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Sealing ability of a retrograde filling materials using Amalgam, MTA, or Zinc Phosphate cement

DR. Maha Adul- kareem AL- Mashhadaney.*
DR. Maha J. AL- Anni.*
DR. Haraa Khairi AL – Hadithi.*

Abstract

This study evaluated the ability of mineral trioxide aggregate (MTA) to seal the root end effectively by comparing its apical sealing ability with that of amalgam and zinc phosphate cement. Forty five, single rooted extracted human teeth were used in this study, teeth divided randomly into three groups. After root–end resection of teeth, 3 mm depth of retrograde class I cavities were performed in 3 groups. Retrofillings of each group were performed with Amalgam, MTA and Zinc Phosphate cement. Following immersion in 1% Methylene blue dye for 42 hours, the roots were sectioned and the depth of dye penetration was evaluated by a stereomicroscope at X-10 magnification. The sealing ability of the retrograde filling materials was determined by their ability to inhibit dye penetration. Data were analyzed by one way ANOVA test and t-test. MTA provides a better seal than Amalgam and Zinc Phosphate cement when used as retrograde filling.

Key words: Retrograde filling, MTA, Amalgam, Zinc Phosphate cement

Introduction

Among the possible causes of failure in endodontic surgery is the improper technique, incomplete cleaning of the canal and incomplete sealing of all communications with periradicular tissues[1,2,3]. So possible infiltration of bacteria through the tubules into the root canal system can take place more frequently in the presence of coronal leakage[4,5] .Many studies have indicated that leakage, whether apical or coronal , adversely affects the success of root canal therapy[6].

The primary goal in apical resection is to perform effective sealing between the apical part of the root canal and periapical tissue by retrograde root end filling. By hermetic sealing with a root end filling, prevention of the passage of the microorganisms and their product into the periapical tissues can be achieved [7,8,9] .

The ideal root-end filling material should be easy to manipulate, radiopaque, dimensionally stable, non absorbable, not affected by the presence of moisture. It should also adhere to the preparation walls & the root canal system, non toxic, well tolerated by periapical tissues and promote healing[10].

Many materials have been suggested as root-end filling materials, including reinforced zinc oxide-

* College of dentistry, AL-Mustansiria University

eugenol (Cavit), gutta percha , zinc oxide eugenol, composite resin and gold foil[11,12].Amalgam has proved to be a successful material for retrograde filling, despite or perhaps because of its microleakage and expansion on setting[13].

An experimental material, mineral trioxide aggregate (MTA), was recently reported to seal off all the pathways of communication between the root canal system and the external surface of the tooth[14]. In addition, the use of MTA as a retrograde root-filling material has been suggested[15]. One reason that MTA has gained attention is its superior ability to resist leakage[16]. Such behavior may be explained by superior marginal adaptation of MTA[17].

The aim of this study was to compare the sealing ability of amalgam, zinc phosphate cement, and MTA as a retrograde filling material.

Material and method

Forty five freshly extracted, single rooted human upper incisors and canines teeth were collected and stored in saline.

A radiograph was taken to assess the absence of anatomical anomalies in the canal system. The working length was determined by subtracting 1mm from the length at which #15k file appeared at the apical foramen. The apical portion of the root canal was prepared with a #40k file and the rest of the canal was flared using a conventional step-back technique. NaOCl 5.5% was used as an irrigant. All canals were dried with paper points and filled with laterally condensed gutta percha and Dorifil sealer (Dorident, Austria). All roots were sectioned 3 mm from the apex at an angle of 90 with a #701 fissure bur in a high speed handpiece with water coolant.

Three mm deep root end cavity was prepared with #21 stainless steel round burs using slow speed handpiece. The teeth were divided randomly into 3 groups with fifteen teeth in each group. Retrograde cavities of the first group were filled with amalgam (Vivalloy, Vivadent,Co.), amalgam was condensed to cavities with condenser and burnisher. Second group retrograde cavities were filled with zinc phosphate cement (Dorident, Austria). The third group cavities were filled with MTA (Dentsply, Tulsa, OK). All the materials were prepared according to manufactures recommendations.

After retrograde root filling procedures were completed, all teeth were wrapped in wet gauze, placed in closed vials, which were placed in an incubator at 37ºC for 24h to allow for a complete set of the barrier materials. The teeth were then coated with two layers of nail varnish except for the apical portion. All specimens were placed into three tubes containing 1% methylene blue solution for 48 hours.

After 48 hours, teeth were rinsed in tap water for 5 minutes and allowed to dry. After removal of nail varnish, the roots were divided into two equal halves along the long axis using a low-speed diamond disc.

Dye penetration was measured in millimeters in all sectioned roots of all groups using a calibrated stereomicroscope at X10 magnification. Statistical analysis of the results was performed using ANOVA & t-test to evaluate the significance of difference between the groups.

Results

Dye leakage extension in millimeter, the means, and standard deviations for each group are listed in table (1). All experimental groups

demonstrated dye leakage. The statistical analysis of the data by one way-ANOVA test showed a highly significant difference between groups (table 2). The results showed there was a high significant difference ($p<0.01$) between the amalgam and zinc phosphate cement (group I &II), and also the difference was highly significant between amalgam and MTA (group I & III). The t-test demonstrated a highly significant difference ($p<0.01$) between zinc phosphate cement & MTA (group II & III) (table 3).

Discussion

The primary aim of the root canal treatment is the elimination and future exclusion of all microorganisms from the root canal system. However, if conventional root canal treatment is impossible or has failed, an alternative approach will be necessary. Periapical surgery which entails apicectomy and retrograd root filling may be performed. A retrograde root filling is placed to establish an apical seal to prevent the passage of microorganisms or their products into periapical tissues [18,19,20].

Although amalgam generally has been the most commonly used root end filling material, it has a number of disadvantages such as scattering of amalgam particles into the surrounding tissues, corrosion and setting properties which allow dimensional changes and fluid leakage. The data obtained in this study showed that all of the amalgam root end fillings leaked with the maximum dye leakages scores, this finding agreed with the findings of Stabholtz et al [21] which showed that amalgam was significantly inferior in its sealing ability to the other materials used which include zinc phosphate cement, reinforced zinc oxide-euogenol (Cavit), restodent, and durclon.

Sealing ability of MTA was superior to that of amalgam or super EBA in different dye and bacterial leakage methods [22,23]. Setting time of MTA was much longer than amalgam and marginal adaptation was better than amalgam [24], in addition to that it provides a hermetic seal.

The present study demonstrated a highly significant difference in the seal produced by MTA when compared with zinc phosphate cement. This came in agreement with Torabinejad et al [22] who investigate the sealing ability of MTA as root-end filling material after root end amputation. Dye penetration was significantly more in amalgam than zinc phosphate cement and MTA. There was a highly significant difference between the specimens that received amalgam fillings and zinc phosphate cement fillings. These results corroborate with previous findings that show MTA seals significantly better than amalgam[25]. Dye penetrations in MTA placed cavities were less than that of others, this is probably due to its superior marginal sealing ability.

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Table (1): Dye leakage values (mm), mean and stander deviation for each group

Groups	No.	Minimum	Maximum	mean	S.D
Group I	15	5.3	6.0	5.6	0.23
Group II	15	3.4	4.0	3.7	0.19
Group III	15	1.7	2.3	1.9	0.18
Total	45	1.7	6.0	3.7	1.54

Table (2): One way ANOVA test among the tested groups

Sours of variation	Sum of Sq.	Df	Mean Sq.	F.	P- value	Sig
Between groups	96.5	2	48	1177.5	0.000	H.S
Within groups	1.5	39				
Total	98.1	41				

H.S: high significant level at P< 0.01

Table (3): T-test

Groups	T-test	P- value	Sig.
Group I &Group II	23.55	0.000	H.S
Group I &Group III	47.19	0.000	H.S
Group II &Group III	25.94	0.000	H.S