**: Leakage was absent in 20% and 33.33% of the samples in MTA and Biodentine™ groups respectively. Leakage score 3 was found in 33.33% and 26.67% of the samples in MTA and Biodentine™ groups respectively with statistically insignificant difference. **Conclusion**: The results of the present study concluded that no statistically significant difference in microleakage was found when comparing the use of Biodentine™ and MTA as materials for treatment of access perforation.

KEYWORDS: Access perforation, MTA, Biodentine.

INTRODUCTION

The goal of a root canal procedure is to maintain function of the tooth without showing pathological symptoms. Perforation is a mistake that can cause widespread negative impact on endodontic treatment. It occurs while accessing the pulp chamber and involves the periodontal tissue.[1] Contact between this tissue and microorganisms lead to decreased healing capabilities of the tissue which supports the tooth, resulting in damage to the tooth and the surrounding bone. Therefore, perforation must be closed immediately in order to minimize any contamination which could occur during or after the treatment.[2]

MTA has shown good results regarding microleakage in comparison to amalgam, resin-modified GIC, and zinc oxide-eugenol. However, the time required for MTA to set is four hours, which is considered to be too long, since it may allow the entry of liquid or microorganisms into the treatment space, thus interfering with the prognosis; and the manual manipulation of the material can lead to differences in treatment results.[3]

Tricalcium silicate base (3CaO.SiO2) has been developed and is marketed under the trade name Biodentine™. It is similar to MTA in nature and basic materials; however, compared with MTA, Biodentine™ has a faster setting time of 12 minutes and it is manipulated mechanically using a machine that can minimize operator error.[4] As scare literature is available on the same, hence this study aims to analyze the differences between microleakage of MTA and Biodentine™ when used for treating access perforation.

MATERIALS AND METHOD

The present study was done in the Department of Dentistry. A total of 30 freshly extracted mandibular premolars were collected and used in the study. The samples were randomly separated into two treatment groups of 15 teeth each. One group was treated with MTA while the other group was treated with Biodentine™. The materials used were: ProRoot® MTA, Biodentine™, glass ionomer cements (GIC), nail polish, and methylene blue 1% solution. The tools used were: plastic instruments, a glass plate, a cutter disc, an amalgamator, a #14 round diamond bur, and a stereo microscope. Teeth were cleaned with a scaler, then immersed in NaCl solution until the preparation and perforation closure were performed. Access to the pulp chamber of the tooth samples was done with a #14 round diamond bur; then the access was formed and outlined with a cylindrical bur. A simulation of a perforation to the pulp chamber was created 1 mm below the cervical line with the diamond bur.

For the MTA group, the MTA was manipulated according the manufacturer's instructions and inserted into the perforation from the pulp chamber direction until it was full and dense. The excess material that came out in the buccal section was flattened with a plastic instrument up to the surface of the tooth. For the Biodentine™ group, the Biodentine™ was manipulated according the manufacturer's instructions and inserted into the perforation from the pulp chamber direction until it was full and dense. The excess material that came out in the buccal section was flattened with a plastic instrument up to the surface of the tooth. Finally, in both groups, the pulp chamber access in the occlusal section of the tooth was closed using GIC.

Each sample was checked for closure density using a digital radiographic photograph. Then the samples were stored for 24 hours in humid conditions using a sponge placed in a plastic container. The samples were then dried with air spray and all tooth surfaces were covered with nail polish, leaving 1 mm in the area around the restoration on the buccal section. Next, the samples were immersed in methylene blue 1%solution for 24 hours, then rinsed under running water for 10 minutes and drained. The samples were split in a buccolingual direction using the disc under cooling water. Next, a stereo microscope was used to observe the teeth. The leakage score was rated with a value of 0 for no penetration, a value of 1 for penetration less than 0.5 mm, a value of 2 for penetration from 0.5 mm to 1 mm, and a value of 3 for penetration of more than 1 mm.

Statistical analysis

Data was collected regarding the permeation of dye along the perforation closure, and the depth of permeation was measured using ZEN 2011software. Two statistical tests were used to analyze the dye penetration. Chi-square analysis was used to test the statistical significance of differences in the two groups, with a significance limit $p<0.05$.

RESULTS

Table 1 shows the comparison of microleakage scores between the MTA and Biodentine™ groups. Leakage was absent in 20% and 33.33% of the samples in MTA and Biodentine™ groups respectively. Leakage score 3 was found in 33.33% and 26.67% of the samples in MTA and Biodentine™ groups respectively. When microleakage score was compared statistically among the MTA and Biodentine™ groups, it was found to be statistically insignificant.

Table 1: Comparison of microleakage scores in the MTA and Biodentine™ groups.

Micro-leakage score	MTA		Biodentine™		Chi square	p value
	N	%	N	%		
0	3	20	5	33.33	1.31	0.52
1	5	33.33	4	26.67		
2	2	13.33	2	13.33		
3	5	33.33	4	26.67		
Total	15	100	15	100		

DISCUSSION

In the present study, testing for microleakage was done by a methylene blue 1% solution penetration method, using an immersion time of 24 hours. Methylene blue 1% solution was used in this study because its molecule size is very small, even smaller than bacteria[5]; thus, methylene blue 1% solution can penetrate farther than other dyes because of its small molecular size (0.5-0.7 nm). Simulation of a lateral perforation was performed using a round #14 diamond bur on the buccal section, placed at 1 mm below the cervical line. This was done because, according to research by Tsesis (2010)[6], lateral perforation is the second most perforated region after the bifurcation. The perforation closure materials were placed through the access to the pulp chamber using a plastic instrument; the material was inserted little by little until a solid filling of the perforation area was achieved. Radiography was used to see whether the closure perforation was complete, or a gap remained between the restoration material and the perforated wall of the tooth.

Biodentine™ material bonds well with the tooth structure. Only 33.33% of the Biodentine™ group received a leakage score of 0. This could have been caused by several factors. One possibility is that the humidity of the tooth samples was reduced so that the reaction between the Biodentine™ and the dentin walls was influenced by a fluid level in the dentinal that was not optimal. Another possibility is that, because the perforated simulation was parallel to the direction of the dentin tubules, the crystals of calcium carbonate which were expected to enter into the dentin tubules and form micromechanical tags did not do so, as they might have done if the perforation had intersected the direction of the dentin tubules. A third possibility is that placement of the closure material was difficult, and therefore placement was not perfect and solid, thus failing to close the perforated pathway.[7]

The MTA material also has good sealing ability and edge adaptation. Due to the nature of the material, MTA experiences expansion during setting, which supports its adaptation to dentin. A study by Reyes-Carmona reported the presence of interfacial layers that were formed by

biomineralization between MTA and dentin.[8] However, only 20% of the MTA group had a leakage score of 0. The possible causes for this are identical to the ones influencing leakage scores in the Biodentine™ sample: reduced humidity of the tooth samples so that the chemical reaction between the MTA and dentin walls was not optimal; parallel placement of the simulated perforation so that the calcium crystals did not form tag-like structures in the dentin tubules; and/or imperfect placement of closure material so that the perforated pathway was not closed. It should also be noted that both groups of samples were kept in humid conditions, as it was suggested by Reyes-Carmona[8] that the tricalcium silicate-based material would harden well under humid conditions.

At least a portion of the samples received a leakage score of 0, which indicates they were in accordance with the conditions that allowed the bioactive character of both cements to be utilized by the fluid contained in dentin tubules, initiating the hardening process and resulting in the formation of hydroxyapatite-like precipitate.[11] The extracted teeth may not have had natural fluid on their dentin tubules, so that calcium hydroxide resulting from the reaction of the calcium silicate of the hydrated restorative material did not react to create the hydroxyapatite-like precipitate to bind with the dentin structures. From the perspective of statistical analysis, the MTA and Biodentine™ showed no significant difference in terms of microleakage, but descriptively the leakage scores distribution obtained by the Biodentine™ sample group was better than for the MTA group in the scores of 0 and 3. This was probably caused by the setting time of Biodentine™, which was faster, so that the expansion due to the setting reaction also occurred more quickly, making the closure tight and providing a good adaptation to the dentine in the area of the perforation. Another possibility is that, because the manipulation process of Biodentine™ was done by machine rather than manually, the powder and liquid could be mixed perfectly and the consistency of the material produced more closely met the parameters recommended by the maker.

CONCLUSION

The results of the present study concluded that no statistically significant difference in microleakage was found when comparing the use of Biodentine™ and MTA as materials for treatment of access perforation.

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