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Research Article

A Comparative Evaluation of Apical Sealing Ability between AH26, MTA and Pure Portland Cement: A *Vitro* Study

Ebtisam Al-thawab[1]* and Irafanaa Khursheed[2]

[1]*Intern Dental Student, College of Dentistry, Qassim University, Saudi Arabia*

[2]*Specialist and Clinical Instructor, Department of Conservative Dentistry and Endodontic, Saudi Arabia*

***Corresponding Author:** Ebtisam Al-thawab, Intern Dental Student, College of Dentistry, Qassim University, Saudi Arabia.

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Abstract

Objective: The aim of this *vitro* study is to compare of apical sealing ability between AH26, MTA and Pure Portland Cement.

Materials and Methods: A total of 30 intact human single-rooted teeth have been used in this *vitro* study. After root canal treatment OF all 30 teeth divided in to 3 groups obturated by different sealers: Ah26, MTA and PC. Dye penetration method was the choice for evaluation of sealing ability. Data analysis by SPSS using by Kruskal Wallis ANOVA test.

Result: Mean Value of dye penetration in mm of AH26 was 0.164 mm then Portland cement 0.0890 and mm for MTA. There was no statistical significance difference in microleakage between the three materials.

Conclusion: Apical Leakage; Ah26; MTA; Portland Cement

Keywords: *Hepatitis C Virus (HCV); Knowledge; Attitude; Students; Health Practitioner*

Introduction

Successful endodontic treatment depends upon many principles. About 60% of endodontic failure is due in adequate apical seal. Hermetic tight seal is required to accomplish complete three three-dimensional obturation [1]. Over the years many techniques and materials have been used to achieve a tight seal. Sealing of root canal include using of a semisolid material (gutta-percha) and cement [2]. The most common sealing cements is Resin-based endodontic cements include Ah26 and Ah Plus. It is widely used in clinical practice. Many studies show that AH26 is least leakage compared with other sealers [3-6]. Recently, Ceramic-based Sealers MTA introduce as root filling sealer since it has proven its successful in managing pathological or iatrogenic root perforations [3,7]. However, MTA considered to be expensive and difficult in manipulation clinically [8].

Major bulk of MTA is formed by Portland cement, with the physical and mechanical properties being similar in most aspects [9]. Many studies performed to use PC as alternative to MTA. PC has chemical composition and physical properties similar to MTA, resulting similar tissue reactions when studied in animal models, however with a lower cost [2,8]. Literature stated (2011) that Pc and MTA cements present similarity both in their compositions and physical, chemical and biological properties, as reported in several studies. Therefore, PC has been studied as an alternative to MTA. After all, no endodontic sealer shows superiority in sealing ability [8].

Materials and Methods

Teeth

A total of 30 extracted single rooted human teeth have been included in this study. All of them were free from debris and soaked in 6% hypochlorite for two hours then stored in normal saline until use. Under visual inspection teeth are sound, no stains or erosion. Preoperative radiographs were done to confirm the canal anatomy. All teeth are dissected by disc micromotor in cemento-enamel junction to obtain a standardized length of 14 mm confirmed by calibrated ruler. after access opening working Length determined by 15 K-File. (Table 1 is list of all material and armamentarium used) (Figure A).

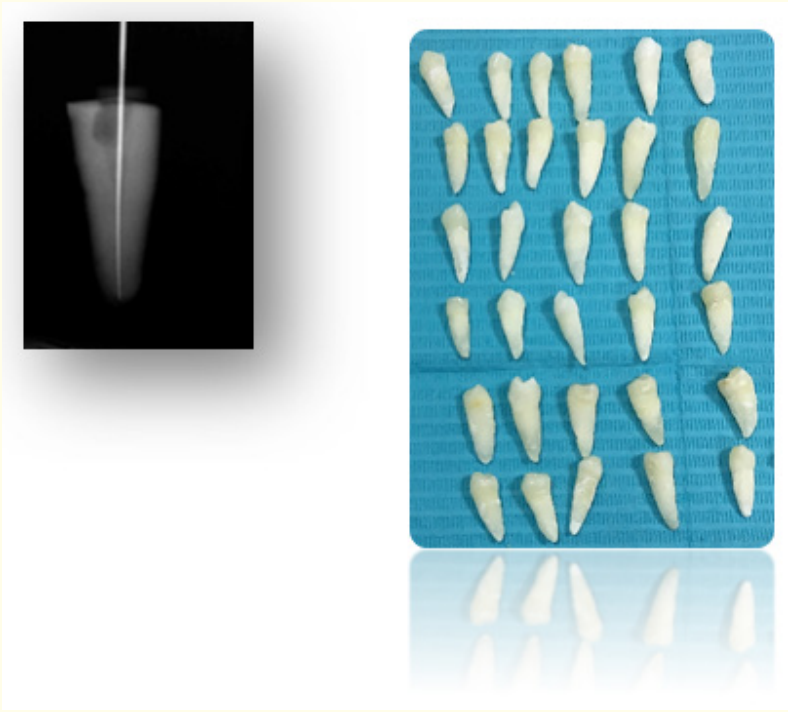

Figure A

Instrumentation

Biomechanical preparation was carried using crown-down technique using Manual K-type files, size 25 as initial Follow by 30, 35, 40.

Irrigation done by Normal saline and NaOCl. The canal was irrigated between each instrument by 3 mm normal saline and NAOH. the smear layer was removed from the specimens with 17% EDTA. Final flush by 5mm of Normal saline. Then dried by paper points canal.

40 size gutta percha cones were selected as master points. The fit of each master point was assessed by radiographs to determine whether the point was fully seated to the working length (Figure B).

Figure B

Obturation

Samples were randomly divided into three groups of 10 teeth (n=10) each one with different endodontic sealer (Figure C).

Figure C

Group A: AH26

Group B: Pure Portland cement

Group C: MTA sealer.

Obturation of the root canals was performed using lateral compaction technique. Excess gutta-percha removed with a heat-carrier and remaining gutta-percha was vertically condensed at the canal orifices with a hand plugger. Radiographs were taken to confirm the quality of obturation.

All the specimens were placed in separate containers with normal saline and maintained at room temperature for three days.

Preparation of specimen for digital analysis of dye penetration: All teeth coated with different color of nail varnish leaving 3 mm from the apical third exposed. Then immersed in 2% Methylene blue dye. Two specimens of each group were taken and evaluated at different period of time as follows:

- After 24 hours, then weekly until 28 days are completed.
- Microleakage associated with different root canal sealers was evaluated and the measurement of dye penetration obtained in millimeter. Longitudinally resected by Isomet machine.
- Then read by digital microscope magnification x50 digital software (Figure D & E).

Figure D

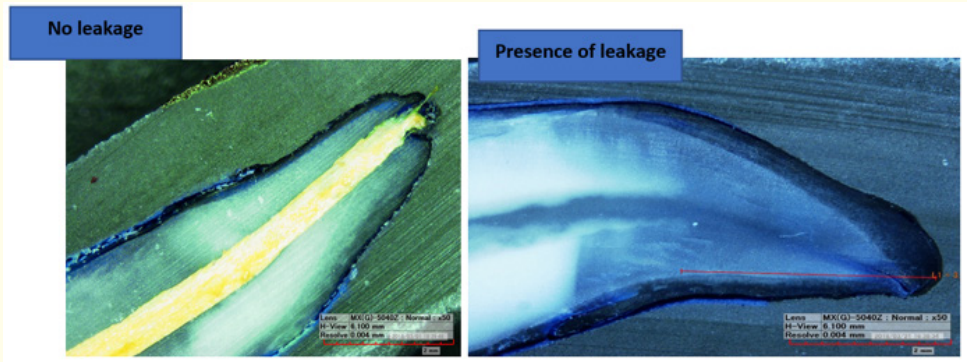

Figure E

Results

Microleakage was evaluated by the mean of all samples (Table 1). Kruskal Wallis ANOVA test was the choice. There was no significance difference between the three materials (Table 2).

Figure F chart shows mean of microleakage for each material.

List of Armamentariums	List of Material
micromotor handpiece	Gutta-percha
Wheel shape bur	EDTA paste (Ethylenediamine tetra-acetic acid)
K-Files	Epoxy resin- based sealer, AH26
Finger spreaders and pluggers	Mineral Trioxide Aggregate
Nail varnish (3color)	Pure Portland cement
Endo Block	Normal saline
Cotton pliers, cement spatula	Absorbent points
Glass Lab	2% Methylene blue dye
Calibration Ruler	6% Sodium hypochlorite
Scissor	

Table 1: *List of all material and armamentarium used.*

Time points	Materials	Mean	SD	Mean Rank	H-value	p-value
24 hours	AH26	0.00	0.00	5.00	0.0000	1.0000
	Portland	0.00	0.00	5.00		
	MTA	0.00	0.00	5.00		
7days	AH26	0.24	0.14	5.00	7.4480	0.0240*
	Portland	0.00	0.00	2.00		
	MTA	1.32	0.73	8.00		
14 days	AH26	0.14	0.15	3.50	1.8310	0.4000
	Portland	0.68	0.98	5.00		
	MTA	0.44	0.19	6.50		
21 days	AH26	0.33	0.24	3.33	2.7560	0.2520
	Portland	1.19	0.72	7.00		
	MTA	0.43	0.17	4.67		
28 days	AH26	0.05	0.09	3.33	1.9150	0.3840
	Portland	0.33	0.29	6.17		
	MTA	0.30	0.26	5.50		

Table 2: *Comparison of three materials with microleakage at different time points by Kruskal Wallis ANOVA.*

**p < 0.05.*

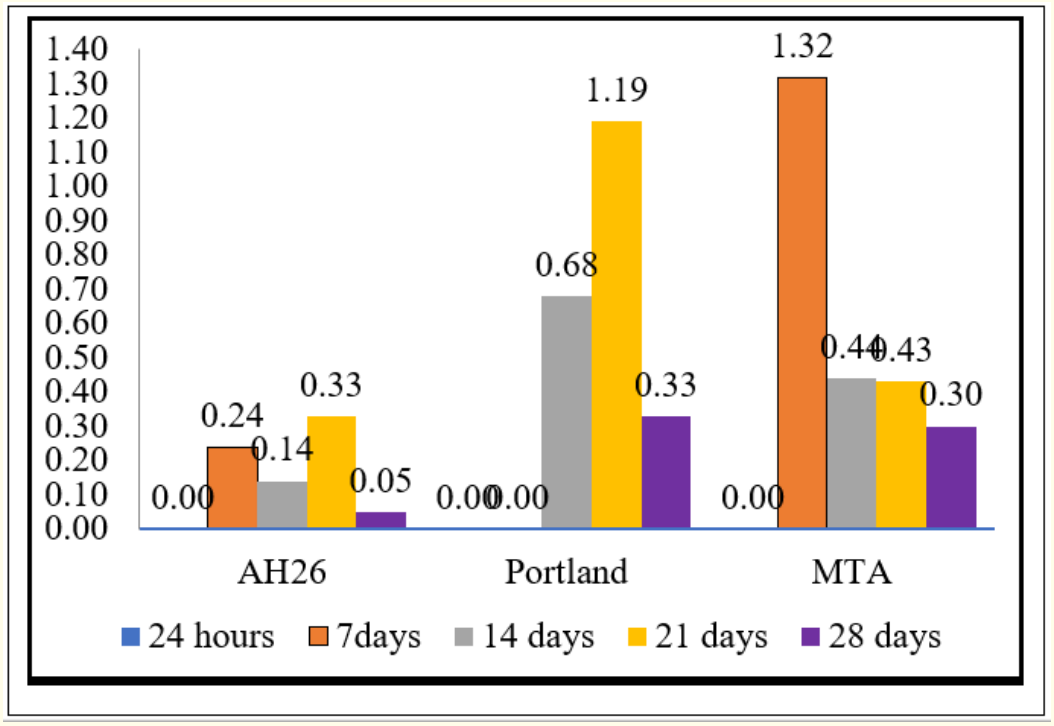

Figure F

Discussion

Tight seal is required to accomplish complete three-dimensional obturation [1]. Over the years many techniques and materials have been used to achieve a tight hermetic seal. Since all current root canal filling materials do not possess "ideal" characteristics. Thus, the present study aimed to evaluate the apical microleakage of three different materials.

The 1st time interval Ah26, PC and MTA show no microleakage Leakage. 7 days later, Samples with MTA show maximum leakage. While PC present with no leakage at all. Mean of microleakage for samples with Ah26 (resin sealer) was 0.14 mm. Similarity, *vitro* Study [15] compare the apical microleakage of a resin based sealer; Adseal with three Mineral Trioxide Aggregate (MTA) based sealers for 7 days. Result showed that (resin based sealer) was least microleakage when compared between three MTA Based sealer. Microleakage The least leakage after 14 days was with AH26 (0.14 mm). PC sealer shows maximum leakage (1.19 mm) after 21 days. The least microleakage after 28 days was with samples filled with AH26.

However, the study was limited for 7 days only. while it has been proved that MTA expand with time. Our study showed MTA was the maximum microleakage after 7 days (1.32 mm) and decreased until reaching (0.30) mm after 28 days. Which support the suggestion that MTA have delayed expansion which gave more apical seal.

Several studies suggest that dimension stability and insolubility contribute better sealing ability.

A review article published (2011)

Conclude that MTA and Portland cement behave differently in aqueous environments. MTA had delayed Expansion upon setting. Which result compromised sealing in the 1st 27 hours. On the other hand, Portland cement with immediate expansion. Which reveal decrease in sealing ability within the 1st 24 hours which support current study [12].

Zemner., *et al.* (2011) support current finding that Ah26 shows least leakage when compared with the AH Plus [11]. The Microleakage was assessed using dye penetration after 2, 4 and 10 days. AH Plus demonstrated significantly more leakage compared to AH26.

An experimental study by Hengameha., *et al.* (2011) compared apical sealing ability of AH26, AH Plus and AH Plus Jet in the 2nd and 30th day by using fluid filtration method. Results show AH Plus Jet had the least leakage on the 2nd and 30th day; whereas AH Plus revealed the highest microleakage rate [10].

Sophiat., *et al.* (2013) stated that MTA could be used as a root canal sealer with equal effectiveness compared with epoxy resin and zinc oxide eugenol sealers [12].

Maryam etc. in 2014 support current findings. Study conclude that leakage in AH26 provided the least apical micro-leakage *in vitro* study when compared with zinc oxide eugenol and MTA [13].

The findings obtained by Tabrizizadeh., *et al*. they assessed the apical sealing ability of MTA alone and laterally condensed gutta-percha with AH26 and showed that the canal obturation with gutta-percha and AH26 sealer may provide a better apical seal compared with MTA alone [14].

MTA expand with time as have been mentioned in study 2011. That explain why MTA leakage decreased as going forward [15].

Portland cement form the bulk of MTA. Literature reports studies revealing the similarities between these materials' properties, including both biocompatibility and bone repair induction (2011) [9]. However, There are limited studies regarding to Portland cement as root canal sealer compared with conventional resin bonded materials ah26.

Naiana V 2011 PC has been proved *in vitro* study and animal experimental study as an alternative to MTA. However, with low cost [9].

A study, using 1% methylene blue dye after 72 hours, reported no leakage beyond the retro fill area with PC.

One possible reason for the sealing ability of PC is its slight expansion upon setting. Mean expansion at 24 hours was noted to be 1.02% for Grey MTA, 0.29% for PC, and 0.08% for White MTA in water immersion [9].

Conclusion

None of all sealers used, completely prevent dye penetration after 28 days. The least microleakage observed in AH26, Portland cement and MTA. PC could be alternative for MTA with lower cost. More Studies are needed to compare Conventional resin sealers with Portland cement for longer time intervals. To get the best apical sealing.

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