

**Research Article****Comparative evaluation of antimicrobial effect of MTA fillapex sealer with two Resin-based sealers****Pouya Nejadshamsi<sup>1</sup>, Sara Bagheri<sup>2</sup>,****Mahtaj Sahranavard<sup>3</sup> and Nazanin Bashardoust<sup>2\*</sup>**<sup>1</sup>Dental Sciences Research Center, Department of Endodontics,  
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**ABSTRACT**

**Introduction:** The main goal of successful endodontic treatment is the elimination of the growth of the microorganisms by instrumentation, irrigation and intra canal medication. Perfect root canal filling materials (sealers) with antimicrobial activity, would be helpful in reducing the number of the microorganisms

**Objective:** The aim of this study was to evaluate the antimicrobial activity of MTA fillapex comparison with Resin-based sealers, AH26 and AHplus, on *Enterococcus faecalis*.

**Material and methods:** In this experimental study, three root canal sealers MTA fillapex, AH26 and AHplus were compared in order to evaluate their antimicrobial activity against *Enterococcus faecalis*. Antimicrobial activity was tested by the method of Agar Diffusing Test (ADT). Microorganism was cultivated in broth culture suspension. The microbial suspension was spread on 5 petri plates contained mueller-hinton agar medium. Then plates were dried for 15 minutes at 37°C. Freshly prepared sealers were placed in well of 6 mm in diameter in agar plates. After the incubation, the diameter of the growth inhibition zone around each well was measured in mm at 24, 48 and 72 hours. The data were analyzed by spss version 21, one-way analysis of variance (ANOVA) and Tukey's honestly significant difference (HSD) pairwise comparisons.

**Result:** The AH26 demonstrated highest antimicrobial activity against *E. faecalis* (16.2 ± 1.014) followed by AHplus (10.33 ± 0.617) and MTA fillapex showed the least efficacy (6.67 ± 0.899)

**Conclusion:** Antimicrobial activity of MTA fillapex was almost weak and AH26 has the highest antimicrobial efficacy followed by AHplus.

**Key words:** Antimicrobial effect, MTA fillapex, Resin-based sealer

**INTRODUCTION:**

The most important part of successful endodontic treatment is the elimination of the growth of the microorganisms by instrumentation, irrigation and intra canal medication<sup>[1]</sup>. Total disinfection of the root canals may not be achieved by only cleaning

and shaping<sup>[2]</sup>. One of the main causes of failure of endodontic treatment is the presence of facultative and resistant microorganism of the oral cavity<sup>[3]</sup>. Perfect root canal filling materials (sealers) with antimicrobial activity, would be helpful in reducing the number of the

microorganisms left in the root canal system even after cleaning and shaping<sup>[3]</sup>. Endodontic sealers are available based on their formulas, such as zinc oxide eugenol-based sealer, Resin-based sealers, calcium hydroxide-based and MTA-based sealer<sup>[2,4,5]</sup>. Resin-based sealers such as AH26 and AHplus, are widely used in endodontic treatment, and antimicrobial activity of them was studied by some authors<sup>[2-7]</sup>. One of the newest MTA-based sealer with enhanced consistency is MTAfillapex composed of MTA, salicylate resin, natural resin, bismuth and silica after mixing. It has been asserted to have good radiopacity, better flow, good handling, great working time and antimicrobial activity because of its alkaline pH<sup>[6]</sup>. Gurel, et al<sup>[8]</sup> (2016), Ehsani, et al<sup>[9]</sup> (2013) showed that antibacterial effect of MTAfillapex was significantly lower than other sealer. But Madani<sup>[10]</sup> (2014) demonstrated that MTAfillapex was more effective compared with AH26. Morgental revealed MTAfillapex has not maintained antibacterial effect after setting<sup>[11]</sup>. Regarding to the tested methods and type of the microorganism, the studies and results of them are different. *Enterococcus faecalis* has been the focus of a lot of studies on microbiology of endodontic infections<sup>[12]</sup>. It is a gram positive, facultative anaerobic bacteria associated with most failed root canal treatment cases, and it is frequently detected from endodontic infections. (24-77%)<sup>[2,3]</sup>. Because of these findings *E. faecalis* was chosen as a test microorganism in our study. Agar Diffused Test (ADT) has been the most commonly method to evaluate antimicrobial effect of sealers<sup>[1,2,3,5]</sup>, so it was the selected test in the present study. There are a few studies reported MTAfillapex antimicrobial effect compared with commonly used Resin-based sealers AH26 and AHplus, and the results of them are controversial<sup>[2,6,8,9,10,13]</sup>. Considering the difference in their methodology and discrepancies in their results, the aim of this study was to evaluate the antimicrobial activity of MTAfillapex comparison with two more common Resin-based sealers, AH26 and AHplus on *Enterococcus faecalis*.

## MATERIAL AND METHODS:

This experimental study was performed in the Endodontics Department, Dentistry Faculty, Guilan university of medical science, and Microbiology Department of Guilan university of medical science in 2016. Three root canal sealers compared in this study were: AH26 (Dentsply de try, Germany), AHplus (Dentsplydetry, Germany) and MTA fillapex (Amgellus, Londrina, Brazil), and in order to evaluate their antimicrobial activity, *Enterococcus Faecalis* (ATCC 29212) was used. Antimicrobial activity of these sealers was tested by the method of Agar Diffusinf Test (ADT). First the Microorganism was cultivated in broth culture suspension adjusted to No.1 Mcfarland standard, and five petri plates containing Mueller-Hinton agar medium (Merck, Darmstadt, Germany) were prepared. After that 10 microliter of microbial suspension was spread on each petri plate. Then plates were dried for 15 minutes at 37°C. Each plates was divided into three sections (for 3 sealers), in each section 1 well with 6mm depth were punched by using of sterile stainless steel cylinder. Sealers were prepared according to the manufacturer's instructions and a sample of each freshly mixed sealer was carefully placed into the well in each section of the 5 plates, with the aid of sterilized spatula (figure 1). All 5 plates were incubated at 37°C under aerobic condition for 72h. The diameter of the growth inhibition zone around each well was measured in mm at 24, 48 and 72 hours after the incubation. The mean diameter of measured zone was recorded for all 3 sealers. The data were analyzed by SPSS version 21, One-Way analysis of variance (ANOVA) and Tukey's Honestly Significant Difference (HSD) pairwise comparisons, and P-value < .05 was considered significant.

## RESULT:

Antibacterial effect was assessed with the measurement of the inhibition zones around each sealer (figure 2). The mean and standard deviation of the inhibition zone (in mm) for three endodontic sealers tested after 24, 48 and 72 hours were presented in table-1.

The ANOVA test revealed the significant difference between 3 sealers regarding antimicrobial effect ( $p \leq 0.001$ ). (table 2).

The AH26 demonstrated the largest inhibition zone on *E. faecalis* followed by AHplus. MTAfillapex had a fewest effect on the tested microorganism. (figure 2). The effectiveness of the AHplus and MTAfillapex decreased slightly with time, but this finding was not established for AH26.

## DISCUSSION:

Our results showed all 3 sealers were antimicrobial, and their antimicrobial activity against *Enterococcus faecalis* was distinctly different from each other. It is believed that the persistence of the microorganisms in the root canal system is the main cause of failure of endodontic treatment<sup>[14]</sup>. *Enterococcus faecalis* is a gram positive anaerobic bacteria, has been found in the necrotic pulp and also in the filled canals of treated teeth with signs of chronic apical periodontitis by establishing itself in dentinal tubules<sup>[1,4]</sup>. Anaerobic microorganisms like *E. faecalis* may be adapted to survive in dentinal tubules and necrotic pulp where the blood supply and oxygen are limited<sup>[5]</sup>. The antimicrobial activity of sealers against this bacteria may be helpful to eliminate it after endodontic treatment and decrease post treatment infections<sup>[14,15]</sup>. In the present study antimicrobial activity of MTAfillapex was compared with two most applied sealers: AH26, ahplus by the ADT method. This method has been widely used to evaluate the antimicrobial effect of sealers<sup>[14,16,17]</sup>. Our results showed that the AH26 and AHplus respectively have the greatest inhibition zone. This finding agrees with those obtained by Farmaki, et al<sup>[7]</sup> (2012), Shantiaee, et al<sup>[5]</sup> (2010), Ehsani, et al<sup>[9]</sup> (2013) and Jafari, et al<sup>[6]</sup> (2016) who reported AH26 is the most effective sealer against the endodontic pathogens. We demonstrated that although MTAfillapex has no significant antimicrobial activity after 24, 48 and 72 hours, but showed inhibition zone with mean 6.6mm, this result agrees with Gurel, et al<sup>[8]</sup> (2016) and Jafari, et al<sup>[6]</sup> (2016) and disagrees with Miyagak's study reported the

absence of inhibition zone around MTA based sealer. Miyagak measured the inhibition zone only after 24 hours of replacing the sealers<sup>[17]</sup>, it may be a main reason of this controversy. Against our results Madani<sup>[10]</sup> (2014) demonstrated that the antimicrobial effect of MTAfillapex sealer on *E. faecalis* was higher than AH26. Rahman<sup>[18]</sup> (2017) also studied antimicrobial activity of MTAfillapex and four different type of sealers and showed MTAfillapex has the highest effect on *E. faecalis*. This controversy may be explained by different methodology or genetic differences in *E. faecalis* species used in our study. In current study a reduction in the antimicrobial activity in AHplus and MTAfillapex from 24 h to 72h, but this change was not statistically significant. Gurel<sup>[8]</sup> (2016) and Reyhani<sup>[12]</sup> (2015) reported same finding. We did not observe any reduction in antimicrobial efficacy of AH26 over the time. Kumar<sup>[2]</sup> (2017) reported similar result about AHplus and MTAfillapex, but Jafari<sup>[6]</sup> (2011) showed reduction in antimicrobial effect of AH26 over the time. Against the results of our study, some authors reported that AH26 had no or the least antimicrobial activity<sup>[14,19]</sup>. Pizzo<sup>[21]</sup> (2006) and Willershausen<sup>[20]</sup> (2011) showed AHplus had no antibacterial effect on *E. faecalis*, but in the present study its efficacy was established. Difference in methodology (ADT or other methods) and tested microorganism may be the main reasons of the controversies. The current study and other same ones<sup>[2,5-9]</sup> have been determined that the Resin-based sealers such as AH26 and AHplus are antimicrobial. The antimicrobial activity of them may be related to release formaldehyde in the polymerization process. There are a few studies evaluated antimicrobial efficacy of MTAfillapex comparison with Resin-based sealers<sup>[2,6,9,10,12]</sup>, and in most of them, same as our study, antimicrobial activity was weak. An ideal endodontic sealer should have maximum antimicrobial activity to eliminate the growth of the microorganisms. There is a controversy about antimicrobial activity of different type of sealers. The sensitivity of the antimicrobial efficacy of sealers may be depend on sealer type

and different diffusibility of them, inoculated microorganism, test method and interval times.

### CONCLUSION:

It was concluded that antimicrobial activity of MTAfillapex was almost weak and AH26 has the highest antimicrobial efficacy followed by AHplus. To achieve more reliable results *in vivo* studies are recommended, also long term follow up of patients treated with MTAfillapex for antimicrobial evaluation.

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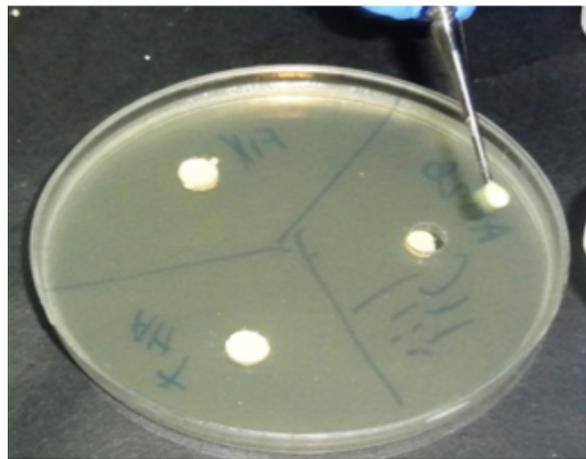
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**Table 1.** Mean and standard deviation of inhibition zone of three sealers

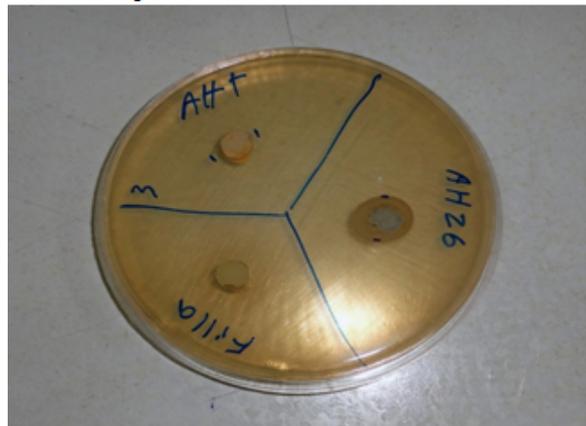
Type of sealer / Period	24hr	48hr	72hr	Total
AH26	16±0.707	15.8±0.836	16.8±1.304	16.20±1.014
AHplus	10.4±0.548	10.4±0.894	10.2±0.447	10.33±0.617
MTA fillapex	6.8±1.095	6.6±0.894	6.6±0.894	6.67±0.899

**Table 2.** Comparison of antibacterial effect of three sealers by anova test.

Sealer type	Mean of inhibition zone in mm	Standard deviation	95% CI	P Value	F	df
AH26	16.2	1.014	15.64-16.76	0.016	2.371	2
AHplus	10.33	0.617	9.99-10.68			
MTA fillapex	6.67	0.899	6.17-7.17			
Total	11.07	0.839	10.331-11.81			



**Figure 1.** Fresh mixed Sealers were carefully placed into the well in each section of the plates with the aid of sterilized spatula



**Figure 2.** The Inhibition zones around each sealer