



Effect of Blood Contamination on Marginal Adaptation of MTA and Endosequence Root Repair Material as a Retrograde Filling

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ABSTRACT

Purpose: This study was designed to compare marginal adaptation of MTA and Endosequence Root Repair Material (ERRM) as retrograde filling materials. **Materials and methods:** 40 maxillary anterior teeth were prepared and obturated with gutta-percha and AH plus using lateral compaction technique. Apical 3mm of the roots were resected and retrograde cavities were prepared with diamond coated ultrasonic retrotip. Teeth were divided randomly into two main groups (I,II) according to blood contamination of retrograde cavities and every group then divided into two sub-groups (A,B) according to retrograde materials (MTA,ERRM). Teeth sectioned longitudinally and examined for marginal gap using SEM. **Results:** revealed that the high mean value in cavities without blood contamination and filled with MTA in group I and the high mean value in cavities smeared with blood contamination and filled with MTA in group II. There was no statistically significant difference between 4 groups. **Conclusion:** MTA and ERRM exhibited nearly comparable marginal adaptation in dry or blood environment.

INTRODUCTION

Orthograde endodontic treatment is a treatment option with predictable outcome essential to save pulpally and periapically involved teeth, however periradicular healing may not occur following non-surgical root canal treatment mainly due to remaining microorganisms. In such cases, surgical intervention is indicated to resolve persistent apical lesion or when non-surgical treatment can't be performed due to restorative causes. Outcome of periapical surgery has been significantly increased as result of improved surgical armamentarium, implantation of

KEYWORDS

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microsurgical techniques and introduction of newer root-end filling materials ⁽¹⁻³⁾.

A retrograde filling material is usually used for filling the root-end cavity to provide a hermetic apical seal to prevent entrance of micro-organisms and its by-products from the root canal system into the peri-radicular tissues. Also it should possess properties like, non-toxic, biocompatibility, be bioactive, radio-opaque, non-resorbable, dimensionally stable, non-irritant, non-corrosive, and easy to be handled, impervious to dissolution or breakdown by the tissue fluids and thus good quality apical root canal filling is essential to ensure successful endodontic surgical outcome ⁽⁴⁻⁶⁾.

Several materials have been used as retrograde filling materials like zinc-free amalgam, gutta-percha, glass-ionomer cements, composite resins, zinc-oxid eugenol and silicate-based materials such as Mineral Trioxid Aggregate. MTA composed of tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide, and commercialized in two different versions, grey and white MTA. It showed promising results because of its good sealing properties, dimensional stability, excellent biocompatibility, radio-opaque, bioactivity and has the potential to stimulate cementogenesis. It was specifically introduced as perforation repair material and retrograde filling material and it is becoming the golden standard for filling retrograde cavities ^(7, 8).

In attempt to find materials with similar properties to MTA and improve handling characteristics, new bioceramic materials have been introduced Endosequence Root Repair Materials (ERRM). It is aluminum-free formulation material composed of calcium silicates, monobasic calcium phosphate, zirconium oxide and tantaium oxide. It has nanoshere particles that allow the material to enter dentinal tubules, and upon setting it creates a mechanical bond. It is a premixed product in both moldable putty and low viscosity past from dispensed from a syringe, which facilitates its application ⁽⁹⁾.

Apicoectomy is procedure in which the root apex is removed and the adjacent periapical tissue is curetted. 3 mm at least of the root-end should be removed to reduce 93% of the lateral canals and 98% of the apical ramifications.

Retrograde cavity prepared in depth of 3mm and locates in the center of the canal and parallel to the long axis of the tooth. An effort to overcome and solve some of disadvantages of conventional retro-preparations, especially designed ultrasonic retrotip was introduced for retrograde cavity preparation that enabled the clinician to prepare ideal retro-preparations in nearly all clinical situations. Because of small size of ultrasonic retrotips they can be easily introduced into the bony crypt parallel to the long axis of the root, which is inaccessible areas ⁽¹⁰⁻¹³⁾.

During endodontic surgery different means are used to control hemorrhage in the surgical field like local anesthetic of vasoconstrictor, electric cautery, chemical cauterization, and mechanical barriers such as bone wax. Even with all of these means, a dry apical field is not always obtainable⁽¹⁴⁾. Unavoidable that moisture or blood will contaminate the retrograde filling materials when they are placed which may affect adaptation of this materials ^(15,16). Aim of this study was compared the marginal adaptation of MTA and ERRM as retrograde filling materials.

MATERIALS AND METHODS

The root canal instruments and materials which were used in the present study are listed in table (1).

Table (1):

Product	Manufacture
AH plus resin sealer	Dentsply, DeTrey, Konstanz, Germany
Diamond coated ultrasonic retrotip	Satelec, Merignac, France
Proroot-MTA	Dentsply. Tulsa Dental, Tulsa, Ok, USA
ERRM	Brasseler USA, Savannah, GA, USA

Forty human maxillary incisors teeth with completely formed roots and straight root canal were selected for this study and the selection was confirmed using preapical radiograph. After access cavity preparation, working length was established and root canal instrumentation was completed using step-back technique up to ISO 40 apical size using manual K-files. After each instrument irrigation was done using 2 mL of 2.6% NaOCl solution for one minute and final rinse with 5 ml of 17% EDTA for 1 min, followed by 5ml distilled water. The root canals dried with paper-points and obturated using standard 2% gutta-percha points and AH – Plus root canal sealer with lateral compaction technique then teeth stored in 100% humidity and 37°C in incubator for one week .

The apical 3 mm of the roots were resected perpendicular to the long axis of the teeth with plan fissure in high-speed hand piece under continuous air/water spray and retrograde cavities prepared using diamond coated ultrasonic retrotip.

All samples checked under sterio-microscope to exclude anyone have crack extend to interference between material and tooth structure. Teeth were divided randomly into two groups I&II (n=20), according to blood contamination and every group was subdivided into two subgroups A&B according to types of retrograde filling materials.

Group I: Retrograde cavities were immediately filled with fresh human blood and then gently aspirated. This way, surface of the cavities were smeared with blood before filling and the samples immediately immersed in molds containing heparinized blood and incubated at 37°C and 100% humidity for one week.

Group II : Cavity left without blood contamination.

The two mean Group I,II divided to two subgroups (A and B) according to filling materials .

Subgroups (IA and IIA) the root-end cavities filled with Proroot-MTA (n=10 each):

Proroot MTA was prepared according to the manufacturer's instructions. MTA mixture was delivered into retrograde cavities using MTA applicator and gently packed with appropriate pluggers and paper points. Excessive materials were removed with a plastic instrument.

Subgroups (IB and IIB) the root-end cavities filled with ERRM (n=10 each):

ERRM putty was incrementally delivered into the root end cavities and gently packed with plugger.

After setting of materials samples were sectioned longitudinally using isomet 4000 micro saw (Buehler, USA) and marginal gap between root-end materials and dentin interference was examined using SEM.

Statistical analysis

All data were collected, tabulated and analyzed. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, followed by t-test was used to compare between two groups in non-related samples and three-way ANOVA tests were used to test the interactions between different variables. The significance level was set at $P \leq 0.05$.

RESULTS

Mean marginal gap obtained at the interface of dentine root-end filling materials was recorded and summarized for four groups in table (2). The mean values and standard deviation in MTA subgroups refer to high mean values in cavities without blood contamination (IIA) than cavities contaminated with blood (IA), and ERRM subgroups showed high mean gap value in cavities without blood contamination (IIB) than that contaminated with blood (IB).

There is no statistically significant difference in marginal adaptation between MTA subgroups (IA and IIA) and ERRM subgroups (IB and IIB) in presence or absence of blood ($p=0.417$). ($p<0.05$)

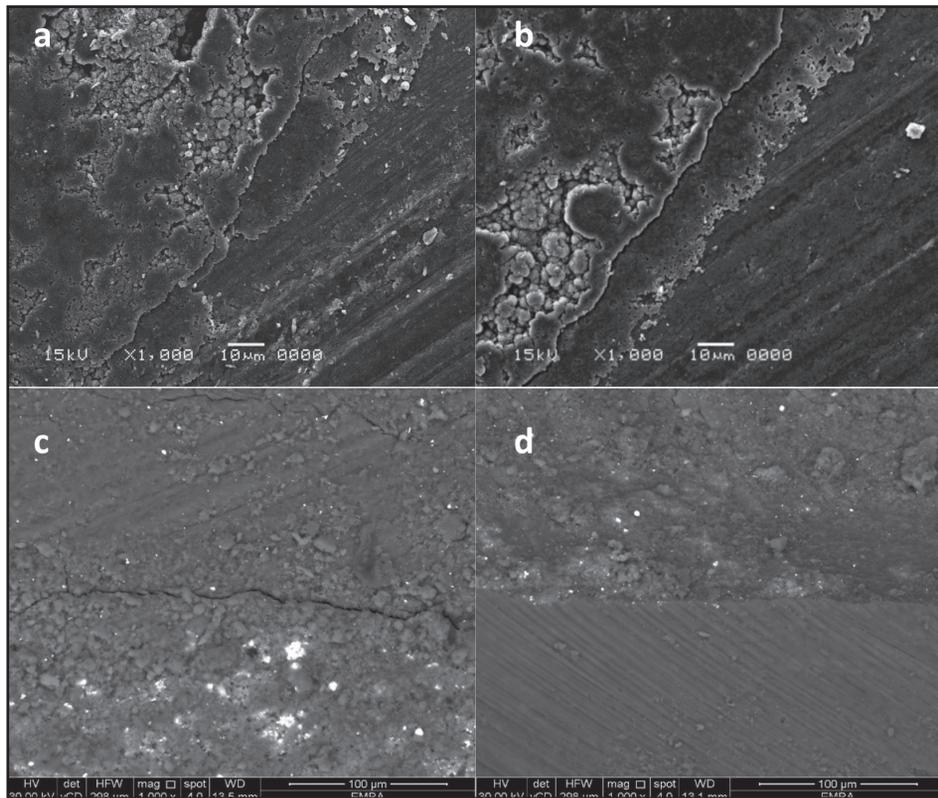


Figure (1): A scanning photomicrograph , **a)** Proroot- MTA in cavity with blood contamination. **b)** Proroot-MTA in cavity without blood contamination. **c)** ERRM in cavity without blood contamination. **d)** ERRM in cavity with blood contamination.

Table (2) *The mean values & stander deviations of marginal gap for MTA & ERRM in presence & absence of blood.*

Variables	Ultrasonic tip			
	With blood		Without blood	
	Mean	SD	Mean	SD
MTA	2.76	0.64	2.81	0.58
ERRM	2.50	0.75	2.63	0.76
p-value	0.417ns		0.547ns	

DISCUSSION

The aim of a periapical surgery is to gain access to affected area, prepare the root end cavity and restore it with a biocompatible seal retrograde filling material that stimulates the regeneration of periodontium. Sealing ability refers to the materials ability to resist microleakage through the entire thickness of the material thus investigating the marginal adaptation provides the indirect evaluation of sealing ability of the material^(17,18).

The presence of blood or moisture in surgical site will contaminate retrograde filling materials which may affect the amount of leakage^(15,16). The aim of this study was to evaluate marginal adaptation of MTA and ERRM as retrograde filing material in presence and absence of blood contamination to simulate the actual clinical condition present in periapical surgery.

Forty extracted human central incisors with type I root canal were chosen for this study to offer a more standardized method for evaluation and eliminate root canal anatomy variations that could affect the results, and the selection was confirmed using preapical radiograph.

Many studies reported that at least 3mm of the root-end must be removed to reduce apical leakage by reducing apical ramification and lateral canals⁽¹¹⁾. Apical root resection which is controlled, refined removal of the root apex producing clean, flat, beveled root face⁽¹⁹⁾. In this study the root resection was done using plane fissure bur which was reported by previous study to produce the smoothest resected root surface⁽²⁰⁾.

The root end cavity preparation aims to remove the root canal filling material and prepare proper cavity that can be filled. It was reported that ideal root end cavity defined as class I which has 3mm depth with parallel walls and coincide to anatomic outline of the root canal space⁽²¹⁾. Ultrasonic retrotip has been reported to provide better control and a centricity in the canal and reduce risk of perforation⁽²²⁾. The diamond coated ultrasonic tips were used in this study which has been reported to reduce chance of microcracks formation⁽²³⁾.

Root-end filling materials used in this study were MTA and ERRM, both are biocompatible and provide good sealing to dentinal wall and studies reported that marginal adaptation of ERRM was comparable and has equivalent sealing ability to that of MTA when these materials used as root-end filling materials⁽²⁴⁾. ERRM is a premixed as compactable putty ready to use with easier handling and application compared to MTA⁽²⁵⁾.

After sample were prepared, materials applied according to manufacture instruction and incubated at 100% humidity and 37° c up to setting. Samples were sectioned longitudinally using water-cooled diamond saw in a precision cutting machine to eliminate the effect of heat generation and avoid dislodgment of the material during sectioning. Previous

study reported similar mean gaps for longitudinally sectioned specimens and transversal resected root-ends filling with MTA⁽²⁶⁾.

Scanning electron microscope was used in the present study to evaluate marginal adaptation of tested retrograde material. It was reported that SEM allows better gap visualization due to high magnification power and depth of the focus⁽²⁷⁾. However SEM has disadvantage of two dimension nature.

The finding of this study showed that no significant difference between tested retrograde filling materials this may attributed that investigated materials had similar composition which calcium silicate as main component.

Marginal adaptation of MTA and ERRM has no significant difference in absence of blood contamination which is in a agreement with previous study that reported comparable marginal adaptation of new ERRM (putty) to that of MTA and recommended their using in filling of root end cavities⁽²⁶⁾. However in another study MTA showed better sealing ability when compared to ERRM⁽²⁸⁾.

In current study, with regarding to Proroot-MTA blood contamination improved marginal adaptation than non contaminated cavities, the difference is non significant. Previous leakage studies showed the blood contamination influence sealing ability of MTA and adaptation to dentin, this can be explained that hydration of MTA in presence of blood results in precipitation of hydroxyapatite crystal and tag like structures formation of MTA/dentine interface⁽²⁹⁾. However according to literature, physical properties of MTA like resistance to displacement and microhardness may be affected by blood contamination⁽³⁰⁾.

With regarding to ERRM subgroups cavities smeared with blood (IB) has less mean gap values than non contaminated subgroup(IIB) and this difference is non significant. However there is no published studies about the effect of blood on ERRM has been found. But it was mentioned that this bioceramic material is hydrophilic material and

nano-sphere particles which make it enter into the dentinal tubules and set in moisture, thus blood may not adversely effect on its sealing properties^(31,32). Therefore, contact with blood during the setting reaction is recommended in laboratory studies on the properties of ERRM.

CONCLUSION

Within the limitations of this study, it concluded that MTA and ERRM exhibited nearly comparable marginal adaptation in presence or absence of blood environment.

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