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Original Research

The Effect of Contact with Moisture on the Voids in the Sealer during Canal Obturation with Lateral Condensation Method: An *In-vitro* Study

Fatemeh Mokhtari[1], Ali Shayesteh Fard[2], Mehdi Tabrizizadeh[3], Amin Davoudi[4], Hamid Badrian[5]

Contributors:

[1]Assistant Professor, Department of Endodontics, School of Dental, Shahid Sadoughi University of Medical Science, Yazd, Iran; [2]Private Practice, Yazd, Iran; [3]Associate Professor, Department of Endodontics, Faculty of Dentistry, Shahid Sadoughi University of Medical Sciences, Yazd, Iran; [4]Student, Dental Students Research Center, School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran; [5]Post-graduate Student, Department of Operative Dentistry, School of Dentistry, Shahid Sadoughi University Medical Sciences, Yazd, Iran.

Correspondence:

Badrian H. Department of Operative Dentistry, Daheye Fajr St, School of Dental, Shahid Sadoughi University Medical Sciences, Yazd, Iran. Tel.: + (0)989132759215. Email: Hamid.badrian@yahoo.com

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Abstract:

Background: The purpose of this study was an evaluation of the effect of contact with moisture on the location and area of gaps or voids in the sealer during canal obturation with lateral condensation method.

Materials and Methods: 60 extracted human teeth were selected. The teeth were divided into 4 groups: In groups, one and two after cleaning and shaping the canals were dried with paper cones, then were filled with gutta-percha and AH26 sealer (in group one) and Rosen sealer (in group two) using lateral condensation method. In groups, three and four canals were not dried and were filled with gutta-percha and AH26 sealer (in group three) and Rosen sealer (in group four). Each root was sliced to three coronal, middle, and apical sections. Using a stereomicroscope with ×40 zoom, digital images of the coronal side of each section were prepared. The surface area of gaps or voids was measured using ArchiCad software in square micrometers unit. The data were analyzed using Kruskal–Wallis and Mann–Whitney tests using SPSS software version 19 at a significant level of 0.05.

Results: The results demonstrated that there was no significant difference between four groups of study in relation to surface area and percentage of gaps or voids in three sections ($P > 0.05$).

Conclusion: Based on the result of this study type of sealer and condition of the canal have not a significant impact on the formation of void following canal obturation.

Key Words: Endodontic sealer, moisture, obturation, voids

Introduction

The main objective of root canal filling is to replace neutral materials instead of space that previously was filled by the pulp tissue, so that stops the canal contamination through blood, saliva leaking through the crown, and prevents entry of microorganisms from periodontium.[1] Ingle *et al*. stated that the most common cause of failure of root canal therapy is lacking apical seal of root.[2] Kaskehashi *et al*. clarified that bacteria are as the most important factor of progression and resistance of pulp and periapical disease. Furthermore, they emphasized that the success rate of root canal treatment depends on reducing bacteria and prevent re-infection.[3]

The important point in treating the root canal is sealing the apical foramen and other intracanal spaces against the invasion of bacteria.[4] In recent years, methods have been developed to fill the canals, but lateral condensation obturation is the most common method. In this technique, the gutta-percha is the central filling material, and sealer is used to fill the voids between the cones together and seal the canal walls.[5] Theoretically, the moisture remaining in the canal will apply their most likely undesirable effects on sealer used. For optimum physical, chemical, and biological sealing level, they should be prepared according to the manufacturer's instructions. One of the points that should be compliance before placing sealer inside the canal is to completely drying the canal.[6,7] Some of these adverse effects are: Change of hardening rate and its solubility, voids in the sealer, covering of dentin surfaces, and preventing penetration of sealers into dentinal tubules as well as stimulatory effects on the periapical region of such as presence of blood in canal.[8,9]

Roggendorf *et al*. investigated the effect of moisture on 5 types of sealers. Overall results showed that statistically drying of canals had no significant effects on canal leakage of each sealer, but significant difference was notified between different sealer.[9] Mutal and Gani conducted a study to investigate the endodontic spores. The results showed that the pores are found consistently in all of the sealers. However, its frequency and sizes in zinc oxide eugenol sealer were more than the epoxy resin and glass ionomer sealers. If the sealers containing calcium hydroxide, the porosity will increases.[10] It is stated that the moisture does not have a significant effect on the apical seal.[11] Two other studies did not find a significant change in leakage of AH26 sealer in dry and blood infected conditions.[12] Hosoya *et al*.[13] examined four methods of drying the moisture canal showed a negative influence on the filled canal with ionomer glass sealers. In this study, the best conditions for drying the canal sealed were paper cones. Walker *et al*.[14] conducted a study on the effect of residual moisture on the

contact surfaces of the canal's dentin and sealer. According to that result, more uniformed distribution of the sealer has been seen in dried group, which showed more depth of penetration compared to the wet sealer in the dentinal tubules. The aim of the present study was to determine the effect of moisture on the location and area of the bubbles or voids in the sealer during obturation with lateral condensation technique.

Materials and Methods

In this analytical-observational *in-vitro* study, 60 extracted teeth with straight roots and the closed apex were selected. The crown was cut from the collar. To determine the length of the canal, a file size #10 (Mani, Tochgi, Japan) negotiated the canal to be seen in the apical of the root. 1 mm was overlooked from the length, and the obtained length was considered as actual working length.

Cleaning and shaping of the canal was done based on step-back technique. So that the apical area was shaped by K-files size #30. The protaper rotary files were used to widen the coronal portion of the canal (Mani, Tochgi, Japan). After each use of the files, the canals were irrigated with 5 mL of normal saline. Removal of the smear layer was done by sodium hypochlorite 5/25% (Chloran, Tehran, Iran) and 17% ethylenediaminetetraacetic acid (EDTA) (AriaDent, Tehran, Iran) in three steps. In the first step, sodium hypochlorite and EDTA were used; and in the other steps, sodium hypochlorite was used. The final irrigation was done with normal saline.

After preparation, the canals were randomly divided into 4 groups:

Group 1: Canals were dried with a paper cone (Ariadent, Tehran, Iran) so that the last three paper cones were navigated to the working length. Then lateral condensation with AH26 sealer (Dentsply DeTrey, Konstanz, Germany) was used to fill the canals

Group 2: The canals were dried like Group 1. Then, lateral condensation with Rosen sealer (Dentaires, Rosen, Switzerland) was used for canal filling

Group 3: The canals were not dried and filled with AH26 sealer using lateral condensation

Group 4: The canals were not dried and were filled with Rosen sealer using lateral condensation.

The samples were kept in the incubator at 100% humidity and 37°C for a week. In the next step, each root was cut into three sections at the coronal, middle, and apical sites, horizontally. So, the thickness of each part was of 3 mm. For measurement of voids or bubbles, digital images of a stereomicroscope from the coronal border of each section were obtained with ×40 of magnification.

These images were then transferred to a computer and the areas of micro bubbles or voids were measured by software ArchiCAD 15 in square micrometers and its ratio was calculated as a percentage of the total area of the root canal. The samples for the presence or absence of bubbles were investigated and ranked based on following scores:

0 = No bubbles in three section

1 = Had bubbles in one section

2 = Had bubbles in two sections

3 = Had bubbles in three sections

The data were analyzed using Kruskal–Wallis and Mann–Whitney tests using SPSS software version 19 at a significant level of 0.05.

Results

In this study, 180 sections were examined by a stereomicroscope for surveying percentage of areas of the bubbles or voids during root canal obturation with lateral condensation technique in both wet and dry environments.

By comparing the surface area of the bubbles or voids (in the apical, middle, and coronal sections of the various groups), a significant difference was not observed (all $P > 0.05$) (Table 1).

The percentage of the surface areas of the bubbles or voids in coronal sections showed significant differences between Rosen groups in wet and dry environments ($P = 0.03$). So that the dry environment had lesser bubbles and voids (Figure 1).

Percentage of bubbles or voids in the studied groups is shown in Table 2. The analyzed results does not show statistically significant differences in the comparison between the sealer and the canal status ($P > 0.05$)

By comparing the bubbles or voids percentage (in the apical, middle, and coronal thirds), despite the large difference between the means of Rosen Sealer and AH26 sealer in humid environments, the difference was not significant ($P = 0.052$). Nevertheless, the AH26 sealer had lesser bubbles and voids in moisture condition.

Table 1: Surface area of voids and bubbles (mm²) in different groups.

Condition of canal	Mean±SD		*P* value
	Dry	Wet	
AH26	2.13±0.93	1.94±0.91	0.99
Rosen	0.93±0.54	0.92±0.44	0.16
P value	0.69	0.11	

SD: Standard deviation

Table 2: Percentage of voids and bubbles in different groups.

Condition of canal	Mean±SD		*P* value
	Dry	Wet	
AH26	1.19±0.69	0.98±0.56	0.90
Rosen	0.87±0.62	1.30±1.10	0.20
P value	0.052	0.64	

SD: Standard deviation

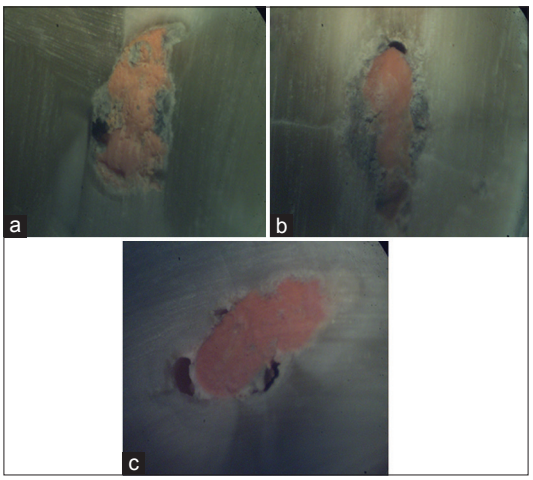

Figure 1: One sample of each group under stereomicroscope: (a) AH26 group exposed to moist, (b) Rosen sealer exposed to moist, and (c) AH26 in dried condition.

Discussion

Drying the canal is always recommended as an important issue before the root canal filling. Several studies[9,13,15,16] have shown that moisture and fluids can have a negative effect on the sealing of the canal. In this study, the quality of root canal obturation by location and area of the bubbles or voids in the sealer during obturation with lateral condensation technique was evaluated in three sections. Leakage test is frequently utilized to evaluate the quality of root canal fillings.[17,18] Differences in leakage evaluation are often at odds.[19] To prevent these weaknesses; the samples were examined with a stereomicroscope at ×40 magnification.[20-25] To assess and measure the surface area of the bubbles details, ArchiCad software was used in this study.

Adhesion and penetration properties of the resin sealer, which allows sealers to rise the strength sealing, are greater when dentin exposure has greater porosity.

Roggendorf *et al.*[9] found that AH-plus sealer had the highest leakage in the presence of moisture; however, Roekoseal and Tubliseal, which are zinc oxide eugenol-based sealers, have most microleakage in the absence of moisture. The difference between present study and that one may be due to differences in methods of study. In addition to the procedure, another factor that can affect the results of these studies might come from the kind of used sealers.

In another study by Hosoya *et al.*,[13] Ketacendo sealer as a glass ionomer base was used. Their results showed that moisture can greatly affect the tested sealer. However, in the present study, no significant difference was found between the dry and moist condition between the tested materials. Walker *et al.*,[14] observed the contact point of sealer and dentin by SME. More uniform distribution was found in the dry group than AH plus sealer which manifests better penetration depth of sealer in the dentinal tubules.

There are so few studies on the effect of moisture on the seal of filling the canal. The remarkable result of the present study is that the effect of moisture content on the sealing of the canal depends on the used sealers more than anything else.

The percentage and overall surface area of the bubbles or empty spaces were studied in three section apical, middle, and coronal. The related results showed that the surface area of the bubbles or voids was increased in all samples from the apical to coronal, significantly.

Akman *et al.*,[26] also mentioned similar results to current study. Sealer thickness increases in all of the samples from apical to coronal, which indicates that more amount of gutta-percha with fewer sealers brings about lesser bubbles and is the best way to reduce the voids. Further description, high numbers of the bubbles and voids in the coronal area seem logical.

Conclusion

With considering the limited research on the effect of moisture on the seal of root canal fillings; the type of sealer and condition of the canal has not a significant impact on the formation of void following canal obturation. Nevertheless, there are several factors that can affect the outcome of the studies. It is recommended that further studies be conducted by the sealer in various conditions.

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