

Original Article

Effect of calcium hydroxide premedication on the marginal adaptation of calcium-enriched mixture cement apical plug

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ABSTRACT

Background: This study was to evaluate the effects of calcium hydroxide premedication on the marginal adaptation of the calcium-enriched mixture (CEM) cement as an apical plug.

Materials and Methods: In this *in vitro* study, forty single rooted teeth were prepared and apical portion of the roots were immersed in sulfuric acid to produce open apices. The teeth were divided into 2 experimental groups. In medicated group, calcium hydroxide was placed in all canals for 1 week and in non-medicated group no dressing was used. Then, a 4-mm apical plug of CEM cement was placed in canals; each root was prepared for observation using scanning electron microscope and the maximum distance between CEM cement and surrounding dentin was measured. The data were analyzed by *t*-test, and significance level was set at $\alpha = 0.05$.

Results: The mean width of gap in medicated and non-medicated groups was 158/1 μm and 147/1 μm , respectively. There was no significant difference between the two groups ($P > 0.05$).

Conclusion: Calcium hydroxide premedication had no adverse effect on the marginal adaptation of CEM cement apical plug.

Key Words: Apical plug, calcium-enriched mixture cement, calcium hydroxide, marginal adaptation, scanning electron microscopy

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INTRODUCTION

Root canal therapy of immature teeth poses a special challenge for the clinician. Due to absence of apical constriction or apical stop, it is difficult to limit the obturation process within the root canal space.

Apexification (a method including long term application of calcium hydroxide to induce apical closure),^[1] has several disadvantages. This treatment requires multiple appointments during an extended period. Susceptibility to fracture, coronal microleakage

and aesthetic concerns during this extended treatment period are additional negative points.^[2]

Placement of artificial apical barriers has been considered as an alternative to traditional calcium hydroxide apexification.^[3,4] The material has been widely employed as artificial apical barrier is mineral trioxide aggregate (MTA).^[5] MTA can be placed in one visit,^[6,7] and induce hard tissue formation.^[8-10] It is biocompatible,^[11-14] and has good sealing and antimicrobial properties.^[14-16] Although, MTA has poor handling characteristics^[17] and a long setting time.^[18]

Calcium-enriched mixture (CEM) cement has been developed with clinical applications similar to those of MTA. MTA and CEM cement showed similar favorable biologic responses in repair of furcal perforation,^[19] pulp cap^[20] and pulpotomy treatment.^[21] CEM cement has appropriate handling characteristics^[22] and exhibited similar sealing properties to MTA when used as root-end filling

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material.^[23] Asgary, *et al.* compared the response of periradicular tissues to MTA and CEM cement as root-end fillings and concluded that CEM cement and MTA were associated with regenerative periapical tissue response when used as root-end filling biomaterials.^[24]

Usually, one or two visits of calcium hydroxide therapy are performed before application of apical barrier, in order to disinfect the root canal system of teeth with nonvital pulps.^[5] However, complete removal of calcium hydroxide from the dentinal walls is reportedly impossible.^[25,26]

The purpose of this study was to evaluate the effects of residual calcium hydroxide on the marginal adaptation of the CEM apical barrier.

MATERIALS AND METHODS

Forty extracted human single-root teeth were selected for this *in vitro* study. The teeth were clinically examined to be free of caries, cracks, restoration, and calcification. The teeth were placed in 5.25% sodium hypochlorite (NaOCl) for 5 h. Thereafter, they were rinsed and stored in saline solution. Clinical crowns were removed from the cement-enamel junction with a high-speed diamond bur (D and Z Germany) under excess water to create a standardized root length of 14 mm.

The root canals were instrumented using K-files (Dentsply Maillefer, Tulsa, USA) up to master apical file #45 and gates-glidden drills #1–4 (Dentsply, Maillefer, Tulsa, OK) in a step back manner. Then the access opening was sealed with coltozol (Coltene, Altstätten, Switzerland) and sulfuric acid was used to produce apical resorption. Briefly, the roots were drowned in melted rose wax (Cavex Holland, Netherlands) up to 3 mm from the anatomic apex. The waxed teeth were immersed in 20% sulfuric acid for 4 days. After that, the teeth were rinsed with a saline solution, the wax was removed with a scalpel (Supa, Tehran, Iran), and temporary filling was removed from the access opening.^[27]

The teeth were randomly divided into two experimental groups ($n = 20$). In medicated group ($n = 20$), calcium hydroxide (pure calcium hydroxide mixed with distilled water) (cina bartar, Tehran, Iran) was placed in root canals using a lentulo spiral (Moyco Union Brach, York, PA) and a radiograph was taken to ensure complete coverage of the canal. After 1 week, the medicament

was removed using 0.5% NaOCl irrigation and stainless steel hand files (Dentsply, Maillefer, Tulsa, USA). In non-medicated group ($n = 20$), no medication was placed into the canals. Small sponges were placed at the external portion of root apices. After that, the roots were placed in the putty molding blocks. The CEM cement was mixed according to the manufacturer's instructions and using MTA carrier, CEM cement was placed in the root canals. A hand condenser was used to condense the material. This process was continued until 4 mm apical plugs were formed at the root apices. Radiographs were taken to ensure proper placement and thickness of the CEM cement plugs. All specimens were stored at 37°C and 100% humidity for 7 days.

The roots were sectioned perpendicular to its long axis at 5 mm of the anatomic root apex using a high-speed diamond saw (D and Z Germany). The specimens were mounted on aluminum stubs, sputter-coated with gold and assessed from the top at a *300 magnification under scanning electron microscopy (Vega II XMU, Tescan, Czech Republic). Marginal adaptation evaluated at the root apices only, and width of largest gap (maximum distance between CEM cement and surrounding dentin) in each specimen was scored and recorded [Figures 1a and b].

The Kolmogorof-Smirnov test was used to confirm normal distribution of the data. The results were analyzed by *t*-test, and significance level was set at $\alpha = 0.05$.

RESULTS

The scanning electron microscope (SEM) observation of root ends revealed gaps between CEM cement and the dentinal walls in all cases. Variations were

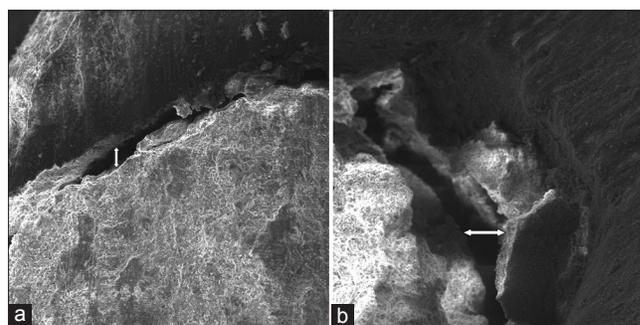


Figure 1: (a and b) scanning electron microscope (SEM) micrograph. A gap between the calcium-enriched mixture cement plug and dentinal wall at the root end can be observed in the (a) medicated group (with prior calcium hydroxide dressing) and the (b) non-medicated group (without prior calcium hydroxide dressing)

observed in these specimens in the width of gaps. The average gap width in medicated and non-medicated groups was $158/1 \pm 67.1 \mu\text{m}$ and $147/1 \pm 34/8 \mu\text{m}$, respectively. No significant difference was observed between two experimental groups ($P > 0.05$).

DISCUSSION

Several studies have shown that MTA has good marginal adaptation in comparison of other root-end filling materials and the gap size is smaller in MTA root-end filled teeth.^[28-32] Marginal adaptation of CEM cement has not been evaluated. The mean gap size in premedicated and non-premedicated root canals was $158.1 \mu\text{m}$ and $147.1 \mu\text{m}$, respectively. These sizes are greater than those observed by Torabinejad, *et al.* ($2.68 \mu\text{m}$),^[28] Bidar, *et al.* ($14.8 \mu\text{m}$)^[31] and Xavier, *et al.* (1.051 and $0.812 \mu\text{m}$)^[32] in evaluation of marginal adaptation of MTA. This difference can be related to several factors. First, in these studies, MTA was placed retrogradely in the root canals and the root-end and marginal adaptation were assessed but in the present study, CEM cement was placed in root canals orthogradely (as an apical plug). Second, the method of measuring the gaps is different; Torabinejad, *et al.* and Bidar, *et al.* used longitudinally sections to measure gap widths between MTA and the root canal walls. Xavier, *et al.* used transverse sections to evaluate the marginal adaptation of MTA as a root-end filling material. Here, the gaps between CEM cement and the root canal walls at the root apices was evaluated, without performing sectioning at the CEM cement and dentinal wall interface. Finally, in this study sulfuric acid was used to produce open apex teeth. Sulfuric acid resorbs the root apex in a disordered manner, producing irregularities at the root end that may hinder adaptation of CEM cement to the dentinal walls and thereby increase the gap size. The size of gaps in this study is comparable with those was observed for marginal adaptation of MTA by same method ($70.2 \mu\text{m}$ and $130.0 \mu\text{m}$ in premedicated and non-premedicated root canals, respectively).^[33]

The present study showed that medication with calcium hydroxide had no adverse effect on marginal adaptation of the CEM cement plug. Hachmeister, *et al.*^[34] also found that calcium hydroxide therapy for one week did not affect the sealing ability of MTA in 70 days. Porkaew, *et al.*^[35] found decreased dye leakage in canals obturated with gutta-percha following premedication with calcium hydroxide.

Bidar, *et al.*^[33] also found that premedication with calcium hydroxide improved marginal adaptation of MTA.

CONCLUSION

According to the results of this study, calcium hydroxide medication had no effect on the marginal adaptation of CEM cement as an apical plug. Because the apical plug technique eliminates the lengthy apexification procedure, *in vivo* studies focused on the success rate of CEM cement apical plug are warranted.

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