Original Article

The Sealing Ability of Resilon and Gutta-Percha in Severely Curved Root Canals: An In Vitro Study

Armita Rouhani[1], Jamileh Ghoddusi[2], Neda Naghavi[1], Zahra Ebadzadeh[3], Majid Akbari[4]

[1]Assistant Professor of Endodontics, Dental Research Center, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

[2]Professor of Endodontics, Dental Research Center, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

[3]General dentist, Private Practice, Mashhad, Iran

[4]Associate Professor of Restorative Dentistry, Dental Research Center, Faculty of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran

Abstract

Objective: The aim of this study was to compare the apical seal of curved canals obturated with Resilon/Epiphany with gutta-percha/AH Plus.

Materials and Methods: Thirty-four extracted human mandibular molars with 25-40 degree canal curvature of the mesial root were selected for this study. After preparation, the mesiobuccal canals were obturated with gutta-percha and AH-Plus sealer (group G) or Resilon and Epiphany sealer (group R). Four specimens served as control. Microleakage was evaluated after passing 3 and 30 days using the fluid filtration technique. The data were analyzed statistically using parametric tests.

Results: In the 3-day evaluation, the mean microleakage in group R was significantly less than in group G ($P< 0.05$). After 30 days, there was no significant difference between the two groups ($P> 0.05$). In group G, the leakage values at the end of 30 days were significantly less than values at the end of 3 days. Although in group R the mean leakage decreased after 30 days, this reduction was not statistically significant.

Conclusion: Resilon/Epiphany provided a better seal than gutta-percha/AH-Plus in severely curved root canals immediately after obturation, although with the passage of time, Resilon/Epiphany was equivalent to gutta-percha/AH Plus in sealing properties.

Key Words: Curved canal; Epiphany sealer; Filtration; Dental leakage; Resilon

Journal of Dentistry, Tehran University of Medical Sciences, Tehran, Iran (2013; Vol. 10, No.2)

Corresponding author:
M. Akbari, Department of Restorative Dentistry, Faculty of Dentistry, Mashhad, Iran

akbarim@mums.ac.ir

Received: 28 November 2012
Accepted: 23 January 2013

INTRODUCTION

Successful endodontic treatment depends on elimination of pulp tissue, bacteria, their by-products and necrotic debris from the root canal system in addition to entomb any residual bacteria and provide adequate seal to prevent re-infection of root canal space [1, 2]. Achieving these goals may be easy in straight canals, but fulfilling these criteria in severely curved canals can be difficult [3, 4]. Apart from unde-

sirable accidents that have been observed during preparation of curved root canals (ledge formation, blockages, perforations and apical transportation), disinfection and removal of infected pulp tissue and bacteria can be more difficult in these cases [5]. Therefore, complete coronal and apical seal of root canal system seems a critical factor when treating severely curved root canals.

Gutta-percha has been traditionally used for root canal obturation. However, it does not bond to root dentin and does not completely seal the root canal system.

Resilon (Pentron, Wallingford, CT) is a synthetic, thermoplastic, polymer-based material which was introduced to the market for obturation of root canal space in endodontically treated teeth. Resilon was developed in order to produce an adhesive bond between the solid core material and the sealer. It has been designed to be used with Epiphany (Pentron Clinical Technologies, Wallingford, CT), a resin sealer with a bonding capacity to dentin. The Resilon/Epiphany obturation system contains three components: core material, sealer and primer [6, 7].

Recently, a self-etch (SE) version of this sealer was developed (Epiphany SE) which consists of two items: Epiphany self-etch sealer and the core material (Resilon). The manufacturer has stated that the method of application of Resilon/Epiphany and gutta-percha are the same. Resilon/Epiphany can be used with any current root canal obturation technique including lateral compaction, vertical compaction, or thermoplastic injection. It has also been shown that Resilon has higher solubility than gutta-percha in chloroform [8].

It has been stated that the resin sealer bonds to Resilon core and attaches to the root dentin and forms a "monoblock".

Adhesion of the sealer to both core material and root surface may have the potential to reduce the microleakage because of its adhesive characteristic and penetration into dentinal walls [6, 9].

It also has been shown that the depth of spreader penetration during lateral compaction of Resilon is more than gutta-percha [10] and root canals filled with Resilon were also significantly more resistant to fracture than that of gutta-percha [11].

Several investigations compared the sealing ability of gutta-percha versus Resilon in straight canals. Some studies showed that Resilon had significantly less leakage when compared with gutta-percha [12-14]. Alternatively, some of them found no significant difference between Resilon and gutta-percha in the sealing ability of root canal system [15-17].

However, to the best of our knowledge, no study has compared the sealing properties of Resilon with gutta-percha in severely curved root canals. The use of Resilon may be helpful to achieve better apical seal in curved canals and may prove to be more effective than traditional gutta-percha technique. Therefore, the purpose of this study was to compare the ability of Resilon with gutta-percha to seal the root canal system in severely curved root canals.

MATERIALS AND METHODS

The Thirty-four extracted human mandibular first and second molars with a 25-40 degree canal curvature of the mesial root and type IV anatomic configuration of mesial canals (two separate root canals from the orifice into the apical foramen, according to Vertucci's classification) were selected for this study [18]. The research protocol was approved by Vice Chancellor for research of Mashhad University of Medical Sciences.

All teeth were carefully examined for absence of cracks, resorptions, root caries and immature apices and restored in chloramine-T before use. Schneider technique was used for determination of root canal curvature [19]. Size 10 K-files (Dentsply Maillefer, Zurich, Switzerland) were inserted into the mesiobuccal canals and radiographs were taken. Teeth

with mesiobuccal root canal curvatures between 25 and 40 degrees were selected. The crowns were removed to a standardized root length of 14 mm and the distal root was also completely removed. A 10 K-file was inserted into the mesiobuccal canal until its tip was visible exactly at the apical foramen. The working length was established by reducing 1 mm from the measured length.

The mesiobuccal canals were prepared by hybrid technique using hand files and Protaper Ni-Ti rotary (Dentsply, Tulsa Dental, Tulsa, OK) instruments according to the manufacturer's instructions. NaOCl (5.25%) was used as irrigant between each instrument. RC-Prep (MD Chelcream, META BIOMED Co. Ltd, Chungbuk, Korea) was used as lubricant with each successive file. For smear layer removal, 5 ml of 17% EDTA was placed in canals for 1 minute and then the canals were irrigated with 5 ml 5.25% NaOCl. The final irrigation was made using sterile water. All canals were dried with paper points and randomly divided into two experimental groups (N=15) and two control groups (N=2).

In group G, a #25 gutta-percha (Gapadent Co., Ltd, Korea) master cone which was coated with AH Plus (Dentsply Maillefer) sealer was inserted into 0.5-1 mm working length. Lateral compaction technique using finger spreader size B and accessory cones (size 20) was performed until the entire root canal was filled.

The excess gutta-percha was cut and the filling was vertically compacted.

In group R, a #25 Resilon master cone coated with Epiphany SE sealer (Pentron Clinical Technologies, LLC, Wallingford, CT) was placed into 0.5-1 mm working length. Obturation of the root canal system was performed similar to group G. After cutting the excess Resilon cones, the coronal surface of obturation was light cured for 40 seconds.

Canals in the positive control group were not filled. The teeth in the negative control group were obturated with gutta- percha/AH Plus or Resilon/Epiphany SE (one of each) similar to experimental groups.

To allow the material setting, all specimens were incubated for 3 days at 37°C and 100% humidity.

Two layers of nail varnish (Arcancil, Paris, France) were applied to the external surface of all specimens in experimental and positive control groups (including apical foramina of the mesiolingual canal), except for 2mm around the apical foramen of the mesiobuccal canal. The negative control group was completely sealed. The first fluid transport measurement was made at this time.

Using the fluid filtration system described by Moradi et al., the apical end of the root (excluding the apical foramen of the mesiobuccal canal) was covered by cyanoacrylate glue (Inter Lock Co., Japan) and was mounted on a latex pipe (Guihua Co., China) and then the free end of the pipe was connected to the system [19].

After reaching balance in the system, the first picture of the bubble position in the micropipette was taken. Four subsequent pictures were taken with 2-minute time intervals (2, 4, 6 and 8 minutes after the first picture).

The same steps were repeated for the next samples. All pictures were transferred to the computer and the bubble position in each picture was determined by professional software. As a result, for each sample, one number was achieved. This number expressed the amount of leakage in the root canal as μL/min/cm H2O.The specimens were separated from the apparatus and were left in the incubator (37°C and 100% humidity) for the next 1 month and again microleakage was evaluated.

The data were analyzed statistically using parametric tests.

Comparison was made between the leakage results of two materials using t-test. Comparison between the leakage results of each material at two time intervals was completed using paired t-test. The significance level was defined as $P<.05$.

RESULT

The specimens in the positive control group showed excessive fluid transport, while those in the negative control group did not leak, which confirmed the functioning and reliability of the experimental model.The mean values for microleakage in experimental groups are presented in Table 1. Analysis of data showed that in 3 days, the mean microleakage in group R was significantly less than group G (P=0.03); but after 30 days, there was no significant difference between the two groups (P=0.30). In group G, the leakage values at the end of 30 days were significantly less than values at the end of 3 days (P=0.003). Although in group R, the mean leakage decreased after 30 days, this reduction was not statistically significant (P=0.90).

DISCUSSION

The results of this study indicated that Resilon/Epiphany system created a significantly better seal than gutta-percha/AH Plus immediately after obturation of severely curved root canals, but with time, Resilon/Epiphany was equivalent to gutta-percha/AH Plus.

There was a reduction in microleakage in gutta-percha/AH Plus group with time. Day 3 of this study showed less fluid transport with Resilon/Epiphany compared with gutta-percha/AH Plus.

These results are consistent with those of Wedding et al., in which root canals obturated with Resilon/Epiphany leaked significantly less than canals obturated with gutta-percha/AH-26 at day 1 and day 7 [14].

Sasgen et al. using computerized fluid filtration technique, also found less fluid leakage with Resilon /Epiphany compared with gutta-percha/AH-Plus or gutta-percha/ Sealapex at 7 days [21].

Stratton et al. using the continuous wave of condensation, stated that the Resilon/Epiphany system had a significantly better seal than gutta-percha and AH-Plus [22].

Bodrumlu and Tunga evaluated the apical sealing ability of gutta-percha/AH 26, gutta-percha/AH Plus and Resilon/Epiphany in two different studies using fluid-transport method or dye penetration methodology and found that teeth filled with gutta-percha/AH 26 displayed the most apical leakage and Resilon/Epiphany sealer showed the least apical leakage [23, 24].

None of these studies used teeth with curved canals. At day 30 of this study, there was no significant difference between Resilon/ Epiphany and gutta-percha/AH Plus in mean fluid transport. Biggs et al. also found that Resilon/Epiphany was equivalent to gutta-percha/Roth or gutta-percha/AH Plus at sealing root canals [15].

Table 1. Mean Microleakage in Experimental Groups in Two Time Intervals (μL/min/cm H2O)

Groups	Sample Size	3 Days After Obturation		30 Days After Obturation	
		Mean	Std. Deviation	Mean	Std. Deviation
G (Gutta-percha/AH Plus)	15	.4573	.30024	.1475	.19630
R (Resilon/Epiphany SE)	15	.2575	.17757	.2455	.30405

Using the bacterial leakage system, Williamson et al. [25] and Fransen et al. [16]. found that there was no statistically significant differences in the resistance to leakage between Resilon/Epiphany and gutta-percha/AH Plus groups. In contrast, Santos et al. using fluid filtration model, showed that root canals obturated with Epiphany/Resilon exhibited higher leakage than specimens filled with AH Plus/gutta-percha at short and long term [26]. In another study conducted by Hirai et al., root fillings with gutta-percha and AH Plus sealer also showed lower leakage than canals obturated with Resilon and Epiphany [27].

These conflicting results may be because of using different models for evaluating leakage, different evaluation periods, various obturation techniques and presence or absence of smear layer.

Importantly, all the mentioned studies evaluated microleakage of Resilon/Epiphany system in straight root canals. In this study, the sealing properties of Resilon/Epiphany system were assessed in severely curved root canals. Instrumentation and obturation of these cases represent a challenge to clinicians. Removal of infected pulp tissue and bacteria can be more difficult and it has been shown that an increased root canal curvature decreases mechanical efficacy of irrigants [28]. Thus, it seems more critical to seal the root canal space to entomb any residual bacteria when encountering teeth with curved canals. Since the Resilon/Epiphany provided better seal than gutta-percha/AH Plus immediately after obturation, the use of Resilon/Epiphany is recommended for severely curved root canals.

CONCLUSION

Although Resilon/Epiphany provided better seal than gutta-percha/AH Plus in severely curved root canals immediately after obturation, clinical studies are needed to support the use of Resilon with Epiphany sealer for obturation of these canals.

ACKNOWLEDGMENTS

This article is based on undergraduate thesis of Dr. Ebadzadeh (no. 2476). This study was supported by the Vice Chancellor for research of Mashhad University of Medical Sciences. The authors declare no conflict of interest.

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