Original Research

Effect of Post-space Preparation with Rotary Devices and Heated Instruments on Microbial Leakage of Gutta-percha and Resilon-Epiphany Obturated Canals

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Abstract

Introduction: After endodontic procedures, root canal reinfection is a main concern for dentists. However, application of a proper apical seal can prevent such contamination. Therefore, it seems necessary to study the factors affecting the development of a suitable apical seal. **Materials and Methods:** In this study, 64 extracted human single-canal premolars were used. An equal length of roots was obtained by cutting the crown. The teeth were randomly divided into four experimental groups of 15 premolars, as well as 2 positive and negative controls. The root canal was manually prepared using K-file and step back method through canal filling by lateral compaction technique. In GP and GH groups, gutta-percha and AH 26 sealer were used to fill the canals, while Resilon and Epiphany sealer were used in RP and RH groups, respectively. Then, to prepare the post space, Peeso Reamer drill was used in GP and RP groups while heat carrier was applied in GH and RH groups to prepare the post space, respectively. The coronal part of each root was contacted with enterococcus faecalis leachate in BHI medium and the root end was placed in the same culture medium. The samples were daily checked for turbidity in the lower culture medium for 90 days. The average duration of bacterial leakage between the groups was compared using independent Student t-test. **Results**: All the positive control samples showed bacterial infiltration within 24 to 48 hours, while the negative control teeth remained uninfected during the test. Comparison of bacterial leakage rates between GP and GH groups showed no significant difference, which was similar to comparison results between RP and RH groups (P=0.549 and P=0.097, respectively). Comparison of bacterial leakage between GP and RP groups, as well as between GH and RH groups, showed a significant difference (P=0.018 and P<0.001, respectively), so that the average duration of leakage was significantly longer in the teeth obturated with gutta-percha/AH26 than with Resilon/Epiphany. There was a significant difference in root canal filler material regardless of the post space development method, i.e. heat carrier and Peeso Reamer (P<0.001). **Conclusion:** Considering the results of this study, the use of gutta-percha as a root filling material results in a better apical seal than Resilon. Application of heat carrier and Peeso Reamer showed no significant difference in effectiveness on the apical seal.

Keywords: Apical Seal, Gutta-percha, Resilon, Bacterial Leakage**.**

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Introduction

The dental pulp is a sterile environment. A number of confounding factors such as caries can cause infection in the pulp and its spread to periapical tissues (1). Elimination of infectious microbial agents in the root canal and prevention of re-infection are the main goals of endodontic therapies (2). Because cleaning and shaping the root canal cannot eliminate all the microorganisms in the canal even with widespread use of cleaning agents, creation of a complete apical seal for an unlimited period as a barrier to prevent the passage of microorganisms and their products is another objective of endodontic therapy, which prevents the development or continuation of inflammation in this area and leads to success of treatment in the long run (1, 3-5). The quality of root canal filling, type of the filling material, method of removal, and quantity of filling material are the factors affecting the quality of apical seal (6-10).

Gutta-percha is a standard material with minimal toxicity among the currently available filling materials, has a tendency for self-sterilization, is easy to work with, and can be conveniently removed from the canal. Inability to bind to dentin walls, which is the main disadvantage of this material, is the reason for simultaneous use of a root canal sealer material (1). Resilon is a synthetic thermoplastic polymer, which has been introduced to create a more effective seal due to the formation of resin tags within the dentinal tubules. The tissue biocompatibility of this material, which is used similar to gutta-percha, has been indicated, and it is capable of binding with resin sealers such as Epiphany. This sealer material is resistant to bacterial leakage by creating a bond between dentin walls and the central core (1, 5, 11, 12).

Several studies have compared the apical seal created by Resilon/Epiphany with that created by gutta-percha/sealer, which have reported different results (13, 14). Today, a post space is used in the teeth subject to endodontic treatment to cause retention for core structure, reinforce the remaining crown tissue, and distribute forces along the root (15, 16).

Preparation of a post space can be done immediately or with delay. The immediate method of post space preparation decreases the number of patient visits, which will result in increased patient's satisfaction (4, 17).

Various methods are used to prepare the post space, including the application of solvents, heating instruments such as heat carrier, and rotary instruments like Peeso Reamers. The aim of this study was to evaluate the effect of post space preparation with rotary devices, as well as using heated instruments on microbial leakage of canals obturated with gutta-percha and Resilon-Epiphany.

Materials and methods

To conduct this experimental study, 64 extracted human premolars meeting the following criteria were used: single-root and single-canal, straight canals, initial apical foramen diameter equal to file ≠20 or 25. Teeth with internal or external resorption, root caries, canal calcification, extra canals and cracks were excluded from the study.

The teeth were randomly divided into four experimental groups of 15 premolars as well as positive and negative control groups (two premolars each).

The crowns were cut from CEJ region using diamond saw at approximately 300 rpm, with water coolant, so that 11-12 mm of each root remained. In all groups, the preparation of root canals was done using manual K-file (Dentsply Maillefer, Switzerland) by Step back technique. The working length was determined through passing the file through apical foramen and subtracting 1 mm from its length, and the last applied apical file (MAF) was considered 35 in all the samples. The coronal part of root canal was prepared using Gates Glidden drills #1-3, (Dentsply Maillefer, Switzerland), the canal was irrigated using 2.5% sodium hypochlorite followed by distilled water and dried using paper points.

Gutta-percha (Ariadent, Iran) and AH-26 root canal sealer (Dentsply, De Trey, Konstanz, Germany) were used for canal filling in GP and GH groups, The master gutta-percha cone having the same number with the master apical file (MAF) was selected. The AH 26 sealer with a creamy consistency was prepared and the gutta-percha cone was smeared with it and placed in the canal, so that it went through the working length and had a slight tug back. A size B finger spreader (Dentsply Maillefer, Switzerland) reaching 1 mm of working length and a secondary gutta-percha #20 (Ariadent, Iran) were used for lateral compaction. Secondary gutta-percha cones were used until the spreader was not able to penetrate over 2 mm beyond the canal orifice. After completing the filling, a hot heat carrier was used to cut the extra gutta-percha.

Resilon and Epiphany root canal sealer were used to fill the canals in RP and RH groups, and the Resilon cone with the same number of the master apical file (MAF) was selected. Resilon cone was smeared with Epiphany sealer and placed in the canal, so that it went through the working length with a slight tug back. Size B finger spreader reaching 1 mm of the working length and a secondary Resilon can #20 were used for lateral compaction. Secondary Resilon cones were used until the spreader was not able to penetrate over 2 mm beyond the canal orifice. After cutting excess material from the

Resilon cone, the obturated coronal surface was light cured for 40 s.

Then, in GP and RP groups, Peeso Reamer #3 (Dentsply Maillefer, Switzerland) was used to leave behind 4 mm of gutta-percha for post space preparation but a heat carrier was used for this purpose in GH and RH groups (18).

The teeth in the positive and negative control groups were prepared similar to the experimental groups; but the root canals in the positive control group were not filled. All root canals in negative control group were obturated in the same way as experimental groups but no post space preparation was done.

The samples were prepared to investigate the bacterial leakage. (Fig. 1) The external surfaces of specimens were covered with two layers of nail varnish from the coronal edge to 2mm short of the apex. All teeth in negative group completely covered with nail varnish including root apex. Coronal third of each root was inserted individually in the latex surgical tube and the connection was sealed with cyanoacrylate glue. The system was sterilized using ethylene oxide gas and placed in the 5 ml sterile glass vial, containing 3 ml sterile Brain Heart Infusion (BHI) (Merck, Germany) to insure that the root apex was placed in the liquid. The coronal chamber inoculated with 0.5 ml BHI containing approximately 10^{8} bacteria ml^{-1} *E. faecalis* (ATCC 29212, obtained from Iranian Center for Scientific Research) using a sterile syringe.. The medium with microorganisms was changed every 5 days. The samples were incubated at 37°C and were daily checked for turbidity in the broth in the apical chamber for 90 days. The time taken for the turbidity of broth in the apical chamber was recorded for each sample.

Statistical analysis

The data were analyzed using statistical tests. The distribution numerical data were examined using Kolmogorov-Smirnov test. The average duration of bacterial leakage was compared between groups using independent samples t-test. Statistical significance was inferred if the P value was less than .05.

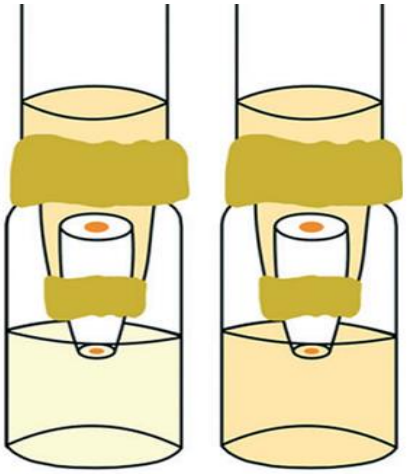

Figure 1. Evaluation of bacterial leakage in specimens: The right sample shows evidence for turbidity of culture medium

Results

One specimen in GH group and two in RP group were lost during preparation. Statistics tests confirmed normal distribution of data in groups.

The average leakage results in different groups are shown in Table 1. Data analysis showed no significant difference between the canals of GP and GH groups (P=0.549), nor between RH and RP groups (P=0.097).

Comparison of leakage time between GP and RP groups showed a significant difference, which was also observed between GH and RH groups (P=0.018 and P=0.001, respectively). The average duration of leakage was significantly higher in GP and GH groups than RP and RH groups, respectively.

Table 1. Descriptive statistics of the study groups

Groups	N	Mean	Standard Deviation	Minimum	Maximum
(GP)	15	73.20	27.28	4	90
(GH)	14	65.07	31.50	19	90
(RP)	13	36.46	33.92	2	90
(RH)	15	23.07	28.39	1	90

Discussion

In the present study, there was no difference in the duration of leakage between removal method of the filling material by Peeso Reamer or heat carrier. In other words, the method of post space preparation had no significant effect on leakage of samples. However, there was a significant difference between the root canal filling material (gutta-percha and Resilon) regardless of post space preparation method (heat carrier and Peeso Reamer). In general, the canals obturated with gutta-percha showed better results than those obturated with Resilon.

Similar to the results of present study, the study of Castelo-Baz et al. in 2013 comparing the sealing capacity of gutta-percha and Resilon by scanning electron microscope (SEM) showed that the apical sealing capacity of Resilon was not superior to that of gutta-percha (19). Zogheib and colleagues in 2012 compared the apical filling of Resilon with gutta-percha after application of warm vertical compaction method, in which no advantage for Real Seal/Resilon system was shown over AH Plus/gutta-percha (20). Stratton and colleagues compared the leakage rate of gutta-percha/AH Plus with Epiphany/Resilon using liquid filtration, which showed better results when using Resilon relative to gutta-percha (11). The difference of their results with the present study may be due to difference in evaluation methods of apical leakage because studies have shown that the use of different methods will result in various outcomes (21, 22).

On the other hand, in this study, the average duration of apical leakage in the group obturated with gutta-percha in which the post space was prepared with Peeso Reamer was higher than the group obturated with gutta-percha in which the post space was prepared with heat carrier; however, the difference between the two groups was not significant. The results of the present study were confirmed by the findings of Kamatagi and colleagues in 2013 who investigated the effect of two methods to remove gutta-percha (i.e. use of heat carrier vs. Gates Glidden drills and Peeso Reamer) on apical leakage rates using dye penetration method, where no significant differences were detected between the use of these two methods (23). In another study by Balto and colleagues in 2005, the apical seal was evaluated for bacterial leakage rate after removing gutta-percha using heat carrier and Peeso Reamer, which indicated a lower level of leakage when using Peeso Reamer (24). This difference may be due to the approach used to investigate the leakage rate.

Conclusion

Given the limitations of an experimental study, the present project showed that the use of gutta-percha and AH 26 sealer provided a better apical seal relative to Resilon and Epiphany sealer. There is no difference between heat carrier and Peeso Reamer with respect to apical leakage rates in post space preparations

References

1. Fouad A, Torabinejad M, Walton R. (2008). Endodontics: principles and practice: SAUNDERS ELSEVIER.
2. Haapasalo M, Endal U, Zandi H, Coil J. (2005).Eradication of endodontic infection by instrumentation and irrigation solutions. Endodontic topics. 10(1): 77-102.
3. Gilheany P, Figdor D, Tyas M. (1994). Apical dentin permeability and microleakage associated with root end resection and retrograde filling. Journal of Endodontics. 20(1): 22-6.
4. Heling I, Gorfil C, Slutzky H, Kopolovic K, Zalkind M, Slutzky-Goldberg I. (2002). Endodontic failure caused by inadequate restorative procedures: review and treatment recommendations. The Journal of prosthetic dentistry. 87(6): 674-8.
5. Siqueira J. (2001). Aetiology of root canal treatment failure: why well-treated teeth can fail. International endodontic journal. 34(1): 1-10.
6. Solano F, Hartwell G, Appelstein C. (2005). Comparison of apical leakage between immediate

versus delayed post space preparation using AH plus sealer. 31(10): 752-4.

7. Vasconcelos BCd, Bernardes RA, Duarte MAH, Bramante CM, Moraes IGd. (2011). Apical sealing of root canal fillings performed with five different endodontic sealers: analysis by fluid filtration . Journal of Applied Oral Science. 19(4): 324-8.
8. Veríssimo D, Vale M. (2006). Methodologies for assessment of apical and coronal leakage of endodontic filling materials: a critical review. Journal of oral science. 48(3): 93-8.
9. Froughreyhani M, Milani AS, Rahimi S, Shakouie S, Fateh S. (2011). Comparison of apical sealing ability of resected mineral trioxide aggregate, gutta-percha and a resin-based root canal filling material (resilon). African Journal of Biotechnology.10 (51): 10516-9.
10. Solano F, Hartwell G, Appelstein C. (2005). Comparison of apical leakage between immediate versus delayed post space preparation using AH Plus sealer. Journal of endodontics.31 (10): 752-4.
11. Stratton R, Apicella M, Mines P. (2006). A fluid filtration comparison of gutta-percha versus Resilon, a new soft resin endodontic obturation system. Journal of Endodontics. 32(7): 642-5.
12. Tay FR, Loushine RJ, Weller RN, Kimbrough WF, Pashley DH, Mak Y-F, et al. (2005). Ultrastructural evaluation of the apical seal in roots filled with a polycaprolactone-based root canal filling material. Journal of endodontics. 31(7): 514-9.
13. Biggs SG, Knowles KI, Ibarrola JL, Pashley DH. (2006). An in vitro assessment of the sealing ability of resilon/epiphany using fluid filtration. Journal of endodontic.32 (8): 759-61.
14. Shipper G, Teixeira FB, Arnold RR, Trope M. (2005). Periapical inflammation after coronal microbial inoculation of dog roots filled with gutta-percha or resilon. Journal of Endodontics. 31(2): 91-6.
15. Summitt JB, Robbins JW, Hilton TJ, Schwartz RS. Fundamentals of operative dentistry: a contemporary approach :shayan nemoudar press 2006.
16. Moshonov J, Slutzky-Goldberg I, Gottlieb A, Peretz B. (2005). The effect of the distance between post and residual gutta-percha on the clinical outcome of endodontic treatment. Journal of endodontics. 31(3): 177-9.
17. Solano F, Hartwell G, Appelstein C. (2005). Comparison of apical leakage between immediate versus delayed post space preparation using AH Plus sealer. Journal of endodontics. 31(10): 752-4.
18. Abramovitz I, Tagger M, Tamse A, Metzger Z. (2000). The effect of immediate vs. delayed post space preparation on the apical seal of a root canal filling: a study in an increased-sensitivity pressure-driven system. Journal of endodontics. 26(8): 435-9.
19. Castelo-Baz P, Martin-Biedma B, Lopes MM, Pires-Lopes L, Silveira J, López-Rosales E, et al. Ultramicroscopic study of the interface and sealing ability of four root canal obturation methods: Resilon versus gutta-percha.(2013). Australian Endodontic Journal. 39(3): 159-63.
20. Zogheib C, Naaman A, Medioni E. (2012). Evaluation of apical filling after warm vertical compaction using two different endodontic materials: Resilon and Gutta-Percha. World Journal of Dentistry. 3(2): 166.
21. Barthel C, Moshonov J, Shuping G ,Orstavik D. (1999). Bacterial leakage versus dye leakage in obturated root canals. International Endodontic Journal. 32(5): 370-5.
22. Pommel L, Jacquot B, Camps J. (2001). Lack of correlation among three methods for evaluation of apical leakage. Journal of Endodontics. 27(5): 347-50.
23. Kamatagi L, Saler S, Rastogi A, Chhabra N. (2013). Permeability of Remaining Endodontic Obturation: Comparison of Immediate versus Delayed Post Space Preparation, An In Vitro Study. Asian Journal of Oral Health & Allied Sciences. 3 (1).
24. Balto H, Al-Nazhan S, Al-Mansour K, Al-Otaibi M, Siddiqu Y. (2005). Microbial Leakage of Cavit, IRM, and Temp Bond in Post-prepared Root Canals

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Vitro. 53-61.

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