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Apical Leakage of Resilon™ Obturation Material

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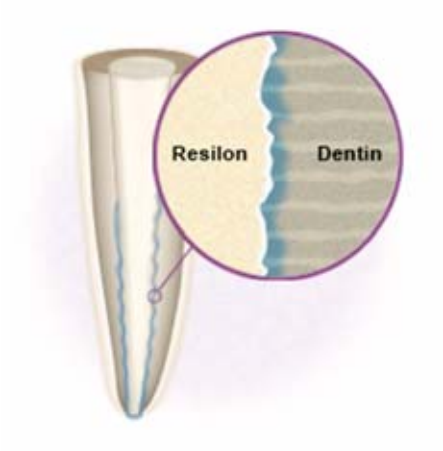

Abstract

Aim: The aim of this study was to assess the apical sealing ability of Resilon™ obturation material.

Methods and Materials: Forty-two single rooted extracted human teeth were selected and randomly divided into three groups. They were obturated using lateral condensation with gutta-percha and AH 26/AH plus and Resilon™; also, 12 root canals were used as control groups. The apical leakage was measured using the dye penetration methodology.

Results: The teeth filled with gutta-percha and AH 26 displayed the most apical leakage. The least apical leakage was shown with Resilon™

Discussion: The differences in leakage among the groups, gutta-percha with AH 26 (2.4 mm, SD:1.87), gutta-percha with AH plus (2.1 mm, SD: 1.69), and Resilon™ (1.7 mm, SD:1.32), were statistically significant ($p < 0.001$).

Conclusion: Based on the data of this study, all groups produced a satisfactory seal. However, Resilon™ and Epiphany™ sealer showed the least apical leakage.

Keywords: Dye penetration, apical leakage, root-canal filling, Resilon™

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Introduction

The aims of modern root-canal treatment are to clean and shape the root canal, removing all organic material, and to seal the pulp chamber and canal. It is well known microleakage between a root-canal filling and root-canal walls may adversely affect the results of root-canal treatment.[1] A sealer used with gutta-percha achieves an apical seal rather well and it fills the irregularities of the canal preparation. The success of root-canal treatment is dependent on the development and maintenance of the seal of the root-canal system.[2]

Many different materials have been proposed as root canal fillings. A complete seal of the root canal system is almost impossible with currently accepted materials using gutta-percha with root-canal sealer.[3]

A new material, Resilon™ (Epiphany™, Pentron Clinical Technologies, Wallingford, CT, USA; RealSeal™, SybronEndo, Orange, CA, USA), has been developed to replace gutta-percha and traditional sealers for root canal obturation. It is a thermoplastic synthetic polymer-based root-canal filling material. In addition Epiphany is a dual curable dental resin composite.

According to the manufacturer, Resilon™ sealer bonds to root-canal filling material and to dentin. Adhesion of the sealer to both gutta-percha and to dentin can improve the sealing properties of endodontic sealers, but the correlation between dentin bond strength and microleakage is questioned.[4]

Various methods such as dye penetration tests,[5] fluid transformation test,[6] radioactive isotope evaluation,[7] electrochemical leakage test,[8] and bacterial penetration test[9] have been used for evaluating the apical sealing property of root canal filling materials. The model used for the measurement of microleakage is a dye penetration method *in vitro*.

The purpose of this study was to assess the apical sealing ability of the new root-canal obturation material Resilon™.

Methods and Materials

Forty-two extracted single rooted human teeth were selected. The roots with open apices, cracks, and resorptive defects were excluded. Teeth were carefully cleaned with curettes to remove the soft tissue remnants and were stored in saline solution prior to instrumentation.

The crowns of the teeth were sectioned at the cemento-enamel junction by using water cooled diamond discs. The canal lengths were visually established by placing a size 15 K-type file (Kerr, Romulus, MI, USA) into each root canal until the tip of the files were visible at the tip of the apical foramen. The working length was established 1 mm short of the apex. The canal systems were instrumented to the working length with a size 40 K-file using a step-back technique. The coronal thirds of the roots were flared up to a size 2-4 Gates Glidden bur (Dentsply, Maillefer, Switzerland) (ISO size 70-150) using a low speed handpiece. The root canals were irrigated with 10 ml of 5.25% NaOCl after the use of each file throughout the preparation. The smear layer was removed with 10 ml of 17% EDTA (Canal +, Septodont, France) for 60 seconds, followed by 10 ml of 5.25% NaOCl. Finally, the root canals were flashed with 3 ml saline solution and then dried with paper points.

The specimens were randomly divided into three equal groups of ten samples each, setting aside four teeth as negative and eight as positive controls. Four roots were only filled with gutta-percha without any sealer and another four roots were merely filled with Resilon™ without its own sealer and served as the positive control group. A summary of the groups is as follows:

- **Group 1:** AH 26 plus Gutta-percha cones (ten samples)
- **Group 2:** AH + plus Gutta-percha cones (ten samples)

- **Group 3:** Epiphany sealer and Epiphany (ten samples)
- **Group 4:** Positive control group (eight samples)
- **Group 5:** Negative control group (four samples)

Roots were filled using the lateral condensation technique with gutta-percha and AH 26 (Group 1) and gutta-percha with AH plus (Group 2) root canal sealers.

For Group 3, Resilon™ bonding material was applied first into the root-canal with its own application brush and excess material was removed with paper points. Next, the Resilon™ master cone coated with Resilon™ sealer was inserted into the root canal and condensed using the lateral condensation technique. The cone excess is cut off with a heated ball burnisher at the orifice level. Light curing was carried out for 40 seconds with a standard light curing unit (Hilux, Ledmax 550, Benlioglu, Turkey).

The negative control group consisted of four roots which were filled with gutta-percha and sealer then completely coated with two layers of nail varnish. For the positive control samples, roots were coated with two layers of nail varnish except for the apical foramen and the coronal access.

Upon completion of the filling process, all samples were stored in saline solution at 37°C for 48 hours.

Apical leakage was estimated using a dye penetration test. The root surfaces were covered with two layers of nail varnish, except for the apical 2 mm. The specimens were then placed into 2% methylene blue dye solution for three days at 37º C. After being removed from the dye solution, the specimens were washed with water and dried. The teeth were sectioned longitudinally in a bucco-lingual direction through the center of the root. Linear apical leakage was measured from the apex to the coronal extent of the methylene blue dye penetration. The linear breakthrough of the dye was estimated using a stereomicroscope (Olympus BX 50, Japan).

The obtained results were submitted for statistical analysis using the analysis of the Bonferroni adjusted Mann-Whitney-U test and the Kruskal-Wallis test.

Results

The positive control specimens revealed full leakage throughout the length of the root canal, while the negative control teeth showed no dye penetration. The mean of the depth of dye penetration for both groups is shown in Table 1.

The analysis of variance showed a statistically significant difference among the apical leakage of the groups ($p < 0.001$). Resilon™ core material and Epiphany™ sealer exhibited the least mean apical leakage value (1.7 mm; SD: 1.32) among the teeth filled with gutta-percha using the sealer, AH plus (2.1 mm; SD:1.69) and AH 26 (2.4 mm; SD:1.87). Gutta-percha with AH 26 (Group 1) showed significantly more leakage when compared to the other sealers ($p < 0.001$).

Discussion

Three-dimensional sealing of the root canal is one of the main goals of endodontic treatment and is essential for preventing apical and coronal leakage in the root-canal system. Several test methods have been described to evaluate sealing quality of obturated root canals. The most popular method is the dye penetration test. Dye-penetration studies are commonly used because they are easy to accomplish and do not require sophisticated materials. Pitt Ford,[10] who compared the dye leakage of several sealers *in vitro*, found the differences seen did not produce noticeably different tissue responses *in vivo*.

Table 1. The mean of the depth of dye penetration.

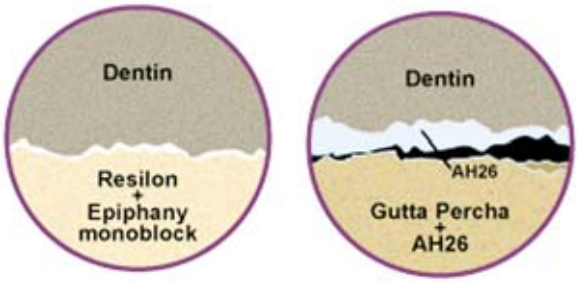
Materials	Mean leakage values (mm)
Gutta percha and AH 26	2.4 ± 1.87
Gutta percha and AH plus	2.1 ± 1.69
Resilon and Epiphany	1.7 ± 1.32

Methylene blue dye was used in this study because it easily allows quantitative measurement of the extent of dye penetration by linear measurement techniques. Its molecular size is similar to bacterial by-products such as butyric acid which can leak out of infected root canals to irritate periapical tissues.[11]

Matloff et al.[12] did not find any correlation between a dye-penetration study and a radioisotopic technique. Additionally, Barthel et al.[13] found no correlation between a dye-penetration study and a bacterial leakage study, whereas De Gee et al.[14] and Pommel et al.[15] found no correlation between a dye-penetration study and a fluid-filtration technique. However, Kontakiotis et al.[16] stated results of the transport fluid method may be changed by using different values of atmosphere pressure, capillary action, and the degree of canal dryness.

Cleaning the dentinal surface by removing the smear layer is an essential step in the process of successful root canal treatment.[17] In the present study the smear layer was removed by the alternating use of NaOCl and EDTA in order to improve the adaptation of the sealer to the canal wall.

The aim of this paper was to assess the degree of apical leakage of a new resin-based endodontic root filling material. Gutta-percha and sealer have been used for many years for root canal obturation. However, new materials and techniques are now available which may increase the potential for successful outcomes by creating a better interface between root canal walls and the filling material to decrease leakage. Some studies[18,19] have shown a relationship between apical leakage and the bond strength of sealers. The sealers have an inverse relationship for adhesion to gutta-percha and to dentin.[18,19] In contrast the attachment between the gutta-percha and the sealer AH26 and AH plus may allow an avenue for leakage. However, in the Epiphany root obturation system, Resilon™ sealer's attachment to root canal walls and to the Resilon™ filling core material appears to be superior. The Resilon™ System may be attributed to the 'monoblock' provided by the adhesion of the filling material to the sealer, which also adheres and penetrates into the dentin walls of the root-canal system.[20]



None of the root-canal filling materials and sealers exhibited complete apical sealing. Epiphany exhibited the least microleakage value and was found to be the best root-canal filling material when used with gutta-percha with AH plus and AH 26. However, the worst apical sealing was seen with the combination of gutta-percha and AH 26.

Conclusions

Data from *in vitro* studies cannot be directly adapted clinically. Further investigation should be conducted to determine if the new obturation material could replace gutta-percha as a root canal filling material. This study showed Resilon™ core material and Epiphany™ sealer had the least apical dye penetration than the other groups.

References

1. Mannocci F, Innocenti M, Bertelli E, Ferrari M. Dye leakage and SEM study of roots obturated with Thermafill and dentin bonding agent. Endod Dent Traumatol 1999;15:60-4.
2. Sundqvist G, Figdor D. Endodontic treatment of apical periodontitis. In: Essential Endodontology. Blackwell Science, Oxford 1998; 242-269.
3. Gutmann JL. Adaptation of injected thermoplasticized gutta-percha in the absence of the dentinal smear layer. Int Endod J 1993 ;26:87-92.
4. Fortin D, Swift EJ Jr, Denehy GE, Reinhardt JW. Bond strength and microleakage of current dentin adhesives. Dent Mater 1994 ;10:253-8.
5. Starkey DL, Anderson RW, Pashley DH. An evaluation of the effect of methylene blue dye pH on apical leakage. J Endod 1993;19:435-9.
6. Wu MK, De Gee AJ, Wesselink PR, Moorer WR. Fluid transport and bacterial penetration along root-canal fillings. Int Endod J 1993:26;203-8.
7. Czonstkowsky M, Michanowicz A, Vazquez JA. Evaluation of an injection of thermoplasticized low-temperature gutta-percha using radioactive isotopes. J Endod 1985;11:71-4.
8. Delivanis PD, Chapman KA. Comparison and reliability of techniques for measuring leakage and marginal penetration. Oral Surg Oral Med Oral Pathol 1982;53:410-6.
9. Wolanek GA, Loushine RJ, Weller RN, Kimbrough WF, Volkmann KR. In vitro bacterial penetration of endodontically treated teeth coronally sealed with a dentin bonding agent. J Endod 2001;27: 354-7.
10. Pitt Ford TR. Relation between seal of root fillings and tissue response. Oral Surg Oral Med Oral Pathol 1983;55:291–4.
11. Kersten HW, Moorer WR. Particles and molecules in endodontic leakage. Int Endod J 1989;22: 118-24.
12. Matloff IR, Jensen JR, Singer L, Tabibi A. A comparison of methods used in root canal sealability studies. Oral Surg Oral Pathol 1982;203–8.
13. Barthel CR, Moshonov J, Shuping G, Orstavik D. Bacterial leakage versus dye leakage in obturated root canals. Int Endod J 1999;32:370–5.
14. De Gee AJ, Wu MK, Wesselink PR. Sealing properties of Ketac-Endo glass ionomer cement and AH26 root canal sealers. Int Endod J 1994;27: 239–44.
15. Pommel L, Jacquot B, Camps J. Lack of correlation among three methods for the evaluation of apical leakage. J Endod 2001;27:347–50.
16. Kontakiotis EG, Georgopoulou MK, Morfis AS. Dye penetration in dry and water-filled gaps along root fillings. Int Endod J 2001;34:133-6.
17. Zmener O, Pameijer CH, Banegas G. Effectiveness in cleaning oval-shaped root canals using Anatomic Endodontic Technology, ProFile and manual instrumentation: a scanning electron microscopic study. Int Endod J 2005;38:356-63.
18. Haikel Y, Wittenmeyer W, Bateman G, Bentaleb A, Allemann C. A new method for the quantitative analysis of endodontic microleakage. J Endod 1999; 25:172-7.
19. Pommel L, About I, Pashley D, Camps J. Apical leakage of four endodontic sealers. J Endod 2003; 29:208-10.
20. Shipper G, Orstavik D, Teixeira FB, Trope M. An evaluation of microbial leakage in roots filled with a thermoplastic synthetic polymer-based root canal filling material (Resilon™). J Endod 2004; 30:342-7.

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