



## Dentin drying methods affect the apical seal of three root canal sealers

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### Abstract

**Aim of the study:** The purpose of this research was to see how drying protocols affected the apical sealing of teeth filled with various sealers.

**Materials and methods:** Protaper rotary files were used for root canals instrumentation of ninety teeth with single root canal. According to the drying protocol, the teeth were separated into three groups (n = 30): "GI–paper points"; "GII–ethanol + paper points"; "GIII–EndoVac + paper points". Using a single-cone approach, every group was separated to three subgroups based on the sealer used: BiooRoot sealer, Epoxy resin and zinc oxide eugenol (ZOE), The apical dye penetration in millimeter was examined under a streromicroscope to assess apical seal. The data was submitted to one –way ANOVA and T test.

**Results:** The result showed statistically no significant difference in microleakage between bioRoot and Epoxy resin ( $p > 0.05$ ) while there was significant differences of microleakage between ZOE and other sealers, and there is no significant difference between drying protocols in canals obturated with each used sealers (BioRoot, Epoxy resin and ZOE).

**Conclusion:** Drying protocols have no effect on the apical seal of the tested sealers.

**Keywords:** BioRoot; Drying protocol; Apical seal; Root canal sealer.

### Introduction

It is necessary to adequately clean, shape, and obturate the root canals to restore the healthiness of the periapical

area. The obturation should facilitate efficient filling and sealing over the full length of the root canal. As a

result, it's critical that the sealers employed in root canal obturation have particular properties, such as insolubility in tissue fluids, biocompatibility, flow ability, suitable setting time, antibacterial activity, and dentine wall adhesion.<sup>1</sup>

Apical microleakage is the most prevalent reason of endodontic failure, and it is impacted by a number of factors, including obturation procedures, chemical and physical qualities of root canal obturation materials.<sup>2</sup>

Of the long history and commonly used sealers is ZOE that based on zinc oxide (ZnO) powder and Eugenol liquid. ZOE is a water soluble that might decrease their physical features when contact with moisture during service, especially at the initial phase of setting reaction. ZOE showed gross leakage due to poor sealing property.<sup>3</sup>

In continuous attempt to improve the performance of root canal sealer, new calcium silicate-based sealers have been developed. BioRoot RCS "a powder/liquid hydraulic tricalcium silicate-based cement" is indicated for single-cone obturation or lateral compaction technique. The powder composed of tricalcium silicate, povidone, and zirconium oxide, while the liquid is a calcium chloride and polycarboxylate aqueous solution.<sup>4</sup>; it has inferior cytotoxicity than other sealers<sup>5</sup>, and has antibacterial activity<sup>6</sup> AH Plus "epoxy resin-based sealer" due to its low solubility, acceptable radiopacity, resistance, and flow, as well as its dimensional stability and excellent bond strength to dentine, has been widely used as the gold typical sealer<sup>(7,8)</sup>. The drying protocol used before root canal obturation may have a direct impact on the bonding of sealer to the dentin, interfering with the microleakage process. as well as the success or failure of the endodontic therapy<sup>9</sup>. Endodontic sealers' sealing

effectiveness and adhesion are affected by residual moisture in the root canal, according to several studies<sup>10</sup>. However, a complete lack of moisture might also result in undesirable results. Moisture is crucial to the setting and hardening of bioceramic endodontic sealers. The complete lack of moisture could be linked to a change in the endo-dontic sealer's setting reaction<sup>11</sup>. Despite the fact that the drying is commonly done with absorbent paper points, Ethanol alcohol has delivered fillings with strong bonding. Simultaneously, mechanical equipment like as the EndoVac allow root canal drying.<sup>12</sup>

Thus, this research assessed the impact of various root canal drying protocols on bond strength of a bioRoot endodontic sealer, compared with an epoxy resin-based sealer (AH Plus) and ZOE.

The null hypothesis was that the bonding of each tested endodontic sealers to the root dentin would not be influenced by the different drying protocols.

## Materials and methods

Ninty single-rooted teeth with mature apices were gathered from Mosul University's College of Dentistry. This study was approved by the ethical committee of the College of Dentistry, University of Mosul, Mosul, Iraq (Uo.Den/H.DM.33/22). Curettes were used to clean the root surfaces, which were then preserved in distilled water. Under continuous water spray, the crowns of all teeth were removed using a safe-sided diamond disc to standardize root length to 12mm from the apex. K-file size 15 was used to negotiate root canals, followed by protaper rotary system preparation "Dentsply, Maillefer, Switzerland". By subtracting "1 mm" apically, the working length of 11mm was found.

The protaper system was configured to speed =300 rpm and torque=2 n.cm with file sizes 20(F1) and 25(F2) during preparation. Each root canal was irrigated with one ml of 5.25 % NaOCL and 17 % EDTA after each file was used, and then cleaned with distilled water.<sup>13</sup>

Based on the different drying processes, the roots were then haphazardly divided into 3 groups (n=30): Group I: "absorbent paper points", Group II: "ethanol irrigation and paper point drying", and Group III: "EndoVac + paper point". In GI, Paper points "Tanari, Manacapuru, Brazil" were placed inside root canal one by one till the final one was fully dry. In GII, A 30-gauge blunt-tip syringe was used to inject 1 mL of 95 % ethanol alcohol into the root canal as close to the WL as feasible.<sup>14</sup>

After 1 minute, the solution was removed and dried with paper points. In GIII, Initially, surplus distilled water was removed with paper points, similar to GI. The following approach was utilized for EndoVac "SybronEndo, Orange, USA": if no resistance was encountered, a macrocannula was injected inside the canal at maximal distance apically. After that, a microcannula was inserted into the WL, and the drying process was completed using a single paper point.<sup>15</sup>

Then each group was divided into three subgroups(n=10) according to sealer used "BioRoot sealer" Septodont, Saint-Maur-des-Fosses, France" , AH Plus sealer "Dentsply De Trey, Konstanz, Germany" and ZOE "Eugentin, Tehnodent, Russia". According to the manufacturer's recommendation, groups were obturated with each type of sealer. The sealer was applied to canal walls using a lentulo spiral (Dentsply, Maillefer) till the canals were filled with sealer. Then the gutta

percha inserted inside the canal. Excess Gutta Percha was chopped off with a hot tool, and the plugger gently condensed it. The coronal orifices of all roots were sealed with Cavit G. The roots were then kept at 37°C for one week to ensure that the sealers had fully set.<sup>16</sup>

Except for 1 mm apically, roots were coated with two layers of nail varnish. After two days to ensure complete dryness of the nail varnish, the roots were put in a container of methylene blue and put in incubator at 37 c for 72 hours. Then roots were rinsed with tap water and two vertical grooves were made with a diamond sectioning disc with a slow speed hand piece under water cooling, one buccally and one lingually. Using a chisel, the roots were separated into two sections.<sup>17</sup>

Under a stereomicroscope (Hamilton, Italy) at 40x magnification with a micrometer calibration slide, dye penetration in mm along the canal walls was measured as see in figures (1) and (2). The measurements were assembled and analyzed by one way ANOVA and t-test using SPSS statistical software at 0.5% level of significance

## Results

Mean and standard deviation of microleakage of different sealers under each drying protocol are shown in table 1.

Irrespective of drying protocols the one way ANOVA indicate no significant difference in microleakage between the BioRoot and AH Plus sealers type(p>0.05), While there was significant differences in microleakage

between ZOE and other used sealers. T test showed there was no significant differences in microleakage between the drying protocol in canals obturated with AH Plus ( $p>0.05$ ), no significant difference in microleakage between the drying protocol in canals obturated with BioRoot sealers ( $p>0.05$ ) and ,there was no significant difference in microleakage between the drying protocols in canals obturated with ZOE sealers ( $p>0.05$ )

## Discussion

The root canal sealer's ability to bond to the root canal is directly affect the quality of root canal sealing after obturation. The adhesiveness of sealers may be affected by the dryness and presence of fluids prior to obturation.<sup>18</sup>

However, no research had examined the influence of various drying processes on the sealing of AH Plus and BioRoot sealer to the root canal walls till now.

As a result, the goal of this research was to see how many drying techniques affected bonding of "a bioRoot endodontic sealer" compared to "an epoxy resin-based sealer" and "ZOE". The null hypothesis was none of the drying methods affect the endodontic sealers' ability to adhere firmly to the root dentin, Once obturation was done with single cone technique.

Many methods were used to evaluate the microleakage such as bacterial activity, scanning electron microscope and dye penetration, and each has benefits and limitations. Dye penetration methods is the most

commonly used method for identifying microleakage, It was selected for this study. Meththylene blue was selected because it penetrates more and has smaller particular size. The dye penetration technique is depend on linear depth of the dye between the root filling and the canal wall.<sup>19</sup>

Because of its superior physicochemical qualities, and sufficient dentin bond strength, the epoxy-resin based sealer selected for comparison to bioRoot, It was widely employed in prior investigations then was regarded a gold-standard sealer.<sup>20</sup>

Our findings indicate that a root canal with moisture after using various drying processes has no effect on bond strength to dentinal surfaces

In addition, no statistically significant difference in microleakage between each endodontic sealer was found, regardless of the drying protocol.

The Epoxy show moderate sealing less than Bioceramic probably due to the polymerization shrinkage but still superior to ZOE due to poor adhesion property to dentin and it is high permeablility. Many literatures have shown the superiority of epoxy-resin based sealers compared to ZOE sealer,in term of bonding, our results are in agreement with those finding.<sup>21</sup>

Numerous investigations have found that endodontic sealers' ability to adhere depends on the amount of root canal moisture, as well as sealers components affect the bond strength in the presence of greater or lower moisture level.

Paula et al. (15) evaluated many drying methods "70% isopropyl alcohol, paper points, EndoVac and 95% ethanol"

before the application of "MTA Fillapex, AH Plus and Sealapex" into root canals, and related to great polarity of molecules of ethanol with the dryness of canals, and resulting in low sealer adhesion. In other research (22), the result was that the bond of iRoot SP sealer low as paper points with ethyl alcohol used to dried root canals . that finding clarified by the fact that there is similarity between sealers used in this study, and other bioceramic sealers, have in their composition 'calcium silicate and calcium phosphate" which required moisture to complete the sealer setting and hardening.

Also, extreme dehydration by the mentioned methods extract the liquid from dentin, may impede the penetration of hydrophilic sealers and affect the bonding . That supports a previous research <sup>23</sup>, which found that keeping dentin moist, rather than dry or wet, before applying bioactive sealers may be beneficial.

Though, in this research, there was no significant difference among experienced drying methods when sealers and gutta percha were used for obturation. The different results of researchs may be related to different in methods, In the study by Tasdemir et al. <sup>24</sup> sealer only was used for obturation of root canals.

Studies have stated that bonding of calcium silicate-based sealers to dentine was lower with complete drying of canals <sup>15,24</sup>.

The current study has some limitations, like the comparison was not done with

other bioceramic sealers. So, it is important to do further studies in order to verify the properties of this sealer matching it with other calcium silicate-based sealers.

### Conclusion

There was no significant difference in microleakage between the sealers used according to different drying protocols. Therefore, drying protocols have no effect on the apical seal of the tested sealers.

### Conflicts of Interest

The authors reported that they have no conflicts of interest.

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Table (1):

	Mean (SD) in "Group I"	Mean (SD) in "Group II"	Mean(SD)in "Group III"
BioROOT	0.79 (0.23)A	0.89 (0.32)A	0.68(0.24)A
AH Plus	1.23 (0.51)A	1.18 (0.59)A	1.29(0.62)A
ZOE	2.91(0.37)B	2.89 (0.8)B	3.28(0.52)B

Different capital letters indicate significant differences

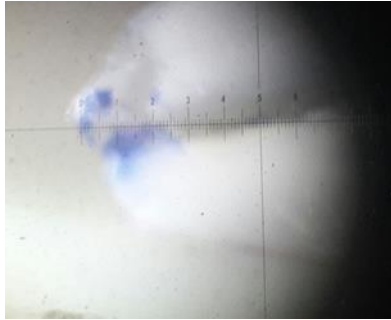


Figure 1

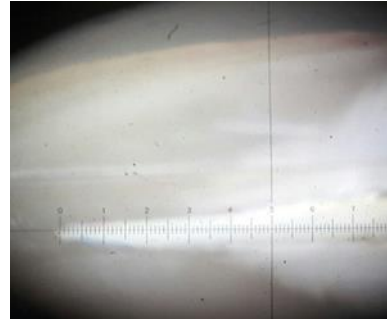


figure 2