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Sealing Ability of Different Retrograde Filling Materials

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ABSTRACT

Aims: The objective of this invitro study was to compare apical microleakage of mineral trioxide aggregate (MTA), glass ionomer cement (GIC), and amalgam used as root-end filling materials. **Materials and methods:** The root canals of (76) extracted human teeth were instrumentd and obturated with gutta percha. Apexes were resected and cavities were prepared to 3mm depth. Teeth were divided randomly into three groups. First group was retrofilled with amalgam, second with GIC, third with MTA, and positive and negative control groups. Nail varnish was applied to all root surface except the tip of the root. Following immersion in 1% methylene blue dye, the roots were sectioned and depth of dye penetration was evaluated by stereomicroscope at x20 magnification. Data were evaluated using Fisher exact test at p<0.05. **Results:** In this study, MTA was determined to be superior to amalgam and GIC in preventing apical microleakage when used as root-end filling. No statistical significant differences was observed between GIC and amalgam**. Conclusion:** Under the conditions of the study, despite some variations, MTA cement provides a better seal than amalgam and GIC when used as retro filling, but along term invivo study is required to prove it.

Key words: Sealing ability, Retrograde filling material, MTA.

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INTRODUCTION

Retrograde filling is a well-established procedure to treat teeth with persistent periapical infections and teeth in which conventional root canal therapy has failed. The root end filling material should improve the sealing of the existing canal filling, preventing the movement of bacteria and bacterial products from the root canal system to periapical tissues[1,2] .These substances should have the ability to adhere and seal the root canal system and it should be also biocompatible, non toxic, non carcinogenic, easy to manipulate, not sensitive to moisture, and dimensionally stable [3,4].

Numerous materials have been suggested as root end filling materials: gutta percha, amalgam, composite resin, poly carboxylate cement, cavit, glass ionomer, and others such as gold foil and leaf, cyanoacrylates, polyhema, and the new root end filling material mineral trioxide aggregate (MTA) [4, 5, 6, 7, 8].

Mineral trioxide aggregate composed mainly of tricalcium silicate, tricalcium aluminate, tricalcium oxide and silicate oxide. The powder composed of small hydrophilic particles ,and the liquid is distilled water, hydration of the powder results in colloidal gel that solidifies in the mineralized structure of the tooth in less than 4 hours [9].

There are two types of MTA: grey and white(tooth coloured form of MTA) both of them have a similar chemical constitution except for the addition of bismuth oxide to make it radiopaque [10].

The purpose of this invitro study was to asses the sealing ability of mineral trioxide aggregate and to compare it with other common retrograd filling materials, amalgam and glass ionomer cement.

MATERIALS AND METHODS

Seventy six caries-free, restoration-free extracted human premolars were selected and stored in deionized distilled water at room temperature prior to the study ,the teeth was thoroughly cleaned, polished with a slurry of pumice and water in rubber prophylaxis cup at a low speed.

For each tooth access preparation was performed, working length was determined by inserting size 10 file and just seen by necked eye from apex then with drown 1.5 mm. Root canals were cleaned and shaped using k- file, k- flexofile and hedstroem files (Ballaigues European Mandatory CH – 1338 Swiss Made) combind with 2.5% sodium hypochloride irrigation solution all teeth were instrumented to size 40 flexofile.

The instrumented canals were dried with paper pionts (North Hamlin Avenue, Lincoln Wood, USA) and abturated with guttapercha cones (Dia Dent International CHO NGJU city, KOREA) and zinc oxide eugenol sealer (Dori Dent, Gmblt, Vienna Austria) using lateral condensation technique, the teeth were then stored at room temperature and 100% humidity for 24h. The apical 3mm of each root was resected with approximately 90 degree to the long axis of the tooth using diamond bur in high- speed handpiece (European Authorized Representative center, Brusseis Belgium) with copious water spary.

The root- end cavities were shaped with low- speed round bur no. 2 (Dentsply, Maillerfer) with water coolant to 3mm depth, [11] measured by periodontal prob, irrigated with saline and dried with absorbent paper points. Seventy- two specimens were randomly assigned to three groups of twenty- four for each:

Group 1: retrofilled with admixed amalgam alloy (Septalloy NG70, Specialites Septodont, France).

Group 2: retrofilled with glass ionomer cement (GIC) type II restorative material (Megadenta Gmblt Dental Product, Radeberg Germany). Applied in putty like consistency.

Group 3: retrofilled with mineral trioxide aggregate cement (MTA) (Angelus Dental Solutions, Goias Londrina PR Brazil) based on a mixture of sterile distilled water to a putty consistency using a powder to water ratio of 1:1.

Amalgam alloy inserted into the retro cavity with conventional amalgam carrier, GIC and MTA inserted into the prepared retro cavities with a no.1 spatula. Each of the materials was condensed into the prepared cavity using small pluggers until the apical level, and burnished with small burnisher.

For MTA used a controlled condensation pressure, because the high pressure may pack the powder molecules closer together to produce a drop in surface hardness and reduction in crystalline formation due to lack of sufficient space for water molecules[12].

The specimens were coated with two layers of nail varnish except the tip of the root where the retrograde filling material was applied, the teeth allowed to dry for 30 minutes.

Two obturated roots with retro preparations received no retrograde fillings used as positive controls . Another two roots were instrumented and obturated with gattapercha and sealer, their entire root surfaces were covered with two coats of nail varnish and were used as negative controls. The specimens maintained in distilled water for 1 week at 37˚C (±1˚C). Then the teeth immersed in buffered 1% methylene blue solution at 37˚C for eight hours.

After which the samples were rinsed under tap water, and nail varnish was removed

For evaluation, each root was longitudinally sectioned with a slow speed diamond sectioning disks through the middle of the retrofilling materials. The degree of dye penetration was evaluated by stereomicroscope (Hamilton by AItaly international Italy) at a magnification level of x20. Two independent examiners evaluated and scored the dye leakage as either acceptable or unacceptable[11]. The acceptable score was defined as either no leakage or leakage that did not extend beyond the retrofilling material into the root canal space. The unacceptable score was defined as any leakage that extended beyond the retrofilling materials into the root canal space. The data were analyzed statistically using non parametric fisher exact test at ($p< 0.05$).

RESULTS

The dye penetration in each root section was evaluated with stereomicroscope (20x magnification).The frequency of micro-leakage at root- end surfaces of the three tested groups are reported in table (1).

Table (1) results of dye leakage for the retro filling materials

Groups	No. of samples	Accepted		Unaccepted		Group* differences
		No.	%	No.	%	
Amalgam	24	14	58.3	10	41.7	B
GIC	24	13	54.2	11	45.8	B
MTA	24	24	100.0	0	0.0	A

*Groups with the same letter has non- significant differences at $p \leq 0.05$ and vice versa.
Significant differences between MTA and each of Amalgam and GIC at $p \leq 0.05$

Positive control samples showed dye leakage through out the length of the canals, while the negative control samples had no dye penetration.

Non parametric fisher exact test reveald a significant differences between the specimens received reverse MTA and other tested materials (GIC and amalgam) at $p<0.001$.

Figure (1)demonstrates the dye penetration in amalgam retrograde filling material, Figure (2) GIC, and Figure (3) MTA filling material .

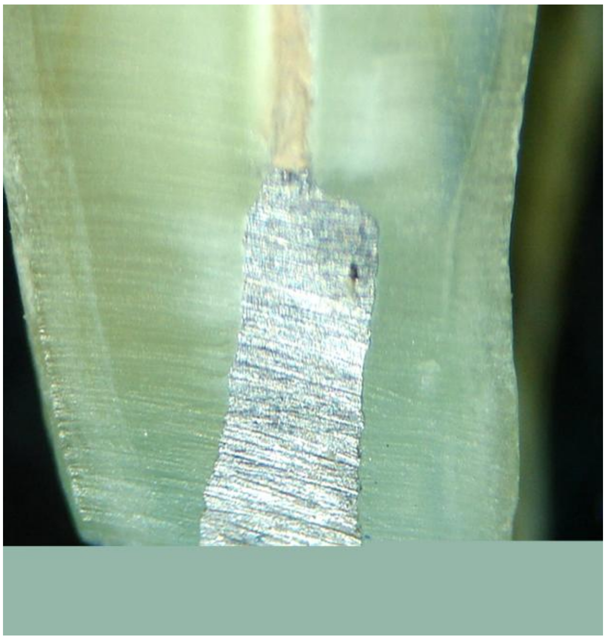

Figure (1) Sectioned root showing the degree of dye penetration in amalgam retrograde filling material.

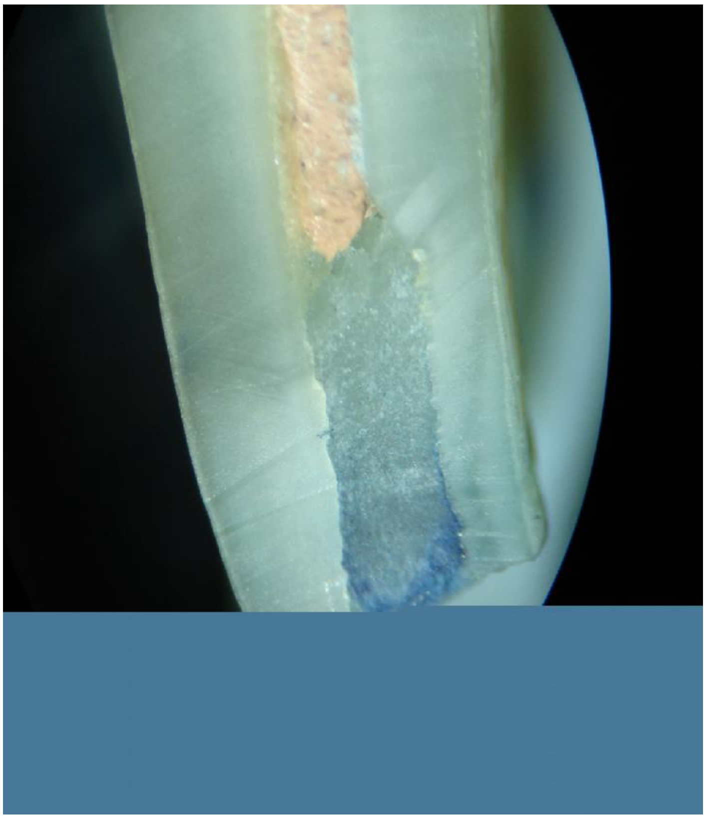

Figure (2) Sectioned root showing the degree of dye penetration in glass ionomer retrograde filling material.

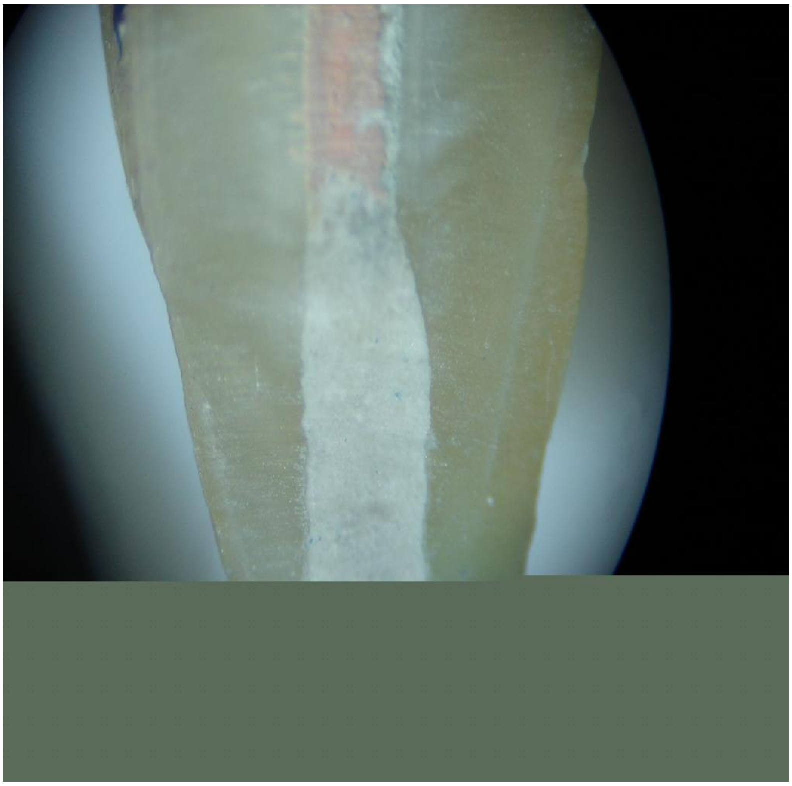

Figure (3) No dye penetration was shown with MTA-retrograde filling material.

Forty one percentage of the group filled with amalgam and 45% of the group filled with GIC showed dye leakage beyond the retrofilling materials, where as the MTA group showed non. The differences between GIC group and amalgam was not significant.

DISCUSSION

The purpose of placing a retrograde root filling is to establish an "apical seal" to prevent the passage of microorganisms or their product into periapical tissues. "Apical seal" is the most important factor in achieving success in endodontics [13, 14].

Leakage studies were used commonly to asses the suitability of potential root end filling materials. In the present study methylene blue dye was used to evaluate the leakage in apical portion, that is due to the molecular size of this material was comparable with that of small bacterial metabolic product. [15]

Under the conditions of the study despite some variations, there were statistical significant differences concerning the sealing ability of all tested materials.

In the present study best sealing ability was obtained with MTA, these result corroborate with previous findings that show MTA seal significantly better than other retrofilled materials [1, 11, 16, 17].

Trabizizadeh and yazdi compaire the microleakage of both MTA and amalgam, their results indicated that MTA had better sealing ability than amalgam. [18]

Evaluation of bacterial microleakage in extracted teeth using different retrofilling materials, showed that MTA had the lowest microleakage value as compaired to other materials. [19]

Few other studies did not show a significant differences in microleakage score between MTA and other retrofilled materials [8, 20, 21].

The high leakage value of amalgam as compaired with MTA leakage in the present study may be due to the contraction of amalgam at the time of primary setting [22], resulting in gap formation between the tooth/ filling interface. [18]

Although amalgam is the most commonly used retrograde root filling material, but it does not provide a satisfactory seal, and there are neumerous disadvantage with this material, such as scattering of amalgam particles into the surrounding tissues, corrosion, and setting properties which allow diamensional changes and fluid leakage. [11, 23]

In our study the analysis of data did not show significant dufferences in the level of dye penetration between amalgam and GIC, this in agreement with the result of " Naito etal" who concluded that glass ionomer appear as effective as amalgam. [24]

Few studies suggested that glass ionomer may be more effective than amalgam, GIC have several advantages properties for their use as retrograde filling material such as adhesiveness to tooth structure and antimicrobial activities. [2]

The finding of the present study suggested that GIC less effective as retrofilling material than MTA, the least leakage value of MTA may related to the possibility of expansion of mineral trioxide aggregate cement in humid environment during hardening time which last about 2h. and 45min., varies according to the density of the air entrapped during mixing and dampress of the receiving site. [9]

This long hardening time for complete setting may reduce the internal tensions and the incidence of marginal infiltration, so can provides a hermetic seal, in addition to its ability to sets in a moist environment. [6]

Clinically, the results of this study showed that MTA provides a hermetic seal and show the least dye leakage value .When such material does not allow the penetration of small dye molecules, it has the potentiality to prevent leakage of larger substances such as bacteria.

Although the result of this invitro study indicated that MTA has the potential of being used as root end filling material, direct extrapolation and relevance of dye leakage studies to the clinical application are needed to determine the suitability of this material in invivo use.

CONCLUSION

The sealing ability of mineral trioxide aggregate, as root end filling materials was tested and compaired with both glass ionomer cement and amalgam, the results indicated that MTA provides better seal than the others.

There were no significant differences in sealing ability between GIC and amalgam. More invitro and invivo studies needed to test the ability of 3 materials to microleakage reduction.

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